Setting up and running a small-scale business producing high-value foods

Opportunities in food processing

a CTA series

Opportunities in Food Processing

A handbook for setting up and running a small-scale business producing high-value foods

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About CTA

The Technical Centre for Agricultural and Rural Cooperation (CTA) is a joint international institution of the African, Caribbean and Pacific (ACP) Group of States and the European Union (EU). Its mission is to advance food and nutritional security, increase prosperity and encourage sound natural resource management in ACP countries. It provides access to information and knowledge, facilitates policy dialogue and strengthens the capacity of agricultural and rural development institutions and communities.
CTA operates under the framework of the Cotonou Agreement and is funded by the EU.

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Preface

This book is the result of a collaborative effort by small business owners and advisers of small-scale food processors in ACP countries. The effort was supported by the Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA). The information contained in the handbook was gathered by the researchers below, who interviewed local enterprises that produce high-value foods and prepared reports that were then compiled by Midway Associates. We hope this book will meet the needs of small-scale enterprises and the agencies that support them by providing technical and business information on the production of high-value foods that was previously difficult to find. It is also intended to help small-scale entrepreneurs to update and improve their businesses to gain market share, benefit their consumers and, of course, improve their own profitability. If you find this book useful, please take a few minutes to complete the feedback form at the end of the book.

The Opportunities in Food Processing series

This is the seventh and final volume of the Opportunities in Food Processing series. The first volume in 2001 was an overview of small-scale processing, including aspects of the science and technology of food processing and business management. The next five volumes applied the principles outlined in the first volume in more detail to the commodity groups: meat and fish products, milling and bakery products, cooking oils, fruits and vegetable products, and dairy products. The aim in each handbook was to provide information that would allow micro- or small-scale food processors in ACP countries to upgrade their businesses. The focus in each book was to improve the supply of processed foods to local markets using technologies that were likely to be available and affordable to ACP processors. Each book assumed a basic level of knowledge and provided detailed information on marketing, financial management, processing and quality assurance, written for people who have English as their second language. Each of the titles is available from CTA at http://publications.cta.int/en/publications/series/opportunities-in-food-processing.

About this book

This volume differs from the previous books in a number of respects. It is not commodity-focused and it groups together a variety of processed foods, or ingredients for cosmetic or medicinal products, that share a common factor of having (or with the potential to have) a high value. It assumes that the intended beneficiaries in ACP countries will already be moderately successful in their food processing businesses, and as a consequence it is written using 'higher level' language than previous books. Additionally, because the value added to processed foods is often higher in industrialised markets, the book includes exporting as well as supplying local markets, with a focus on how ACP processors are able to enter and benefit from value chains[1] for these products. Because the quality requirements for high-value foods, and sometimes their volumes, are both higher than other commodity groups, some of the technologies and staff training requirements described in this book require considerably greater investment than in previous volumes. The book is therefore intended to illustrate potential opportunities for producing high-value foods in ACP countries, rather than a handbook on how to do this.

1 Value chains comprise a set of actors who conduct a linked sequence of value-adding activities involved in bringing a product from its raw material stage to the final consumer.

About the authors

Yeshiwas Ademe currently works as Country Representative and Ethiopian Branch Manager for Valid Nutrition (VN), based in the Republic of Ireland. He is engaged in supporting local production of ready-to-use therapeutic food, supplementary food and complimentary food for malnourished children and HIV/AIDS patients. His background is accounting and he was awarded a BA in Accounting from Addis Ababa University. He has worked in large companies to improve administration, auditing, finance and accounting, set up systems and software and implement computerized accounting systems and business models. Before working for VN, he was Export Manager for a company engaged in exporting oil seeds, pulses and spices to Europe, Middle East, Far East and USA where he set up systematic flows of information to improve reliability, consistency and timeliness of exports and boosted exports from 6,500 MT to 17,450 MT. He also saved the company 30% on the price of imported raw materials and agricultural chemicals. Previously, he was General Manager for a large company engaged in import, export, transport, agro-industry and dairy processing; with more than 600 workers and capital turnover of more than $US 62.5 million. His aim was to import agricultural inputs that improved production by farmers and buy their produce to help improve their livelihoods.

Barrie Axtell is a food technologist with over 30 years' experience working in Africa, Caribbean, Asia and Latin America. His particular interest centres on small-enterprise-based drying of fruits and vegetables and processing high-value crops, such as medicinal plants, spices and essential oils, and small enterprise development. He has co-authored more than 15 books and numerous articles on the role of appropriate technology in food processing.

Dr Peter Fellows is a consultant food technologist and a director of Midway Associates. He has practical experience of assistance to food processors in 20+ developing countries and specialises in support to institutions that assist them. He has taught food technology at Oxford Brookes University, was Head of Agroprocessing at Intermediate Technology and has held the United Nations Educational, Scientific and Cultural Organization (UNESCO) Chair in

Post-Harvest Technology at Makerere University, Uganda. Since 2010 he has been Editor of *Food Chain* Journal for Practical Action Publishing. He is an experienced author and has published 34 books and more than 40 articles on small-scale food processing.

Linus Gedi is an experienced agro-industry expert, who started his career as tutor and Principal at Ilonga Agriculture Training Institute in Tanzania in 1976, before becoming a consultant in 1982. For the past 31 years he has worked on various consultancy assignments, ranging from planning primary crop production, handling, storage and marketing of food products, project appraisal and evaluations. His commodity expertise includes cotton, cashew, sisal, oilseeds, grains, fruits and vegetables, beverages, fishery and meat products. From 1996 to 2003 he worked as the United Nations Industrial Development Organization (UNIDO) National Expert in food technology, training entrepreneurs and trainers and helping them set up small enterprises that achieve high quality production and a cleaner environment. From 2004 to 2012 he worked as a consulting food technologist with the Small Industries Development Organisation; involved in training, promoting/supporting SMEs to invest in agro-food processing and ensuring they produce quality and safe food products. He sits on various national and private advisory bodies on food and agro-industry including the Tanzania Honey Council Ltd. and as Trustee of the Private Agriculture Sector Trust. He is Director and Chairman of Traceability (T) Ltd., a private company that is involved in traceability and food industry consultancies.

Dave Harcourt currently consults on food processing issues, writes sporadically for American blogs and the website ‘Food Processing Africa’. For many years he has run a blog that links to information of use and interest to food processors in Africa; in particular it identifies free online technical information. He qualified as a Chemical Engineer at the University of Natal and obtained a MSc in Biological Engineering from the University of Birmingham, UK. He worked at the South African oil from coal company for four years. The bulk of his career was at CSIR, South Africa’s R&D organisation, mainly for the sorghum beer industry. During this period he undertook process development, brewery design and commissioning, process engineering, consultation and managed a 25-strong multidisciplinary research unit for the NSB and its predecessors. He switched his attention to the potential of food processing as a tool for the development of small businesses after the end of apartheid in 1992, focussing on drying, milling, baking, production of traditional alcoholic beverages, juice processing and oil extraction. Later he worked on alternate fuel, aspects of global warming and the processing of traditional medicines. While at CSIR, he acted as a food processing specialist in many opportunity identification and feasibility studies in Zimbabwe, Mozambique and South Africa.

Dr. Djidjoho Joseph Hounhouigan is Professor of Food Science and Technology at the Faculty of Agricultural Sciences of the University of Abomey-Calavi, Benin. He has been Head of the Department of Nutrition and Food Science of this Faculty from 1992 to 2005, National Director of Scientific and Technological Research at the Ministry of Higher Education and Scientific Research from 2007 to 2009. He is Scientific Adviser and member of the Food Science Advisory Committee of the International Foundation for Science and has 28 years' experience in teaching, research and transfer of technologies for micro- and small-scale enterprises. He has co-authored six books and more than 90 articles in international journals on traditional and improved African food processing and quality assurance. In January 2013, he was appointed Dean of the Faculty of Agricultural Sciences at the University of Abomey-Calavi.

Dr. Cecile La Grenade is a food technologist with over twenty years' experience, particularly in the field of product development. She holds a Doctoral Degree in Food Science from the University of Maryland, USA. She is also an accomplished food technologist and microbiologist. For the past 20 years, Dr. La Grenade managed her family business, De La Grenade Industries, which is a limited liability company in Grenada. The company is well known for the utilisation of nutmeg pericarp, a former unutilised part of the nutmeg fruit, for the manufacture of award-winning, value added nutmeg products, including nutmeg jam, jelly, syrup and savoury sauces. The company's Morne Delice nutmeg Syrup received a grand Gold Medal from Monde Selection in Brussels in 1990. Over the years, the company continued to receive awards including one for the most innovative product at the inaugural Nutmeg Festival held in Grenada in 2012, for her nutmeg-tamarind and nutmeg-ginger sauces. Dr. La Grenade has sat on several steering committees of regional private sector organisations, including the Caribbean Export Development Agency and Compete Caribbean. She was also a director of the Grenada Chamber of Industry and Commerce, focusing on the creation of value added products from indigenous raw materials. In May 2013, Dr. La Grenade became the first female Governor General of Grenada.

Michael Lubowa is a consultant with over 20 years of experience in agro-based industry with a focus on strategic planning, developing business plans and feasibility studies, conducting baseline and diagnostic sector studies, fabrication of food processing equipment, and practical training of trainers in food processing. He is a qualified industrial economist who began his career in 1988 as a production planning executive in BATA, a multinational footwear manufacturing firm, and later worked as a Senior Industrial Economist at a desk for the foods and beverages sub-sector at the Ministry of Trade and Industry in Uganda. He has worked as a consultant on several agro-processing projects, initiated not only by bilateral and multilateral agencies, but also by public/private partnership organizations and SMEs in Uganda. Currently Mr. Lubowa is an associate of Midway Centre Ltd., Uganda.

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Contents

How to use this book

This book is intended to raise awareness of the opportunities for producing high-value foods and ingredients in ACP countries and routes to access the different types of value chains for these products. Whether you want to start a new business, improve or diversify your existing operations, we suggest that you read the book and make notes on what you need to do in the space provided at the end of each chapter in the **READERS' NOTES**.

However, you may not have the time to read the whole book and you may wish to focus on products that are particularly relevant. There are a number of ways in which you can use this book to help you grasp the main points in each subject area.

There is a **SUMMARY** of the most important aspects at the start of each chapter. You can look at the **TIPS FOR SUCCESS** after the summary to provide ideas for improving a particular aspect of your business.

To help guide the reader, in Chapter 3, each section on processing high-value foods has the following format:
production and trade data
pricing data
processing methods that are suitable for small-scale production, and
quality specifications for the product.

CASE STUDIES can be found in boxes throughout the book, providing real-life examples of how small-scale processors of high-value foods have overcome the various problems they have met in their day-to-day operations.

Finally, at the end of each chapter there is an **ENTREPRENEURS' CHECKLIST** that you can use to tick the main actions you need to take to improve your business.

Introduction 1

The focus of this book is the production and sale of high-value foods. However, there is no simple definition of 'high-value', as 'value' can have many different meanings (value to a community, nutritional value, as a contribution to national income etc.). In this book, the term 'high-value' refers to foods that have a premium sale price, above that which would normally occur as a result of processing. It is believed that this is the first time that information on the demand for high-value foods, their production, marketing and quality management has been gathered in a single publication.

This final book in the *Opportunities in Food Processing* series shares the overall aim of previous books: to enable small-scale ACP processors to improve their access to markets and increase sales of high quality foods. This not only benefits processors and consumers, but has other benefits in their wider communities. Governments and development agencies recognise that small-scale food processing has many advantages over other income-generating activities for employment creation, poverty alleviation, nutritional improvement and economic development (Box 1.1).

Box 1.1. Advantages of small-scale food processing compared to other income-generating activities (From Fellows, 2013)

From an entrepreneur's perspective:

- Many types of food processing are readily accessible because people are familiar with the food that they grow and eat and, compared with some other types of business, there are fewer aspects to learn when getting started.
- The crops or animals that are the raw materials for processing are often readily available and sometimes in excess.
- If chosen correctly, processed foods can have a high demand and offer the opportunity to generate good profits by adding value to raw materials.

- High added-value means that processors can earn a reasonable income from relatively small scales of production.
- Small-scale production requires levels of investment in equipment and facilities that are usually affordable; for many processes existing domestic utensils are suitable as a starting point for a small food processing business.

From a policy perspective:

- Small-scale food processing can be used to achieve government or development agency objectives of employment creation; increased food security; agricultural development through improved quality standards and increased demand for raw materials; nutritional improvement; and regional or national economic development.
- Processing retains more value in the country of origin for exported foods.
- Food processing is particularly suitable for women, who may be the specific intended beneficiaries of development programmes.
- In many cases, local engineering workshops are able to manufacture some types of processing equipment, thus creating additional employment, income-generating opportunities and economic development. Further employment is created in subsidiary supply industries such as packaging and printing, or ingredient supplies.
- Most types of small-scale processing have few negative environmental impacts when properly managed.

The high-value foods and ingredients described in this book have retail prices that are up to four or five times those of equivalent ‘ordinary’ products. The higher prices are because:

1) The foods themselves are in some way unique or significantly different to other products such that consumers are willing to pay higher prices (e.g. gourmet mushrooms, unifloral honeys, gourmet coffee varieties, nutmeg jam and Birdseye chillies); or
2) The foods are produced in ways that significantly increase their value by:
   a) Using a unique formulation of ingredients (e.g. spice mixes or liqueurs).
   b) Using packaging to differentiate the product from competitors (e.g. honey, chocolates, spices)

c) Using organic and/or fair traded raw materials and ingredients
d) Targeting sales to niche or specialist markets (e.g. tree nut products for healthcare, beauty and sports markets).

These are each described in more detail in Chapter 2, with details of the production of individual high-value foods in Chapter 3 and methods to assure their quality in Chapter 4.

In addition to the foods that are described in this book, there are many other examples of high-value foods described in preceding books in the series (Table 1.1) and these are not repeated here.

Types of foods	**Book in the Opportunities in Food Processing series**
Speciality sausages, meat and fish pâtés and terrines, cured hams and bacon, smoked seafoods/fish, fish sauces.	Setting up and running a small meat or fish processing enterprise (Axtell and Fellows, 2003)
Celebration cakes, especially with decorative icing, tarts, cakes and high-value biscuits.	Setting up and running a small flour mill or bakery (Fellows and Axtell, 2004)
Gourmet cheeses, smoked cheeses, speciality ice creams, dairy confectionery.	Setting up and running a small-scale dairy processing business (Fellows and Axtell, 2008)
Candied and crystallised fruits, fruit wines and spirits, fruit vinegars, papain, speciality chutneys and pickles, fried fruit or vegetable snackfoods.	Setting up and running a small fruit or vegetable processing enterprise (Axtell and Fellows, 2008)
Cooking oils	Setting up and running a small-scale cooking oil business (Fellows and Axtell, 2012)

Table 1.1. High-value products described in other books in this series

There are two aspects to operating a successful business making high-value foods:

1. Having access to markets that can command the highest prices, either directly by sales to retailers/consumers or by participation in a value chain.
2. Being able to make sufficient investments in equipment and staff skills to meet the quality standards and volumes required for a particular product in a given market;

1.1 Access to markets and value chains

Product-market combinations

For all high-value foods, the main factor that determines the amount of value that can be added by small-scale processors is the selection of the markets in which products are sold and the types of buyers that they deal with. Broadly, markets can be national, regional, or international. Within each, there are specialist sub-markets, or niche markets, such as gourmet products (e.g. mushrooms, spice mixtures, speciality coffees, chocolate, vanilla and honey vinegar), products for special occasions (e.g. honey wine, liqueurs), health products (e.g. herbal teas, baobab extracts and moringa products) and supplements used in sports and fitness markets (e.g. kola extract) or beauty products (e.g. essential oils, aloe-vera and a number of tree nut oils). For each, the value placed on the products is considerably greater than in other markets and the prices are correspondingly much higher.

National and regional markets

For small-scale ACP processors who have less to invest (or little access to finance), national markets are the most accessible and one of the most important considerations is how to access niche markets. Until recently, there were relatively few high-income consumers in ACP countries, but economic development in many countries is increasing these numbers. As a result, the demand for high added-value, luxury products such as liqueurs, chocolate and speciality coffees is growing. The route to achieving the highest added-value is either to directly supply consumers who have high disposable incomes or supply upmarket supermarkets and other retailers where these consumers shop. Some processors target visitors and tourists to ACP countries either directly with products (e.g. nutmeg products in the Caribbean and spice mixes in Africa) that are sold through airport shops or company outlets in tourist areas, or indirectly by selling to hotels and restaurants that cater for high-income nationals and international visitors (e.g. gourmet mushrooms, honey wine and vinegar, insect snackfoods, speciality coffees, macadamia and cashew nuts). There may also be opportunities to supply other processing industries such as local cosmetic or pharmaceutical companies making skincare and medicinal products from semi-processed ingredients or products. Researchers found many examples of this approach (e.g. herbal teas, moringa products, aloe-vera).

When processors have a reasonable share of a local market and are sufficiently profitable to afford additional investment, it is possible to expand into regional markets. This requires additional business skills to export products as well as an understanding of the regional market conditions (Chapter 2). Examples of supplying regional markets in this book include spices, cashew nuts and aloe-vera.

International market entry requirements - lowering the barriers to entry

Until recently, it has been extremely difficult for small-scale ACP processors to access international retail markets, particularly those in industrialised countries. A combination of processors' inability to meet international quality standards or the volumes required, tariff and non-tariff barriers, and control over the markets by larger processors, are just some of the factors that have restricted their access. However, three important changes are taking place that are altering this situation:

1) **The establishment of 'fair trade' type organisations/companies that have an ethical ethos**. Some fair traded products have a higher value in international retail markets than non-fair traded products. These organisations and companies operate in many different ways: they may buy part-processed products at higher prices than the market average, so passing on some of the added value to the processors (e.g. coffee, aloe-vera); others act on behalf of processors to identify and supply international markets (e.g. tree products).
2) **Organic certification.** Organic products and those made using organic ingredients have a premium in many international retail markets (e.g. vanilla, moringa, aloe-vera, coffee). Provided ACP processors can afford the cost of organic certification, there are good opportunities to add greater value to their products. By default, many raw materials from ACP countries are organic because farmers cannot afford synthetic fertilisers or pesticides and bee products collected from areas where these chemicals are not used may be said to be organic.

3) **The internet**. For the first time, it is now possible for small-scale ACP processors to gain direct access to the highest value market of retail buyers and consumers in industrialised countries and, although not yet widespread, a number of small-scale producers are already benefiting from internet promotion and sales. Research for this book has identified some ACP processors who have websites and management and payment systems in place to advertise and sell their products. Some of these processors are ACP nationals who have returned to their country from a period working or studying in industrialised countries, where they have learned the requisite skills. This is taking place in other non-ACP developing countries to a greater extent (e.g. novelty insect products from Thailand). However, the expansion of training and education in computing and information technology by ACP universities is expected to lead to a rapid increase in the numbers of small-scale food processors who can use the internet to access international retail markets

Participating in value chains

Some products are much more difficult for ACP processors to sell directly to consumers or retailers in industrialised countries (e.g. spices, cocoa, food colourants and flavourings, tree nuts and their oils used in foods, cosmetics and medicinal products). These products have long-established supply contracts that are difficult for new entrants to compete with; and export procedures and tariffs are complex and difficult for many small-scale processors to understand. For these products it is necessary for processors to enter a value chain and sell their products to intermediaries (Fig. 1.1).

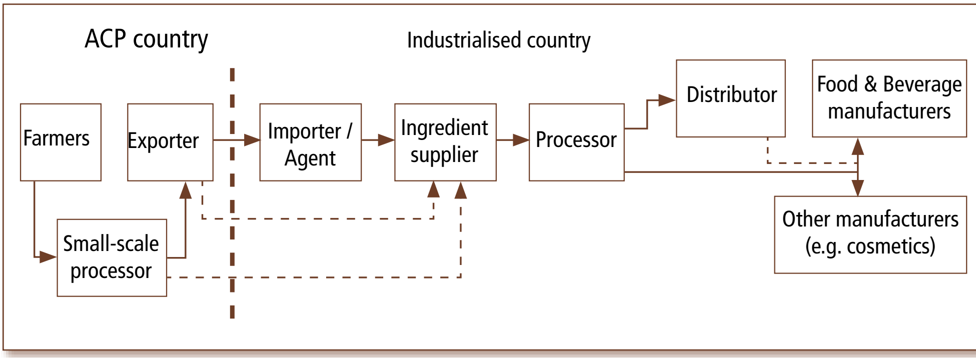

Fig. 1.1. A simplified example of a value chain for natural flavourings and colourants (Adapted from CBI, 214)

Key: solid lines = main market channel, dotted lines = alternative/additional channel (see also section 3.2)

1.2 The need for investment and access to finance

The roles played by different participants shown in the value chain in Fig. 1.1 and their types of investments are described in Table 1.2.

Participant	Roles and investment made
Farmers	Supply raw materials. Investment in labour and materials to grow the crop. Farmer or producer associations/cooperatives may supply larger quantities and/or invest time and resources to establish raw material quality standards.
Small-scale processor	Part-processes the raw material to extract the colourant or flavour and stabilise it for transportation. Investment in equipment, skills and materials. With greater investment in time, skills and resources, the small-scale processor may export the product to an ingredient supplier.
Exporter	May have trading relationships with many small-scale processors, importers/agents and ingredient buyers, dealing with different types of products. Investment in time and resources to ensure export procedures and documentation are correct. May invest to standardise product quality
Importer/Agent	Purchases different products from a number of exporters. Invests time and resources to provide a service to buyers (e.g. providing technical advice or laboratory certification of quality). Importers may also be agents that bring together suppliers and buyers, or agents may be separate businesses that provide this service without owning the product.

Ingredient supplier	Stocks a wide variety of ingredients from numerous sources to supply different types of processors; may also act as importers. Investment in some types of processing (e.g. blending) and time/resources to match ingredients to processor's requirements.
Larger-scale processor	Has detailed knowledge of the ingredient market, quality standards and requirements of food and cosmetic manufacturers. Investment in advanced processing methods, skilled staff and time and resources for quality management procedures. Refines and blends the product to purify and standardise it and ensure that it meets international regulations. Investment in research and development to produce new, often highly specific, formulations of flavours and colourants to meet the needs of individual end-users.
Distributor	Acts as sales agent to increase market coverage, either owned by the processor or independent business. Stocks a range of products, often with offices in different industrialised countries.
End-users	Manufacture consumer products, using a wide range of ingredients, often in small amounts at a time. The small quantities mean that it is more economical to buy ingredients from ingredient processors than lower-cost ingredients from importers/suppliers. Investment in product development for retail products, quality assurance, marketing etc.
Retailers	The final part of the chain, supplying consumers. Investment in retail facilities, transportation, marketing etc. adds final value to ingredients in consumer products.

Table 1.2. Roles and investment by participants in the value chain for natural flavourings and colourants (Adapted from CBI, 2014)

Investment is therefore made by participants at each stage in a value chain and there is an increase in value as the cost of the product increases. Clearly small-scale processors who are able to participate in more of the value chain or supply it at a later stage (further right in Fig. 1.1), can achieve greater added value - but this also requires greater levels of investment. It is the balance of income from the increased value and expenditure on investment in the value chain that determines profitability and the likelihood of processing being successful. It has not been possible to collect data on the value added at each stage of value chains for products in Chapter 3, but details of retail prices are given for each product as a basis for comparison of the final value of different commodity groups.

Processors require a greater financial investment to: 1) control raw material quality and volumes; 2) acquire the necessary equipment; 3) to acquire suitable packaging; 4) to develop quality management skills and buy or hire monitoring and testing equipment, 5) to hire suitably skilled staff and develop their skills and expertise.

Raw material quality. Many processors that were interviewed for this book emphasised the need to select high quality raw materials and to have proper control over suppliers. A common system is to invest in establishing and training contract outgrowers to supply the required varieties of crops (e.g. aloe-vera, coffee) or employ collectors to supply insects or honey of the quality specified by the processor. Others invested in their own farms to guarantee a minimum level of crop supply, which is supplemented by famers in outgrower schemes (e.g. vanilla and aloe-vera). For some processors who sell organic products, it is necessary to obtain (or help outgrower farmers to obtain) organic certification for their produce, which for many has proved complex and expensive (see Chapter 3, Box 3.4.23).

Processing equipment. Many of the high-value products that are included in this book can be produced using the same equipment and procedures that are used for lower-value equivalents (e.g. drying of plant materials, production of wines and spirits, and extraction of tree nut oils), but other products, such as chocolate, cashew nuts and dried mushrooms, may require investment in specialist equipment. In other cases, such as production of food colourants, some food supplements, or health and beauty products that incorporate tree nut extracts, there is a substantial investment required, particularly when these products are sold into highly regulated markets in industrialised countries, where there is a requirement to meet strict quality standards and very small tolerances are permitted in quality variation. This is likely to be beyond the capacity of most small-scale ACP processors. The book therefore describes how semi-processed raw materials may enable processors to become part of these value chains, while leaving the final product formulation and standardisation to larger companies that have the required technology and expertise.

Packaging. Retail packaging can be used to add value and to differentiate a high-value product from competing lower-value equivalents (e.g. honey, chocolate and liqueurs). For most small-scale ACP processors, obtaining specialist imported packaging is a major investment that has been consistently highlighted by research for this book as a significant expense, and for some it is an important constraint on development of their businesses. Some processors have adopted an alternative route to avoid high retail packaging costs and instead supply their products in cheaper bulk packaging to processors in industrialised countries who have access to lower cost and more readily available retail packaging. Additionally, they may sell part-processed products via local agents to intermediary companies that repack and sell them to retailers or other buyers (e.g. cashew nuts, baobab products, mongongo oil, kola extract). The benefits to processors are a foothold in an international value chain and increased sales compared to the domestic market without the need for high investment. The limitation is the lower returns because a larger part of the value is added by the intermediary company. There are many examples of this type of arrangement that have been identified in research for this book, and some, particularly those involving fair trade type organisations, appear to be successful from the processors' standpoint.

Quality management and traceability. All foods require investment in quality assurance (QA) to ensure consistently high quality and safety standards, and to enable traceability of products back to raw material suppliers. But it is especially important for high-value foods to meet the quality requirements of these demanding markets (consumers and other buyers will not pay high prices for products that have variable quality). For most products this requires investment in suitably qualified QA staff and development of standardised procedures to manage quality, described in Chapter 4. Quality standards are more detailed and complex for products that have long-established international trade (e.g. honey, spices and some tree nuts), whereas newer niche markets (e.g. health supplements) have quality standards for their ingredients that are defined by buyers (e.g. baobab fruit and oil, other tree nut oils). Exporting foods to international markets requires an understanding of the individual product quality standards (Chapter 3) as well as meeting international standards for food safety and hygienic production (Chapter 4). Export quality has been achieved by some ACP processors interviewed for this book, but the majority have found that the cost and complexity of QA at this level is too demanding and/or information on product quality standards and regulations in importing countries is not available.

Skilled staff. The investment needed to make high-value foods is often not capital investment in specialist equipment, but in recruiting and/or training staff and funding their time. Examples include developing new food formulations (e.g. spice mixes, chocolates and liqueurs) that take a considerable amount of skill and time to achieve a product that can command a high price and may require a significant investment to conduct market research, select raw materials, develop the process, and undertake many product reformulations and evaluations using taste panels (Chapter 2). Staff expertise is also required to manage and develop opportunities for marketing high-value products to consumers or to sell them on to intermediaries in value chains.

Access to finance

Most small-scale processors that were interviewed for this book did not obtain loans from commercial banks because of the high interest rates. Some obtained finance from fair trade companies or NGOs and others reinvested profits to develop their businesses or attracted new shareholders to provide finance (e.g. Box 2.10 and 3.4.1). None of the interviewees had used government-sponsored schemes to obtain finance and these are outside the scope of this book. However, small-scale processors may investigate whether their governments offer schemes such as national loan guarantee schemes, in which the government provides a guarantee on unsecured borrowing from banks, community development finance schemes that provide loans to a specific disadvantaged geographic area or disadvantaged groups, enterprise finance guarantee loans to SMEs to facilitate additional lending to small-scale processors that lack the security for a commercial loan, and business finance partnerships, such as supply chain finance, that increase the supply of capital through non-bank channels for small businesses.

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Marketing and selling high-value foods

2

Summary of the chapter

- ✔ Start by identifying consumers' needs and decide how best to meet them.
- ✔ Use a feasibility study to make sure that production and sales will be profitable.
- ✔ Differentiate your product from lower-value competitors by selecting specific high-value ingredients, a unique formulation, or 'stand-out' packaging.
- ✔ Decide which sales outlets will enable you to reach consumers who have sufficient disposable income.
- ✔ Examine other markets, including sports or health supplements, and cosmetic manufacturers as well as markets for foods.
- ✔ Examine whether organic certification will be cost-effective.
- ✔ Sell products in domestic markets before considering exporting.
- ✔ Consider supplying part-processed foods to other processors or cosmetic manufacturers, especially if supplying high-value retail markets requires a high investment.
- ✔ Evaluate the benefits of supplying fair trade type organisations.
- ✔ Consider setting up your own website to promote and sell your products.

Keywords: value chains, consumers' needs, feasibility studies, product development, product differentiation, packaging, types of markets, exporting, fair trade organisations, the internet.

Tips for success

- ✔ Be aware of current trends in consumer requirements.
- ✔ Use market research to precisely identify your target consumers.
- ✔ Be imaginative in selecting sales outlets for your products in order to reach consumers who have sufficient disposable income to buy high-value products.
- ✔ Examine opportunities to make your products more convenient for consumers to use.
- ✔ Create an image for your product that meets consumers' expectations of luxury and high value.
- ✔ Examine the demand for 'healthy' foods and assess whether a reformulation of your product can be used to meet this demand.
- ✔ Examine other potential niche markets, including 'health foods', medicinal supplements and special supplements for sports people or those on diets.
- ✔ Select raw materials that are unique or 'special' and promote the processed products as 'gourmet', unusual or 'exotic'.
- ✔ Examine whether the margin on your products can be increased by using organic or fair traded ingredients.
- ✔ Have a well-established domestic market for your products before considering exporting.
- ✔ Consider using one of the fair-trade type organisations or companies to sell your products in high-value markets in industrialised countries.
- ✔ Consider exporting semi-processed products to other processors if suitable retail packaging is a significant constraint.
- ✔ Consider developing a website to promote and sell your products to wider markets.

2.1 Start with the consumer - meeting consumers' needs

Consumers in all types of markets should be able to buy safe, wholesome foods that have honest, informative labelling. These are minimum requirements of all food processors and are legal requirements in most ACP countries. In addition, and especially with high-value foods, small-scale processors must ensure that their products have a consistently high quality, because buyers (Table 2.3) and consumers will not continue to pay high prices if the quality is variable.

Market research

In many countries, particularly industrialised ones, consumers are able to communicate their needs and expectations about the foods that they buy, both through their buying habits and via market research. This enables them to influence the types of foods supplied by food manufacturers, retailers and food service companies (restaurants, hotels etc.). In highly competitive markets, this influence can determine the success or failure of a product. Consumer preferences also influence the type and quality of ingredients that processors use. This can have both a direct effect on food processors in ACP countries who supply products to local markets and an indirect effect on them if they supply ingredients to larger processors in industrialised countries. There are many examples from research for this book, described in Chapter 3, where commercial buyers specify precisely the type and quality of foods that they are willing to buy.

It is therefore important for ACP processors to be aware of the trends that are taking place in consumers' wishes and requirements. Some trends (e.g. the growing requirement for 'convenient' foods in (1) below) have been important in industrialised countries for 40-50 years and have increased in importance over the last few decades among more affluent consumers in some ACP, Latin American and South/Southeast Asian countries. Others, including a requirement to take ethical issues into account, are more recent trends among consumers in industrialised markets. These trends in consumers' requirements for high-value foods may be summarised as follows:

1. **An increasing demand for prepared or semi-prepared convenience foods**. This arises from changes in social trends, employment and population shifts in which increasing numbers of people live in urban areas; there are higher numbers of single households; and households in which both men and women are working and so spend less time preparing meals and prepare them less often (Box 2.1). They frequently do not have traditional meal times and instead consume other foods between meals.

Box 2.1. Convenience foods

Among more affluent, professional groups, especially in urban areas, where both adult family members are working in order to afford high urban rents, they have less time for food preparation and they often have fewer domestic staff available to prepare the spices needed for traditional dishes. There are therefore almost limitless possibilities for small-scale processors to prepare herb and spice mixes, pastes and cooking sauces that can be substituted for freshly prepared spices in domestic cooking (Fig. 2.1).

2. **Increased numbers of affluent people** in areas or countries that are experiencing economic development has led to increased demand for expensive, luxury foods. This is not confined to industrialised countries and there are growing numbers of affluent people, usually in urban areas of many ACP countries and other developing countries. Their increased disposable income results in a higher demand for both speciality foods as occasional 'treats' or an increase in high quality foods as part of their normal diet. This produces an increased demand for both high-value manufactured foods (Box 2.2) and high-value gourmet ingredients by hotels and restaurants (Box 2.3).

Fig. 2.1. Pre-prepared spice cooking sauce (Courtesy of Cécile La Grenade)

Box 2.2. High-value luxury processed foods

Rwandan Bourbon coffee has come to the attention of the specialty coffee market and has become the 'new darling' for connoisseurs of speciality coffee. It is the first single-origin Rwandan coffee and the first Fairtrade produce from Rwanda and is highly regarded for the sweet fruity flavour and rich silky body of the coffee. The beans are 100% Bourbon cultivars, which because of its lower yield, is a variety that is not widely produced commercially for the global coffee market.

Considerable value can be added to chocolate products, especially high-value, deluxe chocolates that are packaged as 'gourmet chocolate gift boxes'.

The sales outlets for his liqueurs are airport shops, hotels and restaurants in up-market areas of cities that have affluent nationals, international visitors and tourists as their clientele.

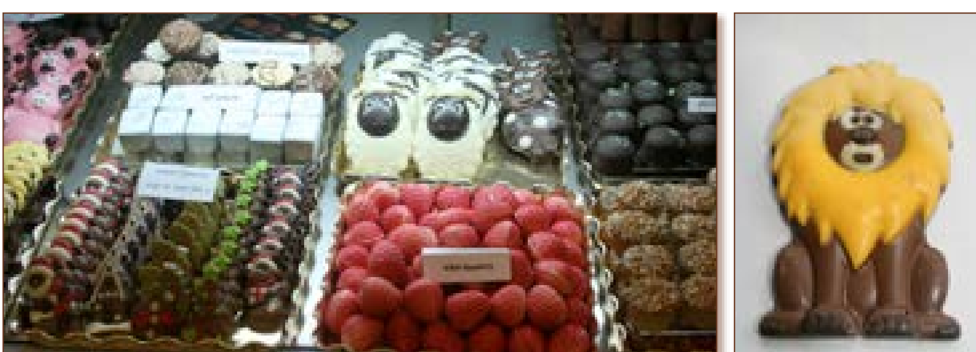

Fig. 2.2a,b. Examples of high-value chocolates
(Courtesy of Barrie Axtell)

Box 2.3. Demand for gourmet ingredients

She specialises in the cultivation of oyster mushrooms and targets sales mainly to high-end buyers such as gourmet chefs in large hotels and restaurants, and final consumers who have Euro-centric tastes and buy them from supermarkets.

The main markets for flavoured oils are restaurants, hotels and high-income consumers. They may also be marketed as gifts, particularly if the infusing ingredient has a strong connection to the country (e.g. spices in Caribbean islands), and sold to tourists at hotels and airport shops.

Mr T. specialises in Kaffa honey types, which are very natural and pure and are preferred by hotels, cafes and restaurants, which like the white honey and its distinctive flavour.

3. **A growing interest in 'healthy' foods and a healthier lifestyle**, which has increased the demand for foods that are lower in fat, salt and sugar; less-processed foods; the use of natural rather than synthetic colourings and flavourings; incorporation of probiotic or prebiotic ingredients in 'functional' foods (see Glossary in Annex B); and organically-certified products. This trend has also increased the demand for foods and food supplements that have reported beneficial effects on health (e.g. herbal teas, manuka honey, kola nut extracts and baobab fruit powder in Chapter 3). In many industrialised countries and increasingly in some ACP countries, these are no longer niche products that are sold in specialised shops, but are now mainstream supermarket products.

Fig. 2.3. Display of food supplements in a 'health food' retail outlet (Courtesy of Peter Fellows)

4. **An increase in foods that are 'targeted' at very specific groups of consumers.** These can be foods that are designed to meet a locally identified need (Box 2.4) or products that are produced for specific groups of consumers (Box 2.5).

Box 2.4. Meeting specific consumer needs

The company produces roasted ground coffee and sells it to local small hotels and cafés. The manager will create specialised blends of ground coffee from different varieties of coffee beans, depending on which type the owners prefer. This is usually based on a combination of the preferred taste and the yield of served coffee that can be made from the roasted ground beans.

He roasts particular types of coffee beans for up-market outlets, especially hotels, cafés and restaurants that cater for higher income local consumers and tourists.

The consumers of honey wine are people who attend special occasions (it is a traditional and cultural drink among well-to-do families). The organisers of the occasion place their orders, often asking the owner to make it stronger or weaker depending on the event. The owner blends the different strengths of wine to meet the taste requirements of the consumers and the event organisers.

Fig. 2.4. Sports supplement website (From www.sspnutrition.com)

Box 2.5. Targeting specific groups of consumers

Some companies have targeted their herbal teas directly (e.g. those aimed at women, such as 'Female Toner®', 'Mother's Milk®', 'Pregnancy® Tea' and 'Just For Kids Nighty Night®' tea).

Kola extracts are increasingly important as herbal medicines or tonics. They boost energy and decrease appetite, and are an ingredient in pre-workout supplements for body-builders and formulated supplementary foods for other sports people.

Baobab fruit powder is marketed as a 'superfruit' and a '100% natural and organic' dietary supplement for diabetics and people with coeliac disease. Among the beneficial effects claimed for regularly eating it are: a reduction of tiredness and fatigue; maintenance of normal blood pressure; maintaining a healthy weight and healthy skin; and preventing ageing.

There has been an increase in demand for Irvingia after it was discovered that eating it resulted in reduced blood pressure and greater weight loss and body fat loss. There are now many weight-loss preparations on the market that contain Irvingia with claims such as "...you can expect it to suppress hunger, improve/control diabetes and lower bad cholesterol."

The main local buyers of moringa leaf powder are Kampala-based herbal processors that prepare moringa tea, herbal aphrodisiacs and cures for joint pains rheumatism, skin disease etc.

5. **A demand for a wider range of flavours and 'exotic' products**. This takes the form of increased demand for 'Western' foods in ACP countries, which may offer small-scale producers opportunities to substitute for imports of these foods, and also demand for 'ethnic' foods in industrialised countries (e.g. spice mixes) and unusual or novelty foods (e.g. insect products as gifts). Up-market restaurants and hotels also increasingly serve foods that contain high-value exotic or specialist ingredients (e.g. wild mushrooms, honey vinegar, 'Birdseye' chillies, acacia or lavender honeys in Chapter 3).

Fig. 2.5. Insects sold as gifts (Courtesy of Thailand Unique)

Box 2.6. Demand for new flavours

There has been an increase in spice imports to Western industrialised countries due to greater consumer interest in a wide range of international and ethnic dishes. This has resulted from increased foreign travel, the establishment of a range of ethnic restaurants and immigrant-owned retail outlets selling their national foods, as well as supermarkets selling authentic ethnic foods that are convenient to prepare.

High-value 'Bubaala' mushrooms are picked from the wild and dried. They have a flourishing market and the processor reports that the demand outstrips the current supply.

Mr. L. says: "When a chef from one the leading hotels tasted the honey vinegar, his eyes lighted up. This shows how unusual the honey vinegar is."

6. **A growing proportion of consumers now consider ethical issues** when making food purchases and fair trade increasingly influences their shopping decisions. Some consumers also prefer organic products because of more environmentally friendly production processes, as well as the perceived health benefits. The certification of products and ingredients as organic and/or fair trade is an important factor in adding value to coffee, herbal teas, herbs and spices, honey and vanilla (Chapter 3). This is also true for products that are not certified as organic but are essentially organic because fertilisers and pesticides are not used in their production (e.g. aloe-vera) (Box 2.7).

Box 2.7. Organic foods

For small-scale coffee processors, the highest added-value comes from speciality or gourmet coffee beans, and the value can be further increased if the coffee is organic and fair trade.

In these areas, farming practices by small-holder farmers are predominantly traditional, with minimal use of agrochemicals. These practices can be said to be 'organic by default', which makes conversion to organic production practices easier. The company has invested in a 25-acre farm to grow moringa trees in order to enter the organic market of moringa products.

The market for organic, ethnic and health foods, of which Rooibos teas are a part, is large and growing and in particular the demand for fair trade certified products is growing. The company was established in 2004 and exports a range of high value-added Fairtrade and organic Rooibos and Honeybush teas to Europe, USA and Canada.

He adopted a marketing strategy that focused on a niche export market for gourmet organic cured vanilla pods to France and the USA and organised vanilla producers to acquire organic certification.

Mr. M. first started in 1999 with exports of organic fruits to Europe at premium prices, 150% above prices for conventional produce.

The aloe-vera is organic by default and the company has certification from the International Aloe Science Council after an audit of the farmers' out-grower scheme and processing facilities. The certificate is only awarded to aloe-vera products made from specific species and they must be produced by sustainable practices that do not harm the environment. The company's products are the first Ugandan aloe-vera products to receive a certificate. This authorises their sale in the USA, Europe and China who are the major consumers.

Organic certified macadamia oil is over four times as expensive as non-organic oil.

The company's export volumes of moringa oil are still low compared to the huge demand for certified organic products. It has explored organic market opportunities and the focus is now on certified organic oil to niche export markets.

Box 2.8. Fair trade foods

The company is a community-based producer of fair trade organic marula fruit pulp and marula oil. It intends to develop marula oil-based additives for cosmetics, soaps, perfumes as well as fruit juices, sauces, beverages and peel chutney. Another company sources marula nuts from community projects to develop ecological sustainability and economic viability through a benefit-sharing agreement that donates 5% of profits to Bushmen communities.

Fair trade or organic certification of cocoa can be used to increase the value of chocolate.

In south western Zambia, more than 3,000 people sell mongongo kernels to Kalahari Natural Oils (KNO), which sources oil for international skin care companies. KNO has been assisted, particularly in its marketing activities, by the Southern Africa natural products trade association, PhytoTrade Africa.

Previously, collectors earned ≈ US$100 per year from harvested nuts, but supplying KNO has allowed some to earn four times this amount, with the average annual income doubled.

Additional value can be added to herbs and spices by obtaining organic and/or fair trade certification, both for export markets and (for organic products) in some developing markets in Africa and South America, where local demand is growing.

A demand for greater transparency and traceability of the origin of foods. Naming the origin of a high quality product can be an important factor in its success and can give further added-value. Some products are strongly symbolic of a country or a continent and, provided that they are high quality, this symbolism can add to their value (conversely, a poor quality product can damage the reputation of the source region for all products supplied from there). Buyers also have requirements on traceability and need to know the whole supply chain in depth.

Box 2.9. Origin of raw materials

Madagascar and Zanzibar are known as the major clove producing countries and their produce has a higher value than cloves from other countries.

Some Caribbean islands are important producers of mace, nutmeg and cardamom and some Pacific islands are noted for vanilla and ginger production, each of which has a high value.

EU regulations for honey include the composition and definition of honeys, and information on their origin, which is regulated by rules on Protected Geographical Indication and Protected Designations of Origin.

Marula and baobab fruits are symbolic of Africa.

Fig. 2.6. The baobab tree is emblematic of Africa (Courtesy of Jialiang Gao)

Each of the above trends in consumer requirements should be taken into account by manufacturers of high-value foods. This is in addition to other specific requirements that they should identify for their individual products and market segments: food processors should have a detailed understanding of who their main consumers are; what are their needs and aspirations, and how the food can meet these needs. This is found using market research and by discussions with all of the people involved in the supply chain for a particular product.

A note on market research for high-value products

Details of the methods used to conduct market research are given in Volume 1 of the *Opportunities in Food Processing* series (Fellows and Axtell, 2000). One particularly important aspect of producing high-value foods is the need to identify the precise nature of the demand, which is achieved using market research. By definition, high-value foods have a higher cost than other products. In ACP countries that have large numbers of people on low incomes, high-value foods are likely to appeal to fewer people and as a result have a more limited market than other foods. In order to assess the likely demand for a high-value food, processors should target their market research more carefully than they would for other foods. For example, when researching the market for an 'ordinary' food, processors might approach members of the public directly or interview owners of general retail foods shops. This is not likely to be sufficient for high-value foods and processors should consider more carefully who is likely to spend the extra amount of money to buy their foods and then find sales outlets where these people are likely to visit. As an example, a manufacturer of high-value celebration cakes should make contact with owners of shops that sell wedding dresses or rent graduation gowns, organisers of celebration events, hotel owners that host weddings or graduation parties, and religious institutions or universities. Each of these organisations and businesses can then recommend the cake manufacturer to potential customers who wish to have a celebration. This then allows the processor to assess each consumer's precise requirements for a celebration cake and in the process add considerable value to the product. In other examples (Box 2.4) a coffee roaster uses market research to target cafés and hotels that are used by people who wish to buy particular types of coffee, and a honey wine producer adjusts the quality of the product to meet the requirements of organisers of special occasions.

2.2 The need for feasibility studies and product development

In some ways, producing high-value foods is little different to producing other foods: processors must fully understand how the market for a particular product operates; know the expected quality required by buyers; the likely demand; the expenditure required to make and sell the food; and the selling price/income needed to be profitable. This information is found using a feasibility study and when written as a business plan, it is used by lenders or shareholders to make an assessment of the business before deciding whether to invest. The methods used to conduct a feasibility study are described in other books in the *Opportunities in Food Processing* series and a summary of the factors to take into account for high-value foods is given in Table 2.1.

Component	Examples of aspects to include
Background to the business	Name, address and contact numbers of business. Type of high-value product proposed and previous experience of the owner in running a food business.
Market analysis	Background and justification of why the high-value product is expected to be in demand. The type(s) of market that the product will be sold in and market segments that will be targeted. Estimated current and potential demand. Existing and potential competitors. Proposed market share and the main assumptions that have been made.
Site, factory layout and facilities	Location of proposed production unit. Plans for modification and/or construction work required to produce the high-value food and timetable. Description of plant layout and service requirements (power, water, fuel etc). Any environmental impacts (disposal of wastes, air/water pollution etc.).
Plant and equipment	Proposed production capacity. Sources and costs of equipment required to process the product(s) and other production inputs (raw materials, packaging). Plan and timetable for commissioning the process to operational capacity.
Raw material supplies	Availability, volume and cost of materials. Seasonality issues and cash-flow. Requirement for specific crop varieties. Competition for raw material supplies. Risk of interruption to supplies due to crop diseases or changing weather patterns.
Staff	Production, quality assurance and other staff (number of people and skills required) and training to be given. Staff recruitment plan/timetable.
Production plan, marketing plan	Production rates needed to meet identified demand and projected increase in demand. Advertising and promotion budget. Description of distribution methods, sales outlets.
Financial plan	Cost of site, equipment and buildings, working capital, total production costs, sources of finance, cash-flow analysis, balance sheet, profitability calculations (rates of return, break-even analysis, risk analysis).

Table 2.1. Summary of components of a feasibility study for high-value foods

2.2.1 Product differentiation

A key consideration, and one of the first decisions that a processor should make, is the selection of the type of high-value food that will be made. The aim is to either make a product that is in some way unique, or to make a product different so that it stands out against competing products (to differentiate the product). All other components of the business plan are concerned with successfully making the product once this initial decision has been made.

Product differentiation can be done by ensuring that the product characteristics, quality and/or image make it more attractive to consumers, or it more closely meet consumers' needs so that they think that the product is special and want to buy it in preference to others. To do this requires a very good understanding of consumers' needs and desires and also experience of dealing with buyers to get to know the precise product characteristics that are in demand. This cannot be achieved quickly, and all the case studies investigated by researchers for this book have shown that successful small-scale processors were the ones who had taken time to develop a high level of market awareness and understanding - often with a number of setbacks along the way. Also successful processors were able to deliver what they promise, both in terms of product quality and meeting the required volume of orders on time. This requires both investment in staff who deliver the promise, and in equipment and working methods to enable them to do so. This again points to the need to conduct detailed feasibility studies and market research and then take time to build up a company and develop its financial and staff assets before entering markets for high-value foods (Box 2.10).

Box 2.10. Building up assets before entering high-value markets

He believes that his spice products have created a niche in the market; they have assured sales and a high income because the market has confidence in his skills and the quality of his products. These form the core strengths of his business. His annual net income is TSh. 50 million from the production of 12 MT of different spices.

In 1992, the D. family started a mango farm and by 2000 the business was producing over 32 MT of mangoes, sold mainly to prime hotels with some exported to the Middle East. They formed a company with two other family members co-opted and Ms F. acting as the Managing Director, but all as a part-time activity with the partners also employed elsewhere. In 2004, the farm became infested with fruit-fly disease that stopped the export trade and the enterprise began exporting rice, beans, grams and chillies. Since this business involved shipping instead of air-freighting fruit, the terms of payment were delayed and this affected the liquidity of the enterprise. There was a need to address business issues more aggressively, which led to running the business on a full-time basis. In 2006, the company started roasting cashew nuts for export and the number of shareholders was increased to 39. This was a bid to raise investment and operational capital, then at TSh. 48 million. Today, the capital base is about TSh. 700 million and the business has expanded into processing cashew nuts for export.

There are many ways in which a product can be differentiated, but two approaches that can be used by ACP processors to produce high-value foods for sale to consumers (as opposed to sales of ingredients to other processors) are to develop a new food and/or to select an attractive package that meet a perceived needs of consumers. The product and package are two components of a 'marketing mix' - others are the places where the product is sold, the price, and the types of promotion used. It is very important that each of components should be compatible with and strengthen the others. Further details are given in Volume 1 of the *Opportunities in food processing* series (Fellows and Axtell, 2000).

2.2.2. Product development

Developing a new product is time-consuming and it can be expensive. ACP processors should plan ahead to allow sufficient time for a new product to be precisely tailored to market requirements, often undergoing several revisions until it is exactly right. They should also have sufficient funds set aside for a product development budget. Further details of product development are given in other volumes in the *Opportunities in food processing* series and a summary is given in Box 2.11.

Some foods have a high-value because of the ingredients used in their formulation (e.g. herb mixtures and cooking sauces in Section 3.1.3 and alcoholic liqueurs in Section 3.6). Formulating a product requires skilled chefs or food technologists who have high levels of culinary and/or design skills. They should be able to produce formulations that are attractive to consumers, either by creating new foods or by modifying existing product types to precisely meet consumer requirements for a particular taste, flavour, colour, texture and/or appearance. Developing an entirely new product can be difficult and expensive and a lower cost approach is to take an existing product and alter it in a way that makes it distinctive and special to consumers. This can involve substituting a novel ingredient (e.g. using nutmeg instead of fruit to make jam (Box 2.12)); or selecting a specific raw material that has a high demand (e.g. unifloral honeys in section 3.5.1 or specific types of chillies in section 3.1.3).

Box 2.11. Creating a high-value product by selecting specific ingredients

Mrs G's inquisitive mind and desire to create new food recipes led her to tinker with nutmeg pericarp, an abundant but underutilised fruit in Grenada. The result was astonishing. Nutmeg jam was successfully developed followed by nutmeg syrup. The syrup became the flagship product of her company and in 1990 Monde Selection in Belgium awarded it a Grand Gold Medal. The nutmeg product range was then extended to include pepper jelly (Fig. 2.7) and an exotic liqueur. The recipe for the liqueur is a family secret that has been handed down through several generations and was commercialised by Mrs G. in the 1960s. It was also the recipient of a Gold Medal from Monde Selection in 1990. Later the product range expanded further to include not only nutmeg products but also rum punch and guava jam and jelly. As a part of its marketing and sales efforts, in 2006 the grounds of the factory were transformed into an herb and spice garden. Cruise ship passengers tour the facility and the development of a garden serves to enhance the tour of the factory. In October 2009, a 'Nutmeg Garden' was opened to visitors when a remodelled visitor centre was commissioned. Visitors now view the production operation, sample the products, take a stroll in the gardens and have the opportunity to purchase the products.

The special honey is harvested from bees that use nigerseed flowers and flaxseed flowers. The honey wine is flavoured with the powdered leaves and twigs of the plant *Rhamnus prinoides*, a hop-like bittering agent that is a species of buckthorn. The powdered leaves and stems are boiled and the extract is mixed with the honey and fermented to wine. It is highly valued by consumers.

Our white chocolate is made from premium cocoa beans and contains naturally dried apricots and raisins and tangy-sweet Michigan cherries. This delectable treat arrives in a custom gift box tied with a satin ribbon.

The company produces pure honey and the owner/manager, Mr T., has determined the honey types that customers prefer. This is usually based on the taste, colour, the region where the raw honey is produced and the yield of liquor that can be obtained from pure honey. The product is sold to hotels, cafés, restaurants, honey wine makers and supermarkets. Wine makers prefer yellowish honey whereas supermarkets, hotels, cafés and restaurants like white honey for use by their customers. He uses his skill and expertise to keep the same taste and colour consistently.

Most grasshopper processors roast or fry them, whereas Mr M. processes them in three different ways to satisfy different consumers' requirements and achieve greater market penetration. The most preferred are toasted and smoked with or without chilli - even though on first glance customers go for the deep fried ones because they are shiny and attractive, they are not as delicious as the toasted and smoked products.

The example of nutmeg products in the Caribbean is particularly interesting because the owner has made the products part of a customer 'experience'. She has identified the tourists who visit Grenada as a group of consumers that are likely to have both sufficient money and a need to buy a souvenir of their visit to the island. By combining a tour around her spice gardens to see nutmegs growing, with an on-site factory shop (Fig. 2.8), she has developed a 'package' that promotes the nutmeg products. This package can in turn be promoted to local tour organisers who work with the tour ship operators, so

that a visit to the factory is a routine part of the tourists' itinerary. In other examples, where local consumers prefer particular types of honey, coffee and spices, the manufacturers have identified outlets that specialise in supplying these products and set up ingredient supply chains in which only the specific varieties of raw materials are selected.

Fig. 2.7. Pepper jelly
(Courtesy of Cécile La Grenade)

Fig 2.8. Tourists in a factory shop (Courtesy of Cécile La Grenade)

Box 2.12. Adding value by creating new products

The company was established in Zanzibar in 1990 by Mr. M., who is the Managing Director. The enterprise deals mainly in spices and herbs, processing them for food, cosmetics and medicines. Mr. M. believes he has sound knowledge of spice and herb processing that he has gathered throughout his career, based on research he did with other partners to come up with the products he markets. He considers this as one of the strengths they have. In addition, he believes his products have created a niche in the market; hence assured sales and increased income, as well as the confidence that buyers have in his skills and the quality of his products. The various food products that are marketed include masala mixes, essential oils, spiced honey, flavoured vinegar, teas and coffee. The non-food products include herbal massage oils, creams, soaps, ointments and lotions. He specialises in spice mixes including pilau mix, fish or chicken masala, biriani masala and vegetable masala. Others are Zanzibar curry powder, Alghassaney spice mix and hot curry powder. There is also a range of herbal teas made using vanilla, hibiscus, thyme, cinnamon, cardamom, as well as masala chai, spice tea and slimming tea. These form his core strength in the business.

Value is added to honey by marketing the honey as a medicinal, gourmet or speciality food. Mixing chopped dried fruits, puréed nuts and seeds, cocoa, cream or milk powder also creates products that increase the value of honey. Other methods of adding value include placing a piece of honeycomb in jars of liquid honey, making 'creamed' honey and adding pollen, propolis and/or royal jelly to the honey.

A note on product development techniques

Developing a new product by modifying an existing product (e.g. by substituting a different raw material) has lower risks, involves less research and has lower costs than creating an entirely new product. For both modified and genuinely new products a systematic approach should be used, which involves some or all of the following stages:

1. Generating new product ideas
   New product ideas should include a description of the product and where it is likely to be positioned in the market. The description includes technological characteristics (types of raw materials, the composition, size or shape of the product, or the method of processing and storage); consumer characteristics (convenience, sensory properties of the food, its use, nutritional value, or social status given by the food); and market characteristics (the type of market that the food is likely to be sold in, amount of sales, price, advertising and promotion required).

2. Screening product ideas
   Discussion panels and consumer surveys are used to obtain views on new product ideas from buyers, consumers and the processor. As a minimum, screening information should include a description of the product and its intended use; the target buyers and consumers; and the relationships to any existing company products and to competing products (Table 2.2). The product characteristics in (1) are ranked in importance to assess the acceptability and likely potential of new product ideas and to select the best one(s).
   A series of prototypes may need to be developed before a new product is acceptable, and a panel of staff and consumers should evaluate each one using 'taste panels'. Details of how to conduct taste panels are given by Kilcast, D., 2010 and Carpenter et al, 2000. Some small-scale processors may require assistance from a food scientist to both conduct taste panels and to understand the effect on food safety or quality of changes to formulations or processing conditions. This advice may be available from an independent food scientist or university department.

3. Feasibility studies to select the new product
   Results of the screening process are combined with detailed information on predicted production; quality management; packaging and distribution costs; potential prices and sales; and the additional investment needed for promotion, equipment and facilities (i.e. a feasibility study of the final product). The combined information is used to select the product that has the highest potential sales revenue and profitability and is most likely to benefit the company's future development.

4. Creating product specifications and quality standards
   Once the new product has been decided, the processor then develops a product specification and prepares detailed quality standards that will be used to control its production. Product specifications may include:
   - Product composition.
   - Sensory characteristics (size, shape, appearance, colour, texture/viscosity, sweetness, acidity).
   - Microbiological safety standards.
   - Nutritional value (for some products).
   - Quality of raw materials.
   - Tolerances in processing conditions.
   - Type of packaging and label design (including any legal requirements - see section 4.4.4).
   - Storage conditions (time, temperature range, humidity) and their effects on the shelf life of the food.

The specifications should show the optimum for each characteristic and the limits of divergence that consumers will tolerate (see CCPs in section 4.2) as well as meeting any legal requirements. They may also take into account ethical standards expected by consumers, such as sourcing local ingredients, organic or fair trade ingredients etc.

Marketing factors	• Potential market size • Compatibility of products with market image • Relationship to competing products • Access to suitable distribution systems and compatibility with existing distribution channels • Acceptable to company's pricing policy • Marketing resources needed • Suitability to existing promotional methods and resources
Development factors	• Knowledge needed to develop product and available knowledge among staff • Time and staff skills available or need to hire professional assistance from a chef or food technologist • Development funds needed/available

Production factors	• Compatibility with existing production equipment • Cost and availability of any new equipment, raw materials and ingredients required • Availability of technical skills to produce the product • Ability to meet any legal requirements
Financial factors	• Overall development costs compared with available resources • Capital investment needed and resources available • Finance needed for market launch and ongoing product support • Profits or returns on investment required

Table 2.2. Some considerations to take into account when screening new product ideas (Adapted from Earle and Earle, 2008)

2.2.3. Packaging

A second method of adding value to a product and differentiating it from competing brands is to invest in new types of packaging. This approach may increase production costs if the packaging material has to be specially made and a careful analysis of costs and likely sales is therefore essential. There are also examples in which processors have used simple, low cost packaging with an attractive design to create a unique product that has widespread demand and high added value. For example, the spices shown in Fig. 2.9a are no different to competing products and are packaged in widely available polyester film that is used by other spice processors. However, in this case the

Fig 2.9. Examples of products that use packaging to add value: a) spices and b) tea (Courtesy of Peter Fellows)

processor has created a highly distinctive product by sealing a postcard into the top package, filling a different spice into each pack and not separating the packs so that they remain sealed together as a single unit. It is targeted as a product for visitors and tourists and sold at hotels, guest houses, restaurants, spice farms, airport shops and other tourist locations as well as retail food outlets.

Likewise, the tea shown in Fig. 2.9b is no different to 'normal' tea produced by other processors, but the distinctive packaging makes it an unusual and desirable gift or souvenir and allows considerable value to be added.

2.3 Types of markets

As with other foods described in the *Opportunities in Food Processing* series, there are a number of different types of national markets for high-value foods that are available to small-scale processors (Table 2.3). In contrast to other foods, there may also be good opportunities for ACP processors to export high-value foods regionally or internationally. Each of these different market opportunities is described in this section. However, it is important to stress that this book is a starting point; research by ACP processors may identify other products and different markets.

Market	Examples of outlets/buyers	Examples of products	See section
Local/national	Hotels, restaurants, airport shops, supermarkets, speciality shops, tourist venues, larger scale processors	Mushrooms products Spice mixes Coffee Liqueurs	3.1.1 3.1.3 3.3.1 3.6
Regional	Supermarkets, larger scale processors	Spices Coffee Cashew nuts Macadamia nuts Honey	3.1.3 3.3.1 3.4.1 3.4.3 3.5.1

International	Brokers, export agents, international company buyers or subsidiary companies, specialist wholesalers, fair-trade buyers	Herbal teas Spices Essential oils Flavourings Colourants Coffee and cocoa Tree nuts and tree oils Baobab fruit Honey	3.1.2 3.1.3 3.2.2 3.2.3 3.2.4 3.3 3.4 3.4.4 3.5.1

Table 2.3. Potential markets for high-value foods

2.3.1 National and local markets

Within an ACP country, the main buyers of high-value foods are likely to be premium shops and supermarkets that serve national consumers and tourists; owners and managers of upmarket restaurants, hotels and other food service outlets; and other food manufacturers. However, in contrast to other foods it is unlikely that there will be many opportunities to sell high-value foods to institutions such as schools, hospitals or military bases because of their low demand and the low prices that they may offer.

Fig. 2.10. Upmarket hotels and restaurants are the main buyers of high-value foods and ingredients (Courtesy of Derek Gaston at Flickr)

Box 2.13. National markets for high-value foods

Increasing tourism has resulted in requirements by hotels and restaurants for local herb production to substitute for imports.

The company made a deliberate attempt to saturate Grenada with its nutmeg products. This meant sales in outlets targeting the local population as well as showcasing its products to the many tourists to the island.
The products are therefore sold not only to supermarkets, village shops, bakeries and restaurants, but also to hotels, tourist vendors, tourist gift shops and the airline catering company to be served on regional and international flights leaving the island. To service the tourist market, the company arranges gift baskets (Fig. 2.11) containing its products and has also invested in a portion control machine for the production of half-ounce cups of jams and jellies for the airline.

The main selling route for roasted macadamia kernels is either local buyers (e.g. hotels, airport shops) or via local export agents who act for importers.

Fig 2.11. Products in a gift basket (Courtesy of Cécile La Grenade)

2.3.2 Exporting

Exporting to other countries has some potential benefits for ACP processors: it can spread the financial risk from fluctuations in the domestic economy over a wider customer base; it can provide a more global business perspective that can improve domestic sales and a company's competitive advantage; and it can provide greater economies of scale, especially if a product is accepted in different countries without adaptation or different packaging. There are two types of export markets: 1) those in countries within the same ACP region in which processors operate and 2) those in other, usually industrialised, countries.

Regional markets

Regional markets may have similar characteristics and similar consumer requirements to local markets, which make it easier to conduct market research, design suitable packaging and meet consumer needs using the same product formulation. However, before supplying export markets it is necessary to build up the company assets and infrastructure to a greater extent than those needed to supply local high-value markets: there is a much higher investment required in staff and in developing working practices within the business to deal with exporting procedures (see 'export documentation' below). There may also be a need to comply with different food labelling regulations.

Box 2.14. Exporting to regional markets

Mr L. established his business making high quality wines in Tanzania in 2006. The marketing strategy is to sell to retail outlets in Mwanza, Shinyanga, Kagera and Kigoma. By maintaining product quality and a consistent supply, the enterprise has a growing market around neighbouring lake regions of Mara, Shinyanga and Kagera. This gives him a high sales income and a lucrative profit - they are strong in the market and their market share keeps increasing. In future Mr L. plans to open depots in Bukoba and Tabora, an outlet in Dar-es-Salaam, and also to penetrate the regional East African market that will include Rwanda, Burundi, Kenya and Uganda.

Not only does the company sell its products on the local market, but it saw the opportunity to replicate its sales model in other Caribbean islands, particularly where there was a significant tourist trade. Through these efforts, regional export sales have increased.

The herbal tea products are sold in its own shops, chain stores and pharmacies, exhibited at trade fairs and exported to hinterland countries.

Uganda, Côte d'Ivoire and Cameroon export nearly all of their production of green coffee beans, whereas Ethiopia and Madagascar have strong national markets. Kenya exports more than it produces, suggesting that coffee from neighbouring countries is routed through the country.

Kola nuts are traded inter-regionally and internationally from kola-producing regions. There are markets that specialise in bulk trade of kola nuts by long distance wholesale traders, controlled by merchants who have the required transport and capital.

The enterprise has developed many products but the most interesting are baobab seeds and baobab pulp powder, sold through supermarkets and exported to Burkina Faso, Togo, Ghana, Côte d'Ivoire, and taken to France by travellers to the region.

To successfully target regional export markets, small-scale processors need a similar understanding of consumer needs as they do for local markets, but this is more difficult to achieve because they rarely meet the consumers, and may not even have direct contact with the buyers who supply consumers. Processors therefore need alternative means of getting information on consumer requirements. Some small-scale ACP processors use family members or friends who have emigrated to the target export country and make arrangements with them to gather information on the characteristics that consumers require of products and information on competing products. It is also possible for processors to enter into more formal arrangements and use contacts in the target country as agents who import and distribute the products. This may be done under a contract, as a member of staff in the company, or using a less formal arrangement. It is also possible to identify a processor in another country who produces complementary, but not competing products and use that company's already established distribution network.

Regional trading groups

Regional groupings or trading blocs have been formed in most parts of the world to create more efficient use of resources and economies of scale, and move towards economic integration and a shared approach to trade and development among member states. For example, in Africa trading groups include ECGLC - The Economic Community of the Great Lakes Countries; COMESA - Common Market for Eastern and Southern Africa; ECCAS - Economic Community of Central African States; and ECOWAS - Economic Community of West African States and the Arab Maghreb Union. As an example of the work of these groups, the Southern African Development Community (SADC) promotes regional cooperation, trade and economic development and works toward the development, promotion and harmonisation of its member states' policies. SADC has produced the Standardisation, Quality Assurance, Accreditation and Metrology (SQAM) initiative, whose objective is to eliminate any technical barriers to trade among member states and with other trading blocs. The Caribbean Community (CARICOM) and the Caribbean Forum of African, Caribbean and Pacific States (CARIFORUM) are working to establish a centralised agency to cover food safety, animal health and plant health matters. In the Caribbean and Pacific, the UN International Trade Centre (ITC) works with Small Island Developing States (SIDS) (Table 2.4) to improve their export performance through regional collaboration, focused sectoral programmes, institutional support and strengthening the private sector. This is intended to improve management systems for export procedures and export facilitation services and reduce export transaction costs. ITC also works to ensure that technical barriers to trade, as well as sanitary and phytosanitary measures, do not prevent these countries from accessing the international markets. Many SIDS also benefit from the Enhanced Integrated Framework programme, used to facilitate export trade, and they are also signatories to international, regional and bilateral trade agreements to deepen regional integration and improve participation in the globalised economy.

Africa	Caribbean	Pacific	Others
Cape Verde Comoros Guinea-Bissau Mauritius Sao Tomé & Principe Seychelles	Antigua and Barbuda Bahamas Barbados Belize Cuba Dominica Dominican Republic Grenada Guyana Haiti Jamaica St. Kitts & Nevis St. Lucia St. Vincent & the Grenadines Suriname Trinidad and Tobago	Cook Islands Federated States of Micronesia Fiji Kiribati Marshall Islands Nauru Niue Palau Papua New Guinea Samoa Solomon Islands Timor-Lesté Tongo Tuvalu Vanuatu	Bahrain Maldives Malta Singapore

Table 2.4. Small Island Developing States that are members of the UN

The Pacific Islands Forum is an inter-governmental organisation that aims to promote economic cooperation between 16 member states in the Pacific region. The Melanesian Spearhead Group (MSG) is the strongest sub-regional political and economic alliance in the Pacific, promoting free trade between member countries. Its members are Papua New Guinea, Solomon Islands, Vanuatu, Fiji and the territory of New Caledonia, which constitute over three quarters of the population, land area and GDP of the Pacific group of nations. Preferential trade agreements between the Pacific States include the Pacific Island Countries Trade Agreement (PICTA), the South-Pacific Regional Trade and Economic Cooperation Agreement (SPARTECA) and the Pacific Agreement on Closer Economic Relations Plus (PACER-Plus). The Asia Pacific Economic Cooperation (APEC) forum promotes free trade and economic cooperation between 21 Pacific Rim countries and three countries of the Pacific sub-region (Australia, New Zealand and Papua New Guinea) are members (Anukoonwattak, 2012).

In theory, exporting foods within these regional trading groups should be easier than exporting to other countries. The offices of the trading groups are located in each member country and they may supply detailed information on export procedures and any assistance that is available to small-scale food processors.

International (or inter-regional) markets

The main international markets for foods or ingredients that are produced in ACP countries are Australia and New Zealand (for Pacific processors), North America, the industrialised countries of Europe and Asian countries such as Japan, China and other industrialised South East Asian countries. Trading blocs have also been formed in these regions. The North American Free Trade Agreement (NAFTA) is an agreement signed by the governments of Canada, Mexico and the United States to create a trilateral trading bloc. The Association of Southeast Asian Nations (ASEAN) comprises Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The major economies of Europe are part of the European Union (EU). EU Economic Partnership Agreements (EPAs) are agreements with ACP states and are a key component of the Cotonou Agreement; the framework for economic cooperation between the EU and ACP countries. Under EPA schemes, preferential market access is provided on a reciprocal basis for exports from each region. The EU has granted unilateral duty-free market access to ACP countries since 2008, while ACP countries are allowed 15 (or for some, up to 25) years to open markets to EU imports.

The structure of international trade in foods and food ingredients or cosmetic ingredients uses a wide variety of channels (Fig 2.12); the more direct the trade channel, the more beneficial is the return for a producer in the country of origin. However, international exporting requires a processor to have a profitable business already in place supplying local markets, the expertise to arrange exports and to have sufficient finance available.

Some commercial buyers purchase raw materials directly from producers so as to better control and maintain quality through to the finished product. This is the preferred trade channel when large amounts of a raw material are needed regularly. Companies that have a fluctuating demand for raw materials from year to year prefer to buy from agents or from importers in their own country. In these second type of trade routes the raw material is often bought and sold by many businesses before it finally reaches the final buyer and producers have little control over the prices paid and hence their income.

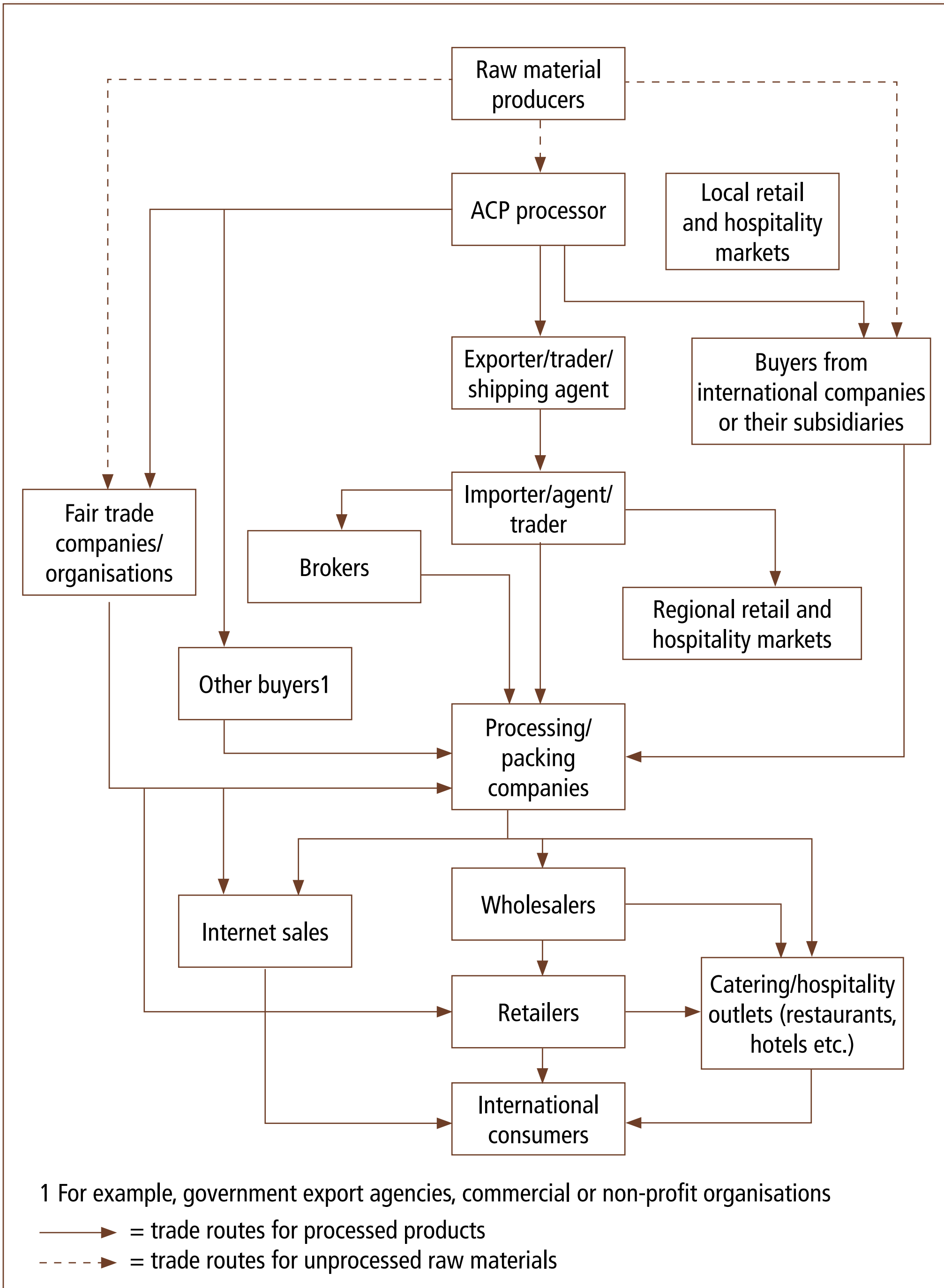

Fig. 2.12. Simplified trade routes to markets for products made by ACP food processors

There are large companies in most industrialised countries that import and process ingredients and then sell them to the end-product manufacturer (e.g. herbs and spices, aloe-vera and tree oils in Chapter 3). Such companies are often represented by subsidiaries in the producing countries (see cashew and cocoa processing in Chapter 3). They obtain the raw materials by contracting growers, from company-owned farms, or indirectly through agents and brokers that buy materials from farmers. Increasingly, international companies are also establishing operations in ACP countries to source and process raw materials locally.

Box 2.15. Sourcing raw materials by international companies

In 2011, a large Indian processing company established facilities in Ghana to process up to 50 MT of cashew nuts per day, with the intention of also setting up factories in Benin, Côte d'Ivoire, Mozambique and Tanzania. The company sees the benefits of local processing as saving the cost of transporting raw cashews to India; obtaining nuts more cheaply compared to buying from agents; improved farmers' incomes by paying farmers a higher price than agents do; and reduced export costs of processed nuts to Europe compared to those from Asia.

The EU and other East European countries are the main target markets. As with other long-standing exported crops, sales of cocoa beans take place to well-established export agents or they are sold to directly to international buyers, in this case from chocolate processors.

International honey traders buy honey from producers worldwide and offer a complete service, managing every aspect of the supply chain including raw material selection, quality and authenticity testing, logistics and timing of deliveries.

Annatto seed and extracts are mostly bought directly from producers by buyers from the main processing companies and there is little involvement of intermediate brokers or dealers, although some smaller companies make up annatto formulations for onward sales. Some multinational food companies have bought local processing companies and export the extract to their factories.

Export market prices are attractive and unprocessed aloe-vera constitutes about 95% of total sales value. Post-harvest value-added processing of raw aloe-vera leaves produces frozen fillet pulp, which is exported to Kenya, Europe and the USA and also sold to local cosmetic manufacturers.

An alternative approach is to sell high-value products to buyers from other countries who either visit periodically or have an office in the ACP country. This arrangement enables processors to focus on production and leave the export procedures and paperwork to the buyers. However, the income to processors is lower because the agent's costs are taken into account in the price paid to processors. Examples of this approach are more common with crops and raw materials than with finished products. Examples include cashew nuts, cocoa and coffee and herbs and spices (Box 2.16 and Chapter 3). These crops are usually part-processed by drying to stabilise them for storage and shipment. Many of these products have been traded internationally for centuries and the relationships between producers and local agents or buyers is very strong, making it more difficult for a new processor to enter the market and compete with existing producers. It also means that processors who supply part-processed raw materials do not gain the full benefit of the added value from the final products. To address this, many ACP countries have export promotion councils or ministries and have joined trading groups that aim to promote regional and international food exports. Examples include private and state-supported organisations and associations in several African countries that promote and market locally-processed cashew nuts and aloe-vera to international buyers (sections 3.4.1 and 3.2.5).

Fig 2.13. Herbal tea (Courtesy of Peter Fellows)

Box 2.16. Exporting ingredients to international markets

Most spice processors supply export agents and brokers, who deal with import agents or processing companies in the importing countries. In a few cases, processors have established direct relationships with larger processors in industrialised countries, often through family connections.

The product mix includes moringa oil that is exported to buyers in the USA, European countries and Kenya.

They supply kukui nut oil to cosmetic companies in the USA that import the oil.

Hibiscus powder food colouring is exported to the USA and Europe, with Germany being the main importer.

Fresh kola nuts, dry nuts or kola powder are sold within the region and also exported to Europe and North America.

There are direct relationships with US, Japanese and European processors that pack and market macadamia nuts. Exports of bulk kernels to large wholesalers in the consuming countries are also possible. They re-package the nuts after roasting and sell them to retailers. However, processors may get lower prices from wholesalers than from sales of roasted nuts to local markets.

Alternatively (or additionally) the processor may choose to work with another manufacturer as a joint venture in the target country; establish an in-country office with local staff; or hire agents or consultants to obtain the required information and to guide decision-making. Finding and working with a good partner company takes time to produce results, but this arrangement may provide the best opportunity to understand the importing country, the needs of potential buyers and how to deal with the local regulations.

Box 2.17. Working with another company to export foods

He has a sister company in the USA that assists in selling his products, and although they are branded differently, they have the origin described and this promotes the Zanzibar company.

Where high-value ingredients are used by larger companies as part of the formulation for a processed food, nutritional supplement or cosmetic, the company usually requires the ingredient to be in its most natural form, with processing only used to stabilise it against deterioration. Examples are given in Chapter 3 of tree nut oils, aloe-vera and food colourings that are each sold to agents or international buyers and then further processed and formulated into the final product in the importing country. Despite the (usually) higher costs of processing in an industrialised country, this gives the ingredient buyer a large degree of control over the quality of the final product, necessary to meet strict legislative standards and consumer quality requirements in their home markets.

A potential route for processors in ACP countries to obtain a larger proportion of the added value is to formulate and process the final product themselves and sell it to international retailers or directly to international consumers. This has been achieved successfully by a processor in Grenada, by producers of herb and spice mixes in Tanzania and by marula liqueur manufacturers in South Africa (Box 2.18).

Box 2.18. Selling final products in international markets

They decided to target extra-regional markets. These efforts were successful and the company began exporting to the USA and the UK, currently exporting 55% of its final products. Sales on the international market are largely obtained from attendance at trade fairs, but the company also uses visitors to the island as its worldwide ambassadors. Its distributors in the USA and UK use the internet to market products and the company's own webpage has also proved to be a successful marketing tool (Fig. 2.14).

ACP liqueurs, especially Amarula, have a strong export demand.

The current markets for cashew nuts, groundnuts, pickles and fruit candies are East African countries and the Middle East and total sales have grown from TSh. 91 million in 2006 to TSh. 392 million in 2011.

Sorrel is also sold via internet suppliers and in the UK the calyces and ready-made hibiscus syrup are available in Caribbean and Asian grocery stores. It can also be found as flowers or syrup in places where there are African immigrant communities.

Fig. 2.14. An ACP company's products being promoted on its website (Courtesy De la Grenade Industries)

However, it is more difficult for ACP processed or formulated foods to compete in industrialised markets and to be successful ACP processors should have the following capabilities:

- Achieve consistently high quality required for industrialised market requirements.
- Be able to supply the required volumes.
- Have the skills and knowledge to correctly formulate and/or process the food.
- Have a sufficient marketing budget to compete for a share of the market with large-scale processors in industrialised countries.

The ability of many small-scale ACP processors to penetrate markets in industrialised countries has, until the last few decades, been limited by these factors. However, two developments have dramatically altered this situation for some types of products: the creation of fair trade companies and organisations; and the internet.

2.4 Fair trade organisations

(Note: there are a large number of variations in terminology (e.g. 'Fair trade', 'Fairtrade' etc. that are explained in Fair Trade, 2011).

Fair trade organisations have been in existence for around 50 years. They aim to create trading partnerships between buyers in (mostly) industrialised countries and producers in developing countries. The relationships between buyers and sellers are based on mutual respect, and involve dialogue and transparency in decision-making and pricing policies to achieve greater equity in trading conditions than those of conventional supplier agreements. The minimum price offered by fair trading organisations is an important 'safety net' for producers, which protects their incomes when market prices fall below sustainable levels. Many fair trade organisations also campaign for changes to the rules and practices of established international trade and some also contribute to sustainable development and improved rights for producers. Over the last decade, the number and type of fair trade organisations has expanded and 'fair trading' has become more complex. It now includes alternative trade organisations that take a number of forms, including commercial companies, NGOs and trade organisations (Box 2.19). There are also organisations, such as the International Labour Organisation (ILO, 2013) and the Ethical Trading Initiative (ETI, 2013), an alliance of companies, trade unions and voluntary organisations, that aim to improve the lives of workers who make or grow consumer goods. The Ethical Company Organisation produces a publication of comparative ethical shopping rankings for over 700 companies and brands in more than 60 product sectors (ECO, 2013).

Box 2.19. Examples of fair trade companies and organisations

A commercial company: "Aduna operates as a virtuous circle – natural ingredients with outstanding properties for health and beauty go in one direction; sustainable income streams to producers go in the other. It's an exchange that leaves both consumers and producers better off: our business is driven by a passion for serving both in equal measure. Ten percent of our profits also go into the Aduna Foundation which supports social innovation projects in the communities where our products come from." (Aduna, 2013).

A trade association: "PhytoTrade Africa is a trade association of the natural products industry in Southern Africa. Its purpose is to alleviate poverty and protect biodiversity in the region by developing an industry that is not only economically successful but also ethical and sustainable. It guarantees that indigenous raw materials have been sustainably wild-harvested by, and for the benefit of, poor rural people. Products are also produced in accordance with social and environmental guidelines, described by a charter that guarantees a supply chain with clear lead times; fair and sustainable pricing; prompt payments; and full traceability. There is a commitment to biodiversity conservation and management and social and regulatory equity and organic certified processes." (PhytoTrade, 2013). See also baobab, mongongo kernel oil, Ximenia seed oil and marula in section 3.4.

A retailer: "The Co-operative was the first major retailer to champion Fairtrade, pioneering the sale of fairly traded goods before the 'Fairtrade Mark' was introduced ... with more Fairtrade products sold, for the size of our business, than any of our competitors." (Co-op, 2013).

Fair trade organisations can act as buying agents, exporters and processing companies, and for many ACP processors these have become the preferred buyers because of their fairer trading terms and conditions. However, qualification conditions needed to supply these organisations and the costs of registration and annual re-certification mean that this sales route is not open to all processors (see, for example, Haggar et al, 2012). Typical processed food products that are of interest to fair trade organisations are shown in Table 2.5. (There is also a large market for fair-traded fresh fruits, vegetables and flowers).

Beers and ales made with fair trade sugar
Biscuits and cakes
Cereals and cereal bars (muesli, flapjacks, fruit bars, sports foods)
Cocoa and chocolate products (dark, milk, white, fruit and nut, mint chocolates, drinking chocolate, hot chocolate, cocoa powder).
Cocoa butter (for cosmetics)
Coffee
Dried cereals and pulses
Dried fruits (e.g. apricots, raisins, sultanas, apples, mangoes)
Fruit pulps, juices and soft drinks
Herbs and spices
Honey
Jams and spreads
Mango butter (for cosmetics)
Molasses
Nut oils and oils from oilseeds
Shea butter (for cosmetics)
Sugar
Sugar confectionery (e.g. toffees, fudge, mints)
Teas and herbal teas
Tree nuts and groundnuts (peanuts)
Wines and spirits (e.g. Chardonnay, Sauvignon Blanc, Cabernet Sauvignon, Shiraz, Pinot Grigio, rum)
Yoghurt

Table 2.5. Processed food products sold by fair trade organisations

There are a number of national and international fair trade federations that coordinate and promote the work of fair trade organisations: Fairtrade International (previously Fairtrade Labelling Organisations (FLO) International) is an association of three producer networks and 20 national labelling initiatives that promote and market the Fair Trade Certification Mark (Fig. 2.15) (Fairtrade International, 2013). The producer networks are: 1) Fairtrade Africa, divided into four regions (Eastern, Southern, West and North Africa) with each having representatives from producer organisations (Fairtrade Africa, 2013); 2) the Latin American and Caribbean Network of Small Fair Trade Producers (CLAC), which consists of nearly 300 small producer organizations in twenty countries of the region (CLAC, 2013); 3) the Network of Asia and Pacific Producers (NAPP), which has more than 135 members representing producer organisations, small farmer organizations and promoting bodies who are certified by the Fairtrade Labelling system (NAPP, 2013).

Fig. 2.15. Fair Trade Certification Mark

The FLO certification system inspects and certifies producer organisations in more than 50 countries. There are two sets of Fairtrade standards: one set applies to smallholders working in cooperatives and the other applies to workers, whose employers pay reasonable wages, guarantee trade union rights and ensure health and safety standards. Fairtrade standards also cover the terms of trade: most products have a Fairtrade price, which is the minimum that must be paid to producers to ensure that they can cover their average costs of sustainable production. When the market price is higher than the Fairtrade minimum, the buyer must pay the higher price. Producers and traders can also negotiate higher prices on the basis of product quality and other factors. In addition to the minimum price, producers receive an additional Fairtrade 'Premium', to invest in a communal fund to improve the social, economic and environmental conditions in their communities (e.g. education and healthcare, improvements to increase crop yields and quality, or processing facilities to increase income). The Fairtrade certification system is operated by a separate company 'FLO-CERT', which employs auditors to check compliance with Fairtrade standards and ensure that producers receive the Fairtrade minimum price and premium (FLO-CERT, 2013).

The World Fair Trade Organisation (WFTO - previously the International Fair Trade Association) is a global association of fair trade producer cooperatives and associations, export marketing companies, importers, retailers, national and regional fair trade networks, and fair trade support organisations. It has 350 members in 73 countries. Full members of WFTO are named Fair Trade Organisations (FTOs), which can be trading organisations or non-trading organizations (e.g. Fair Trade support organisations and networks of Fair Trade organizations). WFTO operates a 'guarantee system', which mostly applies to the trading organisations, and the WFTO Fair Trade Standard distinguishes between compliance criteria that are applicable to producer FTOs or marketing FTOs. The WFTO guarantee system is an internal quality management system based on best practices of producer group Internal Control Systems (ICS) and Organic Participatory Guarantee Systems (PGS). The three main components to assess members' compliance with the WFTO Principles are:

1) Self-assessment every two years
2) A monitoring audit by an approved WFTO auditor every two to six years depending on the risk category and
3) Visits by peers who are nominated by the FTO, again every 2 - 6 years.

WFTO uses the Fair Trade Certified Mark (FTO Mark, Fig. 2.16) that identifies registered fair trade organisations (whereas the FLO system labels products) (WFTO, 2013a). Cooperation for Fair Trade in Africa (COFTA) is the Regional Chapter for WFTO in Africa, with a network of Fair Trade producer organisations (COFTA, 2013) and the Regional Chapter for the Pacific has information available at (WFTO, 2013b).

Fig. 2.16. FTO Mark

The Network of European Worldshops (NEWS!) is the umbrella network of 15 national Worldshop associations in 13 different countries in Europe (NEWS, 2013). The European Fair Trade Association (EFTA) is a network of European alternative trading organisations which import products from producer groups in developing countries. The organisation currently has eleven members in nine countries (EFTA, 2013).

These four federations (Fairtrade International, International Fair Trade Association, NEWS! And EFTA) together created FINE (an acronym of the first letter of their names), which aims to harmonise fair trade standards and guidelines, increase the quality and efficiency of fair trade monitoring systems and advocate fair trade politically.

Other fair trade organisations include:

- Fair Trade USA audits transactions between US companies offering Fair Trade certified products and the international suppliers, to guarantee that farmers are paid a fair price (Fair Trade USA, 2013). In 2011, Fair Trade USA split from Fairtrade International and launched a new set of standards named 'Fair Trade for All' and pilot projects to extend their certification to coffee plantations and unassociated smallholder coffee farmers - groups that are excluded from FLO standards. The organisation 'Scientific Certification Systems' conducts audits and certifies new producer groups. Fair Trade USA also launched Co-Op Link, an initiative to strengthen producer organisations by providing them with increased market opportunities in the USA, improved access to capital and an expanded range of capacity building and quality improvement initiatives.
- The African Fair Trade Society is a socially conscious organisation that imports shea butter from West Africa (AFTS, 2013).
- The Fair Trade Federation, an association of Canadian and American fair trade wholesalers, importers, and retailers (FTFa, 2013).
- The Fair Trade Foundation supports the Fair Trade Action Network, an international fair trade web-based network that links volunteers from European and North American countries, supports Fair Trade Towns initiatives, information packs for schools and encourages grassroots networking at the international level (FTFb, 2013).
- The International Resources for Fairer Trade organisation in India. IRFT gives farmers and artisans access to mainstream markets worldwide, by partnering with WFT.Organisations (in UK, USA, Netherlands and Germany) (IRFT, 2013).

Box 2.20. Experiences of supplying fair trade organisations

Over 5000 farmers in cooperative groups now grow hibiscus, producing over 700 MT p.a. and contracts have been secured with soft drinks companies in South Africa, France and California. The project also acquired organic certification for the growers and intends to gain Fair Trade certification as well as continuing to develop market linkages to sustain the enterprises.

The high cost of organic and fair trade certification, plus a lack of capital and cash-flow for product development, threatens the company's ability to provide high quality products that differentiate it from other suppliers.

Qualification conditions needed to supply fair trade organisations and the costs of registration mean that this sales route is not open to all herb and spice processors.

He sells vanilla to re-packers who are often fair trade organisations that guarantee fair prices and purchase vanilla at times of glut. They sort vanilla according to its size and quality and re-pack it before selling it to processors and gourmet chefs. Mr. M. believes that these processes are part of the value-added activities that should be done at source and further erode the negotiating power of the exporter to get higher prices.

In order to qualify as a supplier to a fair trade organisation, processors should have products for which there are fair trade standards and they should operate in a country that is covered by the standards. These standards concern minimum social, economic and environmental requirements, which producers must meet in order to become certified as a fair trade supplier (these are in addition to food quality standards). Once accepted as a fair trade supplier, certified producer groups are able to sell some or all of their production under fair trade terms. Currently (2013), there are an estimated 2000 companies certified to ethical and fair trade certification schemes around the world. Further information on fair trade organisations is described by Brett, 2011.

Criticisms of fair trade

A number of studies into the effects of fair trade, particularly on coffee farmers in Latin America, have questioned whether the benefits of fair trade actually reach the farmers, and whether other poorer farmers, who are not registered with fair trade organisations, are disadvantaged. For further information see Haggar et al 2012 and the links from Griffiths, 2012.

> **Box 2.21. Alternative fair trade model**
>
> The Direct Contact Trade Model was developed as a result of frustration at the failure to differentiate quality within the Fair Trade market, the unfairness of concessions made to large businesses using the Fairtrade logo where unfair practices occur in their business, the cost burden of Fairtrade certification on small-scale farmers, and the marketing sales levy fees paid by the company that it believes could be more effectively targeted to farmers. The approach does not rely solely on certification, although some coffees are Fair Trade certified, but paying sustainable prices that meet the cost of production and allow for investment.
>
> The company establishes a link between coffee quality and value by paying an additional incentive premium to motivate farmers to improve their coffee quality and produce coffee with an intrinsic high value. The company also sets minimum purchasing commitments so that farmers can plan for the next harvest and it supports forward finance for smallholders, either directly or by cooperating with specialised pre-finance agencies (Union, 2013).

2.5 Using the internet

If small-scale processors have sufficient investment funds available, a more profitable approach, compared to dealing with agents or other buyers, is to sell products directly to consumers in industrialised countries. Until a few years ago, such an approach would have been inconceivable, but with the advent of the internet and growing access to computers by small-scale processors in many ACP countries, this is increasingly possible (Box 2.22). There are several groups of consumers who can be targeted by web-based promotion of products: for example, expatriates from ACP countries who want 'a taste of home' (see spice mixes in Chapter 3) 'gourmet' websites that specialise in selling speciality and high-value foods (e.g. speciality honeys and mushrooms, gourmet chocolates, insects as novelty gifts and insect products such as propolis and beeswax candles in Chapter 3); and specialist suppliers of foods and supplements to sports, health and fitness markets (e.g. baobab fruit powder dietary supplements, dika nut diet supplements for weight control, kola extracts for energy drinks, or formulated supplementary foods for body-builders and other sports people - see Chapter 3).

The investment requirement is for computer hardware and software, paying for expertise to set up a website, finding supplies of packaging materials that are suitable for protecting products when they are mailed internationally; and devising a secure payment system. These requirements are beyond the capacity of most small-scale food processors and they should seek professional expertise from local university staff or computing companies/consultants to assist with the development of the internal company infrastructure to advertise and sell products via the internet.

Fig. 2.17. Example of an ACP processor's website (Courtesy of Golden Tree)

Box 2.22. Selling via the internet

The company website has on-line advertising to displays its products and receives inquiries and orders from potential export buyers.

Canned and dried Mopane worms are both exported and sold via the internet for a retail price of £15.95 per pack of 40g.

Hibiscus powder is also sold via internet suppliers at $60-78/kg.

The company spends little on advertising, relying mainly on the shelf presence of its liqueurs in stores and bars. They have a website but do not sell online; the products are listed online by exporters, wholesales and retailers. Although the majority of its production is sold into the South African market it has recently entered the export market.

A simple but attractive website acts as an online advert and a source for the company's contact details.

Mr. S.A. also owns a herbal clinic in Zanzibar where he practices his skills in herbalism and also promotes the food spices and herbs. Other promotions for his products are through company brochures, participation in local and international trade fairs and exhibitions, and through his website.

A note on non-food products

The focus of this book is on high-value foods, but during the research in ACP countries it became apparent that producers also supply high-value ingredients to manufacturers of healthcare, medicinal and cosmetic products (e.g. see moringa, aloe-vera and tree nut oils in Chapter 3). Plants and extracts are often traditional products in ACP countries and there is now a growing demand for new and innovative products that contain these ingredients in healthcare products, cosmetics and natural medicines in industrialised countries. These products are covered by product-specific EU regulations and by the FDA in the USA. Due to the aging populations in industrialised countries, anti-aging creams have a large demand. The trend towards better skincare is no longer limited to women in industrialised countries and the demand for cosmetic products for men also shows strong growth. Cosmetic products that contain ingredients aimed at beauty enhancement and skin health, are known as 'cosmeceuticals' and this market is also showing strong growth. Some of these ingredients, especially some tree nut oils, have high potential for small-scale food processors to supply to additional non-food markets and increase the diversity and profitability of their operations. However, details of the market structure, supply routes and demand are beyond the scope of this book and sources of further information are given in the relevant sections of Chapter 3.

Box 2.23. Healthcare products and natural medicines

The main local buyers of moringa leaf powder are private health units that use it to prepare multivitamin food supplements; herbal processors that prepare moringa tea, medicinal herbal aphrodisiacs and cures for joint pains, rheumatism, skin diseases etc. There are also cosmetic enterprises that make moringa soaps, baby ointments, beauty lotions and creams. Individual households also buy moringa leaf powder directly from the company as culinary additives or to make herbal tea.

Export procedures

In order for ACP processors to export foods to regional or international markets, they have to deal with organisations that are different and additional to those in their home market. As a minimum these include the international department of their bank (to set up foreign exchange account); the international section of the tax office; a freight forwarding agent; the department of customs and excise or a customs broker. The rules and procedures governing international sales are also different to those in domestic markets and are summarised as follows:

Legal issues

Knowledge is needed of the laws relating to importation in the importing country and any restrictions on the types of foods that may be legally imported (e.g. whether any country of origin restrictions exist). Detailed information on import permits, certificates and inspection procedures are also required before offering a quotation to a buyer in another country. Careful attention should be given to accurately completing the paperwork required by freight handlers and customs authorities in both the producing country and the importing countries. If the food is packaged for retail sale, the label must comply with food labelling regulations of the importing country.

Financial issues

An international quotation is usually valid for 90 days to allow time for the buyer to arrange payment and any import permits that are required. If processors are dealing with a buyer for the first time, especially if a large order is involved, they should request a reference from the buyer's bank before any contract is signed. Payment is most commonly made using a letter of credit or bank draft. Buyers pay in their own currency and, unless the importer uses the same currency, the buyer's bank arranges the payment. If the bank uses the 'spot' or current exchange rate, there are potential unplanned losses due to currency fluctuations. It is therefore better to use 'forward' rates of exchange, which are a contract with the bank to sell the currency forward at some time in the future. Processors should therefore make quotations using forward rates of exchange that will be applied on the date when the payment will be made. These do not offer complete protection against exchange rate losses (e.g. if there is a delay in payment after the contracted payment date, the contract with the bank expires and the exchange risk is borne by the exporter), but this can be overcome by insuring the credit risk. The buyer's bank arranges payment to the processor's bank in the buyer's currency. Both banks charge a fee for the transaction, which varies according to the method of payment and should be taken into account when making a quotation.

Shipment issues

Export shipments are more complex than distributing products within a home country: unless there is a land border that can be used by international freight hauliers' trucks, shipments involve air or sea freight and movement of foods to and from the exporting and importing ports or airports. The haulier's (or carrier's) liability varies with different types of arrangement (Table 2.6). The selection of the type of carriage should be fully understood and agreed between the processor and the buyer, and the costs included in the quotation. When shipping foods internationally there are greater risks of damage in transit or theft, compared to distribution in company-owned vehicles. For some products there is greater risk of damage from heat, high humidities, crushing or vibration when foods are handled by port workers or left for long periods on quaysides or airport loading areas. Hence, packaging and transport containers are likely to have higher costs than those used for distribution to domestic buyers.

Term	Meaning
Carriage and Insurance Paid (CIP)	The seller pays for carriage and insurance to a named destination point, but risk passes to the carrier when the foods are handed over.
Carriage paid to (CPT)	The seller pays freight charges and is responsible for delivering foods to an agreed place to be handed over to an agreed carrier or freight forwarding agent. Risk transfers to the buyer upon handing foods over to the carrier.
Cost and Freight (CFR)	The seller pays the costs and freight charges to bring the foods on board a names ship at a named port of destination. Insurance for the foods is not included. Risk is transferred to the buyer after the foods are loaded on the vessel.
Cost, Insurance and Freight (CIF)	The same as CFR except that the seller must in addition procure and pay for the insurance. (Maritime transport only).
Delivered at Place (DAP)	The seller pays for carriage to the named place and assumes all risks until the foods are ready for unloading.
Delivered at Terminal (DAT)	The seller pays for carriage to the import terminal and assumes all risks until the foods have been unloaded at the terminal
Delivered Duty Paid (DDP)	The seller is responsible for delivering the foods to a named place in the buyer's country, completing export and import formalities and paying all costs including import duties and taxes.

Ex-works (EXW)	The seller makes foods available and ready for collection at its premises. The buyer clears them for export and pays all transport, insurance and duty costs and bears the risks to the final destination.
Free Alongside Ship (FAS)	Suitable only for maritime transport. The seller places the foods alongside a named ship at the named port. The buyer is responsible for loading onto the ship and bearing all costs after this.
Free Carrier (FCA)	The seller delivers the foods to the carrier (named by the buyer) at a named place. The seller pays for carriage to the named point of delivery and risk passes to the buyer when the foods are handed over.
Free on Board (FOB)	The seller clears the foods for export and loads them on board the vessel nominated by the buyer at a named port. Costs and risks pass to the buyer when the foods are on board the vessel.

Table 2.6. International Commercial Terms (Incoterms®) used in international distribution (From Fellows, 2013, adapted from Santacoloma et al, 2009 and International Chamber of Commerce, 2014)

Foods should be insured during transit from the time products leave the processor's factory until they reach the buyer (known as a 'through basis'). The forwarding agent usually arranges insurance or the processor may get advice from an insurance broker. Insurance premium costs are likely to by about 1% of the value of a shipment and the cost should be included in the quotation. A common method of insurance involves the processor having responsibility for loss or damage to foods until they are unloaded at the importing country and the buyer taking responsibility for insurance during transit from the importing port.

Export documentation

There may be more than 40 separate documents required for international shipments, depending on the regulations in the exporting and importing countries, the terms of sale, method of payment and type of transport used. Table 2.7 shows some standard export documents. Processors should provide accurate information to freight forwarding agents or customs brokers for them to complete the documentation. Any discrepancies or incorrect information in the documentation may cause long delays, prevent the foods being exported, or result in their seizure by customs agents.

Name of document	Description and use
Air waybill	This is the bill of lading for airfreight shipments, issued by the freight forwarding agent for the airline. An ocean bill of lading is used for sea freight shipments. 'Negotiable bills of lading' are consigned to a bank instead of the buyer - the bank collects the funds from the buyer before releasing the documents and so protects the exporter. Ocean bills of lading can be negotiable but air waybills cannot because of the shorter journey times, which do not allow time to transfer the title between parties.
Bill of lading	This is a contract between the processor/exporter, the freight carrier (airline, shipping company or road haulier who crosses national boundaries) and the freight forwarding agent. It identifies who has responsibilities for paying transport fees between the export and import ports. It may be sent directly to buyers only if they have paid in advance so that they can immediately clear the foods through customs on arrival. Otherwise it is sent to the buyer's bank and the processor controls possession of the foods until they are paid for.
Certificate of origin	This is used to identify the place of manufacture of the food (not the place from which it is exported) and can affect the duties charged by importing customs authorities. It is needed if a buyer wishes to claim preferential tariffs and banks may require it to issue a letter of credit. 'Blanket' certificates of origin may be used to cover multiple imports of identical foods within any twelve month period.
Commercial invoice [1]	This is a legal contract for the exact amount of the sale which cannot be amended later. It is a record of the shipment and how the payment is to be made, used by both the exporter and the buyer. It is prepared by the processor once the buyer has accepted the offer and placed an order, and either sent directly to the buyer or via the bank, with a copy to the freight forwarding agent, who uses it to prepare the shipment documentation. It describes precisely the type, amount and grade/quality of the foods being sold and the terms of the sale. Other information that should be included is the name and address of the exporter and buyer, the agreed price and terms of payment, an accurate description of the packages (number, type, weights, dimensions, markings), type of shipping container and markings on the container, the date, place and method of shipment, delivery location and details of freight and insurance costs. The customs broker uses it to prepare customs entry forms in the importing country and import customs officers use it to calculate duties (based on the value of the goods on arrival or the 'Ad Valorem' rate) and allow customs clearance. The seller's bank and the buyer's bank use it to make the payment and the insurance company uses it to provide insurance for the shipment.

Fumigation certificate	Required by some customs authorities (e.g. for grains, herbs and spices) as evidence that they have been fumigated.
Letters of credit	An export letter of credit is a form of trade guarantee provided by the buyer's bank in favour of the seller, describing the conditions on which payment may be made. It should be made 'irrevocable' (i.e. it cannot be altered without the consent of both banks). Other options are a transferable letter of credit that enables all or part of the credit to be transferred to a third party. A revolving letter of credit may be used for regular shipments to the same buyer.
Bill of exchange	This is used in countries that do not allow use of an invoice for exports. It describes when the payment should be made (e.g. on demand or at a fixed time in the future) and thus allows the buyer to pay after delivery. It can also be used to withhold delivery in the event of non-payment.
Packing lists	These are attached to the shipment and are used by shipping companies and forwarding agents to itemise each package, to identify the type of foods being carried, the type of packaging materials, the gross and net weights of products, volume and dimensions, package markings, shippers and buyer's reference numbers, and any handling instructions. Customs authorities use them with the commercial invoice to apply appropriate duties and allow customs clearance.
Phytosanitary certificate	Used by importing customs authorities to confirm that an animal or plant health inspection has been made.
Proforma invoice	To prepare a quotation for a buyer. It describes the offer only at the time that it is made and it may be altered later during negotiation of the sale. The buyer may need it to obtain permission to exchange currency or to import the product.
Banker's draft	This is sent by the processor's bank to the buyer's bank either a 'sight draft', payable when the buyer receives the delivery documents, or a 'term draft', payable in multiples of 30 days after sight of the documents.
Food standards documentation	Required in some countries to certify the safety or purity of foods and compliance with legal standards (e.g. for storage and transport of foods, especially temperature control of chilled and frozen foods). It is the legal responsibility of the buyer to ensure that imported products conform to national food safety requirements. In most countries, food laws allow customs or enforcement officers to inspect and seize food that is suspected of not complying with food safety legislation.

Import/export certificates and permits	These may be required for import or export of alcoholic beverages in some countries and they are also used for organic products. Biodiversity certificates needed for products covered by the CITES convention.
Shipper's letter of instruction	This contains information required by the freight forwarding agent or carrier to make transport arrangements. It contains the shipping company's name, identification number, contact name and details, shipper reference numbers (bill of lading, invoice, purchase order), the product value on the invoice, product information (description of the foods, weight, number of packages, volume, identifying marks), freight billing information (a cost per kilo is charged on either the weight or volume of the shipment, depending on the density of the cargo; the carrier charges the higher of the two costs), name and address of the buyer, names of other parties to notify (e.g. importer, customs broker) and any special delivery or storage instructions.
Shipper's export declaration	This is a legal record of the shipment prepared by the freight forwarding agent that is used by export customs authorities to control exports of foods that need an export licence.

Table 2.7. Examples of standard documents for exporting foods

[1] Note: a consular invoice, obtained from the consulate of the importing country or from the freight forwarding agent, may be required by the consulate to assess the transaction for fraud (e.g. importers asking the seller for a false, low-value invoice to avoid paying the full duty on the foods). The assessment may be part of a pre-shipment inspection that some countries use.

Beware of fraud: If requested to issue false invoices by a buyer, processors will be guilty of conspiring to defraud customs in the importing country, which may carry heavy penalties.

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Entrepreneurs' checklist

Have you:

❏ Used market research to identify the needs of consumers or other buyers?

....

❏ Prepared a feasibility study to assess whether the high-value product can be made and sold profitably?

....

❏ Selected the raw materials, ingredient formulation and packaging to differentiate your product as high-value, gourmet or exotic compared to competing products?

....

❏ Selected niche markets in which consumers have sufficient disposable income to buy high-value or luxury products?

....

❏ Decided the most cost-effective way to bring your product to these markets and the types of sellers who can reach the target consumers?

....

Reader's notes

Please use this space to write your own notes on Chapter 2.

Production of high-value products 3

Summary of the chapter

The chapter describes the production and sales of more than 36 high-value foods, cosmetics and food ingredients, including for each, where appropriate:

✔ Sources of raw materials and cultivation requirements.

✔ World production data.

✔ Methods to add value.

✔ Routes to market.

✔ Typical retail prices.

✔ Methods of small-scale processing.

✔ Product quality standards.

✔ Packaging and storage requirements.

✔ Boxes contain case studies from ACP producers in boxes to illustrate some of the opportunities and issues facing small-scale processors.

Keywords: World production, production methods, retail prices, product standards, mushrooms, herbal teas, medicinal plants, herbs, spices, spice mixes and pastes, flavoured plant oils, essential oils and oleoresins, natural flavourings, vanilla, natural colourants, aloe-vera, coffee, cocoa and chocolate,

tree nuts and nut products: cashew, kola, macadamia, baobab, Chilean hazelnut, Gabon nut, irvingia, kukui, marula, mongongo, moringa, Trichilia, ximenia, honey, honeycomb, royal jelly, beeswax, propolis, honey vinegar, edible insects, alcoholic liqueurs.

Tips for success

- ✔ Select a high-value product that matches the investment you have available.
- ✔ Select the specific varieties of raw materials that add value to a product.
- ✔ Confirm that the raw materials are able to successfully grow in your area.
- ✔ Fully research the technologies required to make the product you are considering, including packaging requirements.
- ✔ If you need to formulate a new recipe for a product, involve a chef to help balance the flavours. Keep an accurate record of the quantities of each ingredient; if you don't you will not be able to reproduce the product.
- ✔ Ensure that you know the quality standards that apply to the product and ensure that the production process allows these to be met.

Introduction

There are thousands of products made from plants or their components that are used as foods, food supplements, in cosmetics and many other products. Examples of high-value plant products are described in other volumes in this series, including speciality cooking oils (Fellows and Axtell, 2012), some types of candied fruits and fruit purées (Axtell and Fellows, 2008).

It is not possible in a book of this size to describe (or even list) the production of all high-value plant products and a selection is therefore included to demonstrate the different types. This section begins with whole dried foods, including mushrooms, medicinal plants and herbal teas. This is followed by a section on dried herbs and spices and products, such as dry spice blends, cooking pastes and sauces that contain herbs and spices and (3.2) on plant extracts, such as essential oils, oleoresins and natural colourants. Section 3.3

describes the production of coffee, cocoa and cocoa products, followed by two sections (3.4 and 3.5) that describe speciality, high-value tree nuts and their products, and insect foods including honey and bee products. The chapter concludes with a description of speciality sugar products and alcoholic liqueurs in sections 3.6 and 3.7.

3.1 High-value dried foods

Excluding herbs and spices (section 3.2), the most valuable dried plant foods are speciality or gourmet products that may be unusual in a particular market, difficult or costly to produce, or having individual flavours or other characteristics that consumers particularly desire. A dried food that has a higher value than the 'normal' equivalent is 'sun-dried' tomatoes, which can retail in industrialised countries at $25-35/kg (Healthy Supplies, 2013a), compared to ≈$10/kg for other dried tomatoes. They have a high demand for use in pasta, bread and other bakery products and as an ingredient for sauces, chutneys and a wide variety of dishes by restaurants and hotels. In this section, three groups of products: 1) dried mushrooms; 2) herbal teas and medicinal plants; and 3) herbs and spices, are used to illustrate how and why these products are considered to be high-value.

3.1.1. Dried mushrooms

Warning: some fungi are poisonous – do not attempt to process mushrooms unless you have received training in their identification and safe cultivation or collection.

There are many thousands of different types of fungi and some produce fruiting bodies above ground that are known as mushrooms. Mushrooms are popular in Western and South East Asian cuisine in particular. They are also eaten as part of daily meals in many ACP countries and some are used for their reputed medicinal value. Although the commonly eaten button (or white) mushrooms (Agaricus bisporus) are valuable and their cultivation can add considerably to household incomes, they are not as valuable as the speciality mushrooms that are described in this section. Additionally, button mushrooms require relatively low temperatures for cultivation, which are more difficult to achieve in tropical countries without the additional expense of cooling the cultivation room.

Box 3.1.1. Benefits of mushroom processing

Ms R.'s commercial mushroom cultivation and processing is a lucrative cottage industry. It is suitable for low-income urban and rural-based households in Uganda. The business is labour-intensive, which generates full- or part-time employment and can be established with a low capital outlay and with minimal requirements in terms of space and equipment.

The main high-value markets for ACP mushroom producers are likely to be in the food service sector, particularly high-end hotels and restaurants where they are used as ingredients, and also upmarket supermarkets that stock a range of speciality mushrooms. In some ACP countries, local varieties of wild mushrooms can also have a high domestic demand and are sold in rural markets, by street hawkers or on-street urban stallholders.

Box 3.1.2. Markets for mushrooms

Ms R. sells dried mushrooms by a combination of direct sales to customers who visit her premises (family networks, members of women's groups and neighbourhood residents) and indirect sales by distribution to local supermarkets, small groceries and market vendors in urban centres. She also sells fresh mushrooms in 200g packets transported in plastic containers to supermarkets and groceries, delivering them in her air-conditioned van twice per week. One large supermarket has a procurement subsidiary company that receives deliveries and distributes the mushrooms to different chains. Using these methods, she gets first-hand information about customers' mushroom needs: "Selling both fresh and dried mushrooms has its benefits because I can know what types of mushrooms are in demand."

She specialises in the cultivation of oyster mushrooms and targets sales mainly to high-end buyers such as gourmet chefs in large hotels and restaurants, and consumers buy them from supermarkets and groceries in Kampala City.

She believes that the large market for mushrooms in Uganda is due to a tradition of consumption of both dried and fresh mushrooms. People are knowledgeable about edible mushrooms and appreciate their flavour, consuming them as part of traditional cooking. High-value native 'Bubaala' mushrooms are picked from the wild by rural people and dried for sale. They have a flourishing market, as evidenced by their sale in local markets and by vendors along highways and she reports that the demand for dried wild mushrooms outstrips the current supply.

In the case of cultivated fresh button mushrooms, despite steady growth in recent years from producers in the highlands in the West of the country, the wholesale and retail markets have been depressed by Kenyan and South African imports (button mushrooms require cool temperatures and hence much is imported). She says that there is a demand for fresh button mushrooms (about 50% of total demand), oyster and shiitake mushrooms (40%) and she claims to command a 5-8% market share of the fresh mushrooms sold in Kampala. The local consumption of dried oyster and shiitake mushrooms is mainly by consumers with Euro-centric tastes, expatriates, visitors and tourists at hotels.

Prices for fresh oyster mushrooms sold to supermarkets range between UG Shs 3,500 - 4,000 per kg (US$1.4-1.6) with retail prices in one supermarket for Ms R.'s mushrooms being UG Shs 10,350 per kg (US$4.14).

The fragile texture and short shelf life (a few days) of fresh mushrooms means that production units must be located close to the buyers to minimise losses during handling, transport and storage. Mushrooms have a relatively high respiration rate compared to other fresh produce, which reduces their storage life and causes loss of firmness in their texture. Naturally occurring enzymes also react with oxygen and form brown pigments that darken the flesh, especially if the mushrooms are bruised or otherwise damaged during harvesting. Loss of moisture during storage causes wilting and shrivelling.

Spoilage during storage can also be caused by bacteria, which produce rapid deterioration when the mushrooms are removed from cold storage. All of these changes cause rapid loss of quality that makes the mushrooms unsaleable. To minimise losses, fresh mushrooms should be cooled to 0-2°C within five hours of picking and stored under refrigeration at 1-4°C to give a shelf life of a few days. Alternatively, mushrooms may be stored at 8-10°C in containers that are wrapped in plastic film that has a high barrier to moisture, oxygen and CO_2. Respiration of the mushrooms inside the pack causes the level of CO_2 to increase and oxygen levels to fall, so extending the shelf life by a few days. Clearly the refrigeration and/or specialist packaging films increase production costs for processors.

Box 3.1.3. Packaging high-value mushrooms

Supermarkets and groceries each require different forms of packaging, depending on their clienteles' purchasing habits and the way they express their corporate image. Some supermarkets re-pack her mushroom deliveries in 200g or 400g amounts in transparent polyethylene or polypropylene packaging. Others prefer deliveries to be already packaged in trays that have the supplier's label. Ms R. uses all the following packaging materials: polystyrene trays, PVC film overwrap and printed labels showing either the supermarket brand name or her company name.
For dried mushrooms, Ms R. uses heat sealed polythene sachets containing 100g of mushrooms. She owns a manually-operated stainless steel food wrapping machine designed to wrap polystyrene and plastic foam trays and a heat sealer for plastic bags.

Fig. 3.1.1. Dried oyster mushrooms packed for a supermarket (Courtesy of Michael Lubowa)

To overcome the constraints of handling fresh mushrooms they may be dried. Dried mushrooms are stronger and more resilient to breakage or other damage and when properly packaged can have a shelf life of several years. These characteristics enable them to be sold in wider markets, including export markets. The most common high-value dried mushrooms used in up-market cuisine are shown in Table 3.1.1. (For comparison, the price for button mushrooms was $3.00-4.50/kg in 2013).

Type of dried mushroom	**Summary of characteristics**	**Price**	**Value ($/kg)**
Morel (Morchella elata, Morchella conica)	Considered by connoisseurs as the finest edible fungi, high intensity flavour with rich earthy aromas.	£260.33/8x30g or $31.50/oz	1084.71 to 1627.06
Shiitake (Lentinulla edodes)	Cultivated mushroom, meaty texture & unique flavour.	£6.79/40g	254.63
Organic kibbled Shiitake (bulk sales)		$15.00/lb	33.03
Porcini (or Cep or Cepes) (Boletus edulis).	Intense, smoky, nutty flavour, adds depth of flavour and richness. Only found in the wild.	£21.75/ 500g to £34.95/ 50g	652.50 to 1048.50
Chanterelle (Cantharellus cibarius)	Uncultivated and relatively difficult to find & very sought after. Tender texture and flavour.	$30.00 /1/2 lb to $110.85/lb	132.16 to 224.16
Black trumpet (Craterellus cornucopioides),	Great delicacy. Waxy, charcoal-grey outer surface, inside velvety blackish-brown, buttery.	£5.75/50g	172.50
A selection of dried wild forest mushrooms: Boletus, 40%; Pleurotus, 25%; black fungus, 25%; cepes, 10%.	-	£14.95/50g	44.85
Organic Crimini (or Italian Brown mushroom)	Intense flavour.	$18.50/1lb	40.75

Lobster Mushroom (Hypomyces lactifluorum)	Parasitic mushroom, uses another mushroom as host & dramatically increases the flavour of host. Bright red exterior with firm white flesh, soft texture, delicate flavour.	$84.90/lb	187.00
Dried Oyster mushroom (Pleurotus ostreatus and other Pleurotus species	Popular for cooking, torn instead of sliced, especially stir fried or sautéed, because they are consistently thin, and cook more evenly than other types.	£8.20/100 g	123.00

Table 3.1.1. Retail prices for high-value dried mushrooms (From Black Star Gourmet, 2013; Dartagnan, 2013; Healthy Supplies, 2013b; Fungus Amongus, 2013; The Good Food Network, 2013; Confit Direct, 2013; Gourmet Store, 2013; Tropical Wholefoods, 2013)

Notes: Retail prices are at March 2013. Currency conversions: £1 = $1.5, €1 = $1.3. Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

The wide range of prices in Table 3.1.1 ($30 to $1600/kg) is due to their demand, which in turn depends on the rarity of the mushrooms, whether they are cultivated or only collected from the wild, and their individual flavours. Wild-collected mushrooms have the highest value due to the high costs of harvesting and their lower, more variable yields, compared to cultivated mushrooms.

Mushroom products

Dried mushrooms may be powdered for use in soups or as an ingredient in other dishes. Some (e.g. Reishi or Chaga mushroom powders) are used as medicinal or health foods. Most commercial soup manufacturers use powdered button mushrooms, whereas the high-value products are sold as gourmet ingredients and can fetch higher prices. For example, in 2013 Shiitake mushroom powder retailed at $82.00/kg; Cep mushroom powder at

Fig. 3.1.2. Examples of dried gourmet mushrooms (Courtesy of Michael Lubowa)

$162.00/kg; and Chaga mushroom powder for chaga tea at $839.00/kg (Fine Food Specialist, 2013; Justingredients, 2013; Indigo, 2013).

Box 3.1.4. Markets for mushroom products

She reports that only two companies in Uganda process mushroom powder for soup and the bulk of the mushroom powder is imported from Kenya and South Africa.

Fig 3.1.3. Gourmet dried mushroom powders (Courtesy of Pistol River Mushrooms)

There are more than 270 identified species of medicinal mushrooms that have known therapeutic properties, including anti-cancer, anti-hyperglycemic, anti-inflammatory, anti-diabetic, anti-viral and anti-microbial properties. Other medicinal properties derived from mushrooms include immune suppressants used in organ transplants and in cancer chemotherapy and radiation treatments. Although tablet and liquid preparations made from medicinal mushrooms are very high-value (e.g. Aloha, 2013), this is a highly specialist type of processing and is not described in detail in this book. Further information can be found at NAMA, 2013; Anon, 2009; and Wasser, 2013. However, medicinal mushrooms are also collected and sold many in ACP countries, although as described in Box 3.1.5, these are not always suitable as a small-scale commercial processing enterprise because of quality issues.

Box 3.1.5. Local market for medicinal dried mushrooms

Many communities in Uganda consume local mushrooms as medicines and fertility enhancers. There are two main types: dried wild 'Nakayebwa' mushrooms (Termitomyces microcarpus) which are large brown mushrooms with white stalks that turn black on drying, and 'Bubaala' mushrooms, which are small and white, turning creamy brown when dried. The demand for these mushrooms is very high and the supply is low, but they are not considered by Ms R. because they are very fragile and highly perishable: they have spoiled by the time they reach the company premises after travelling the long distance from rural areas where they are located. Also the mushrooms sold by mushroom gatherers have a low quality and are highly contaminated with soil particles, insects etc.

Trade in dried mushrooms

Mushroom production, consumption and trade is mostly focused on North European countries, Korea and the USA (Table 3.1.2). However, although the volumes are much smaller, there are significant imports of mushrooms into some ACP countries (Table 3.1.3). There may therefore be good opportunities for import substitution in these countries, provided that the production costs and sales prices can be made competitive.

Box 3.1.6. Competition from imports

Ms R. asserts that demand for dried local wild mushrooms outstrips current supply. There is evidence of steady growth in demand for high quality oyster mushrooms, but the wholesale and retail markets have been depressed by several new market entrants and also by Kenyan and South African imports, which have led to an over-supply of the product.

Producing country	Exports (MT)	Importing country	Imports (MT)
Poland	179,525	UK	98,290
Netherlands	109,455	Germany	82,035
Ireland	40,915	Russian Federation	49,734
Belgium	30,463	USA	40,787
Canada	29,574	Netherlands	38,044
Lithuania	24,942	France	37,961
Korea	21,116	Belgium	37,486
USA	9,769	Ireland	26,589
Germany	6,766	Italy	15,269
Hungary	6,376	Austria	13,105

Table 3.1.2. Trade in dried mushrooms in 2010 (FAOSTAT, 2013)

Mushroom cultivation and drying are well-established in European countries, which are also the main markets (Table 3.1.2). It is anticipated that ACP producers would have difficulties in competing on quality, volumes and prices with these producers in European markets. However, there may be opportunities for import substitution in their own country or region.

Box 3.1.7. Starting a mushroom processing business

Ms J. started a micro-scale mushroom business after undergoing training in mushroom cultivation while being a member of a women's group in 1994. She says: "During my childhood, I used to pick wild mushrooms and I acquired the knowledge and experience to identify and handle edible mushrooms. So when it came to cultivation of oyster and shiitake mushrooms, I quickly adapted to it". She started serious commercial small-scale oyster mushroom cultivation as a business activity in 2005. "I started as a side income-generating activity to supplement my family household income. Then my core business activity was merchandise retailing in a shop". However, she dropped the retail merchandise business to focus on commercial mushroom cultivation because the market was growing.

Mushroom production is a labour- and management-intensive activity that requires considerable planning and close supervision. Mushroom processing is run as a family business in the suburbs of Kampala. The proprietor is responsible for the day-to-day running of the production operations, while her son, a university student, assists her in record-keeping, sales and

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marketing of the mushrooms. In addition to involving three other family members in the business, she employs two workers on a permanent basis. She sees her business strength as the established local markets which she created through partnerships with major supermarkets and groceries. However, Ms R. says: "Sometimes I receive orders for fresh shiitake mushrooms from gourmet chefs but I don't often take them on because the required delivery time is three weeks whereas the preparation, cultivation and harvesting takes at least two months. The alternative is to source from other women's group members, but their quality in terms of hygiene and colour of the mushrooms does not appeal to these customers".

Import data for Eastern, Southern and West Africa and some Pacific and Caribbean islands show imports from four to over 1000MT p.a. of dried mushrooms. This includes lower-value button mushrooms, but is also likely to include some of the high-value mushrooms in Table 3.1.1 that are required by hotels and restaurants that cater for tourists, expatriate Western residents and local wealthy families who have acquired a taste for these ingredients. Even substituting the lowest imports of 2-10 MT p.a. with local production of dried mushrooms could form a profitable small-scale enterprise.

ACP country	Imports (MT)
Botswana	1,329
Jamaica, Trinidad and Tobago	131-138
Swaziland, Namibia, South Africa, Zambia, Saint Lucia, Maldives	50-100
Fiji, Cook Islands, New Caledonia, French Polynesia, Papua New Guinea, Barbados, Zimbabwe, Tanzania, Uganda, Ghana, Benin, Niger, Ethiopia	10-50
Côte d Ivoire, Nigeria, Congo DR, Rwanda, Kenya, Malawi, St Vincent & Grenadines, Vanuatu	2-10

Table 3.1.3. Imports of dried mushrooms to ACP countries in 2010 (FAOSTAT, 2013)

Mushroom cultivation

Mushroom cultivation has been promoted for many decades in ACP countries as a means of income generation and improved nutrition by a number of development agencies (e.g. Zero Emissions Research and Initiatives (ZERI) with UNDP and the University of Namibia (Shu-Ting Chang and Keto Mshigeni, 2005 and Kivaisi, A., undated). Abundant agricultural and food processing wastes that are normally discarded can be used as substrates for mushroom cultivation (e.g. straw, corn cobs, sawdust, banana leaves, cotton seed hulls, spent brewer's grain, coffee pulp, as well as newspaper and cardboard). The cultivation conditions required for mushroom 'fruiting' are: 1) a high humidity (80-95% relative humidity for most species); 2) a specified temperature range that varies with different species and strains (some, such as oyster and shiitake mushrooms, have both cold and warm weather strains); 3) good ventilation or fan-assisted air movement to produce low levels of CO_2; and 4) low light levels inside cultivation rooms for most species, although some require darkness. Details of cultivation conditions for different mushroom species are described by Stamets, 2000.

Depending on the climate in ACP countries, fans, humidifiers or air conditioning may be needed in larger growing rooms, which can increase production costs. Processors should therefore consider the growing requirements alongside the demand for different types of mushrooms before investing in production facilities. However, when the species of mushroom is able to grow well under ambient temperature and humidity conditions, the investment required by small-scale mushroom processors can be relatively modest, making it a potentially profitable operation.

Box 3.1.8. Low-cost mushroom cultivation

Ms R.'s mushroom business thrives on an indoor mushroom production method that demands a high level of knowledge and understanding of the inputs needed to achieve high efficiency and short growth cycles for commercial production. She uses substrates that are a mixture of sorghum stalks and spent brewers' grain wastes. Other inputs include spawn for seeding the beds and a water supply to make steam to pasteurise the substrate, to clean the fresh mushrooms and the equipment; and to keep a high humidity to sustain mushroom growth. A power supply is needed for refrigerated storage of fresh mushrooms. She cultivates oyster mushrooms because they are easier to grow than many other species, and they can be grown in a limited space, such as a low-cost indoor shelter located within her residential compound. To maintain the correct humidity, she has lined the housing with plastic sheets.

The substrates are packed in 50kg jute bags and then sterilised. Then spawn is added into each bag and mixed. The mixture is divided and re-packed into 3.5kg plastic bags. She prefers to use black plastic bags so that there is no need for a dark incubation room.

The supply of mushroom spawn is critical to the success of a small processing enterprise: not only should it be grown under strictly controlled hygienic conditions to avoid contamination with bacteria or other fungal strains, but it should also be supplied at an affordable cost. Supplies may be sold by a local research institute or university, or spawn 'plugs' may be obtainable from specialist importers or via the internet (e.g. Suttons, 2013). Processors should also have the skills to multiply spawn from a 'mother' culture to provide sufficient stocks to inoculate the required amount of substrate (Box 3.1.9).

Box 3.1.9. Supplies of spawn for mushroom cultivation

She sources supplies of oyster mushroom spawn from the Agricultural Research Institute or University School of Food Technology. Her quarterly spawn requirements are estimated at 20kg. Her training has enabled her to prepare the spawn: "I can even handle mother spawns to produce final spawns, which I would sell to small-scale mushroom cultivators if I was not limited by not owning a laboratory facility". Some entrepreneurs have low yields of mushrooms, caused by low quality spawn, often due to poor storage.

Box 3.1.10. Requirements for mushroom production

Ms R. has a jumbo-sized domestic refrigerator which can operate at 4-7°C to store fresh mushrooms under refrigeration and it is also used to store bottles of spawns. She is constrained by unreliable power supplies and uses a stand-by generator, but the cost of fuel is very high, currently UG Shs 3,650 (US$ 1.46) per litre.

Substrate preparation requires high levels of hygiene and sanitation to produce and handle fresh mushrooms that meet the complicated grading system used by buyers from supermarkets. High yields take place after 25 to 40 days and then fall for up to three or four months, which requires more management of temperature control, monitoring of humidity and checking the screening of the mushroom house ventilation system to keep flies out. These activities require extra labour which adds on the cost of production.

Drying

The moisture content of fresh mushrooms is reduced by drying from 70-95% to ≈10%. Although mushrooms may be dried in the sun, higher quality is achieved by drying in cabinet dryers at 40-60°C for 12-18 hours. A lower temperature (≈50°C) is reported by Kulshreshtha et al, 2009 and Byung Sik Kim, 2004, to result in better rehydration characteristics, less shrinkage and a lighter colour than higher temperatures of 70°C and 90°C.

Box 3.1.11. Drying mushrooms

Ms R. says sun-drying is very cheap and cuts down the drying time, especially if she has large amounts of unsold fresh mushrooms or wild-gathered mushrooms that require preservation before they spoil. She produces about 30kg of dried mushrooms weekly and packs them in polythene sachets of 100g. "This maintains their flavour and tenderness when rehydrated, whereas solar drying of wild mushrooms tends to darken their colour and also lose the natural flavour. I tried to use solar dryers similar to those used in fruit drying, but my mushrooms became brittle and were breaking into powder while packing. Also, on a cool day the mushrooms re-absorb moisture before drying properly and get spoiled" says Ms R.

Quality assurance

Methods for the management of the quality of cultivated mushrooms are described in MGAP, 2010. Other methods of Good Manufacturing Practices (GMP) and guidelines for Hazard Analysis Critical Control Point (HACCP) programmes apply to mushroom cultivation and are described in Chapter 4. Individual industrialised countries have standards for dried mushrooms, especially for limits on contamination by maggots or mites (e.g. USDA, 2009), and CODEX has standards for the quality, classification and size designation of mushrooms (CODEX, 1981). Even where mushroom production is for local sales, these standards and any ACP government regulations should be used to produce high quality mushrooms for the target market.

Box 3.1.12. Quality assurance in mushroom processing

Supermarket buyers require the following practices to ensure the quality and safety of fresh mushrooms:

Growing - keeping doors closed to prevent insects from entering; regular cleaning with a full clean after every mushroom picking; disposing of spent compost at a distance from the premises (often sold as fertiliser for home gardening).

Harvest - staff pick only mature and well-formed, non-diseased mushrooms (any diseased mushrooms should be collected separately and disposed of) and pack them in clean baskets or containers with perforations on all sides.

Washing - immediately after picking in clean water.

Inspection – to identify any damaged or broken mushrooms, which are removed and sold in the neighbourhood as third quality.

Grading and slicing - grading into various standards as per market requirements (e.g. mushrooms for small groceries and some supermarkets are cut to the desired stem lengths). First quality mushrooms for supermarkets have their stems completely cut off.

Drying – indoor air drying to produce clean mushrooms that are packed in 100g or 200g amounts in heat-sealed polyethylene sachets.

Delivery and distribution - mushrooms are packed, weighed and labelled. Alternatively, on delivery of packed mushrooms one buyer labels the product 'specially produced on behalf of …….. (name of buyer)'.

There is no brining process because supermarket buyers prefer non-salty mushrooms. Although brining produces hygienic mushrooms, salt is costly and it is time-consuming to de-salt the product, making the mushrooms uncompetitive.

The quality of sun-dried oyster mushrooms may be lower because of high moisture levels, often above 12%, plus contamination with sand and dust that lowers their quality and value. This is key reason why supermarkets order insignificant volumes of dried mushrooms.

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3.1.2. Herbal teas

Introduction

This section focuses on the production of high-value herbal teas (or 'tisanes') that are drinks made from the infusion or decoction of herbs, spices, or other plant materials in hot water. They are popular because of their fragrances and are pleasant to drink. For other people, herbal teas may be used instead of tea and coffee to reduce caffeine consumption and many are also drunk for their perceived medicinal benefits (known as 'phytotherapy'), including stimulant, relaxant or sedative properties. These benefits are often anecdotal and not medically proven, and some countries prohibit unsubstantiated claims about the medicinal effects of these products (e.g. MRHA, 2014a).

Box 3.1.13. Claims made for a herbal tea (From Dr. TeaTM, 2013)

Benefits:
- Increases the metabolism
- Boosts the energy
- 100% Natural and nourishing
- Stay fit & lose weight
- Enhances mind-body wellness
- It destroys the stubborn fat groups, break down fat and make it burning
- Strengthens your immune system
- Melt away body fat; boost energy; and even clarify skin, giving your face a clear, radiant glow
- Fast effective and free of risk
- Make your skin firm, smooth and delicate with a variety of nutrients and vitamins
- Quick result
- Amazing effects of the slimming tea.

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Health and medicinal value of herbal teas

There is a distinction between plants or their extracts that are used solely for medicinal purposes (e.g. quinine) and those that may be used in herbal teas. For example, in the Pacific, particularly Hawaii, and in the Caribbean, the fruits and leaves of the Noni tree (*Morinda citifolia*) are sold and used as a medicine. Although it is widely considered to have beneficial effects against cancer, to date it has not been approved as a cancer drug. It gained EU approval in 2002 to be used as a novel food and it is marketed as a juice or in capsule form for high prices, typically $US 40/litre. The Bo tree is a member of the fig family (*Ficus* sp.) and has been used to treat epilepsy in many parts of the world; the fruits contain significant amounts of serotonin, which significantly inhibits seizures.

The use of medicinal plants is highly regulated and the therapeutic dosages are described in regulations (e.g. MHRA, 2014b; EU, 2014). The study of the chemical and medicinal components of natural products is known as 'pharmacognosy' and this specialised area is beyond the scope of this book. Further information is available at websites such as the American Society of Pharmacognosy (ASP, 2013). Some medicinal plants are prohibited from use in herbal teas, but plants that are permitted in teas are largely unregulated in their dosage or use. In most countries, the legislation does not require herbal tea manufacturers to offer evidence concerning their efficacy, but it does include them as food products and requires them to be safe for consumption (see also section 4.1).

Herbs, spices and other plants have traditionally formed the basis of healthcare in many ACP countries and many are documented to have a range of health benefits: for example, rosemary is used to treat headaches and poor circulation; bay leaves can be made into an infusion to relieve arthritis; African basil is used to treat diabetes, as an expectorant and as a mosquito repellent. Herbal teas are an important component of traditional Chinese medicine to enhance health and wellbeing: for example, 'liang cha' or 'cooling tea' is used as a drink to cool down the body when it is overheated due to weather or sickness. Similarly, in Sri Lanka, Ayurvedic herbal teas have a long history within indigenous medicine to treat a wide variety of ailments, including colds and fever.

Antioxidants in herbal teas

Antioxidants (substances that slow the rate of oxidation reactions) are found in many plants and can contribute to defence against cardiovascular disease and intestinal cancers, and help lower cholesterol levels. Many herbal teas contain polyphenols, which are natural pigments in the flowers and other parts of the plants from which the herbal teas are produced. The antioxidant properties of herbal teas from temperate plants have been widely studied but there are fewer studies of those made from tropical plants. However, one comparative study (Chan et al, 2010) has shown that tropical teas are more diverse and have more variable antioxidant properties than temperate teas. In general, herbal teas have lower levels of antioxidants than true teas, with only lemon myrtle, guava and oregano teas having comparable properties to black teas.

Caffeine

Most types of non-herbal teas contain caffeine. Excessive intake of caffeine (above 400 mg/day) is not recommended and pregnant women are recommended to limit their daily caffeine intake to a maximum of 250 mg/day. Caffeine levels depend on brewing time and stirring during preparation of tea, the amount of tea leaves used, the size of the leaves and the preferred strength. The average caffeine content of black tea (made from *Camellia sinensis*) is 60-70 mg per cup (200ml) and that of green and white teas is 30-40 mg per 200ml (Twinings, 2013). (In comparison, coffee contains 80-100mg caffeine per cup, again varying with the brewing time and preferred strength). Most herbal teas are naturally uncaffeinated.

Types of herbal teas

Teas may be made from a single source or blended mixtures of plants, using dried flowers, leaves, seeds or roots (Fig. 3.1.4). Some examples of herbal teas that are, or could be, produced in ACP countries are shown in Table 3.1.4. A comprehensive list is available at MRHA, 2013.

Fig. 3.1.4. Components of a fruit tea mixture: apple pieces, rose hips, orange peel, papaya pieces, peppermint leaves, liquorice root, lemon grass, cinnamon, blackcurrants, rose and mallow blossoms (Courtesy of Selena)

Type of herbal tea	Part of plant	Notes (properties, effects or location)
Anise	Seeds or leaves	Thought to help asthma, colic, bronchitis, and nausea
Bee Balm	Leaves	Analgesic, antibacterial, antifungal antioxidant
Caraway	Seeds	Used to increase appetite, to treat digestive disorders and worms, colds, fevers, sore throat
Catnip	Flowers and leaves	Relaxant or sedative
Cerasse or bitter melon	Leaves	Remedy for a variety of ailments, particularly stomach complaints, preventing and treating malaria and viral diseases such as chickenpox and measles
Chamomile	Flowers	Sedative
Cinnamon	Sticks	Anti-viral, anti-bacterial and anti-fungal properties, helps to increase blood flow and reduce swelling and pain from arthritis and rheumatism
Citrus	Peels or zest	Cold and flu remedy
Coffee (Cascara)	Leaves or cherries	Stimulant
Fennel	Seeds	Aid to digestion, treatment of Irritable Bowel Syndrome, anti-inflammatory properties for treatment of joint pain and arthritis.
Gentian	Roots	Used to treat digestive ailments and as an appetite stimulator
Ginger	Roots	Reduces motion sickness, improves digestion and reduces joint inflammation
Hibiscus (Roselle)	Petals	Popular in the Middle East, Sahel and Caribbean

Honeybush	Leaves	Related to Rooibos in South Africa with sweeter taste
Kava	Roots	South Pacific, for promoting relaxation
Kratom	Leaves	Medicinal and stimulant properties
Lemon Balm	Leaves, stems, flowers	Indigestion relief
Lemon grass	Stalks, leaves	Used for aiding digestion, calming nervous disorders and helping in the treatment of high blood pressure
Liquorice	Roots	Laxative, eases the pain of arthritis and other inflammatory diseases, treating bronchial disorders
Lime	Tree blossoms	Treatment of colds, fevers, infections, inflammation, high blood pressure, migraine, used as a diuretic and to reduce muscle spasm along the digestive tract), sedative
Mint	Leaves	Alleviates digestive disorders, relieves nausea, decongestant, effective at repelling mosquitoes and treating inflamed insect bites
Neem	Leaves (or flowers or bark)	Treatment of upper-respiratory ailments, nausea, vomiting and abdominal pains associated with infection, inflammation and liver disorders
Nettle	Leaves	Tonic and rejuvenator, relieves bronchial congestion, muscle and joint pain, diuretic properties
Peppermint	Leaves	Relaxant, relief of stomach cramps
Raspberry	Leaves	Health benefits for women in different stages of pregnancy
Rooibos (Red Bush)	Leaves	In South Africa, antioxidant properties
Sage	Leaves	Used to treat sore throats and coughs, treatment for rheumatism and excessive menstrual bleeding
Thyme	Leaves	Antiseptic
Valerian	Roots	Sedative, treatment of insomnia and conditions connected to anxiety and psychological stress, depression and attention deficit-hyperactivity disorder. Used for muscle and joint pain and menstrual cramps

Table 3.1.4. Examples of herbal teas and their properties (Adapted from Anon, 2013)

The teas listed in Table 3.1.4 are each from a single source, and many companies market the tea using the name of the ingredient (e.g. 'Chamomile Herbal Tea', 'Raspberry Leaf Tea' or 'Peppermint Herbal Tea'). Further value may be added if the ingredient is grown organically. More often herbal tea producers combine ingredients to produce a range of products. These may be labelled with the combination of ingredients (e.g. 'Cinnamon Apple Spice Herbal Tea' or 'Honey Vanilla Chamomile Tea'), whereas other producers describe the tea using the expected benefit (e.g. 'Sleepytime Echinacea Complete Care Wellness Tea', 'Smooth Move® Laxative Tea', 'Just For Kids Tummy Comfort® Tea', 'Just For Kids Nighty Night®', 'Tension Tamer Herbal Tea', 'Gas Relief™', 'Breathe Easy®' and 'Heartburn Soother®'). Some companies have targeted their expected consumers directly (e.g. teas aimed at women consumers: 'Female Toner®', 'Mother's Milk®', 'PMS Tea®', 'Pregnancy® Tea', 'Weightless®'; or at men: 'Heart Tea' and 'Prostate Tea'). There are also herbal teas for specific occasions (e.g. 'Holiday Chamomile', 'Holly Jolly Ginger Aid®', 'Nighty Night® before Christmas'). Yet others aim to give an historic or geographical association (e.g. 'Bengal Spice Herbal Tea') (the trade names are from Celestial seasonings, 2013 and Traditional Medicinals, 2013).

Box 3.1.14. Herbal tea production

The company was established in 2004 and exports a range of value-added Fairtrade and organic certified Rooibos and Honeybush teas to Europe, USA and Canada, and also sell them in the home market in South Africa. The choice of this business was based on the unique qualities of Rooibos and the growing awareness of health, environmental and ethical issues that were driving consumers. The company was previously certified as a Fairtrade supplier of herbs, herbal teas and spices and the move to Rooibos and Honeybush teas offers it the opportunity to expand its product range. The company sources Rooibos from certified farmers and contracts out blending and packaging for both local retail sales and exports. As a result, it employs only one person, but creates employment for farmers, the packaging company and other smaller suppliers. It sees these relationships with small enterprises and farming cooperative groups as a main strength.

The NGO specialises in the technology of herbal aromatherapy, producing many high-value products such as medicinal soaps, decoctions of herb powders and teas effective in treatment of skin disease, malaria, high blood pressure, diabetes, ulcers, osteoarthritis, haemorrhoids, liver and genital infections. It employs health agents and traditional practitioners as permanent workers to upgrade the ancestral knowhow and show the benefits of traditional medicine - knowledge which is disappearing. The main products are Hypertalic tea (anti-hypertensive, anti-stress, facilitates sleep, stabilises blood pressure); Asral-Kankpé tea (anti-inflammatory; anti-rheumatic; its effectiveness is reinforced by using with Sativon soap and the pomade Kankpé and Argilocum); Camorinda tea (aphrodisiac; reduces sexual weakness and premature ejaculation, prevents prostatitis, frigidity and vaginal dryness); Obesitar tea (stabilizes bad cholesterol). The products are sold in its own shops, chain stores and pharmacies, exhibited at trade fair and exported to hinterland countries. Their clients export products to Europe and America.

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Of the herbal teas already produced in ACP regions, South African Rooibos (or Red Bush in Afrikaans) tea (Box 3.1.15), produced from the *Aspalathus Linearis* plant, is perhaps the most well-known. It is so-called because the needle-like leaves turn a mahogany red colour when they are dried. Rooibos tea has gained popularity due to its perceived health benefits and can now be found throughout the world. It is used in traditional African medicine to treat digestive ailments, skin problems and allergies. It is caffeine-free, rich in vitamin C and antioxidants, with a high level of flavonoids. Another herbal tea from South Africa is produced from the Honeybush (*Cyclopedia intermedia*), which produces honey-scented flowers. Other African teas include Makoni tea in Zimbabwe, Soumbala in Burkina Faso and hibiscus teas in West Africa and North Africa (Box 3.2.6). In the Caribbean, one manufacturer produces a range of herbal teas that combine ginger with mint, ginseng, honey, lemon or sorrel as well as lemongrass and peppermint teas (Dalgety, 2013).

Box 3.1.15. Sourcing and processing Rooibos tea

Since Rooibos is harvested only from February to May, the company has to ensure that the necessary quantities are harvested, processed and securely warehoused to supply tea for the whole year. This requires careful management, scheduling and logistics. The logistics of producing products against variable demand in 12 different packs with three teas and eight flavours requires careful control to avoid inefficient overstocking or shortages. The supply of organic, Fairtrade Rooibos is limited by the number of small farmers who are willing and able to be certified and can produce to the standards required. Other farmers who are not certified Fairtrade and organic may supply the company with Rooibos tea if this grade is requested by customers. Fermentation and drying of the teas are carried out on-farm, whereas blending and packing are subcontracted to a contract packer. The challenge is management of packing in small amounts, having a sufficient supply of all ingredients and packing materials in the correct quantities and producing high quality on a low budget.

Box 3.1.16. Rooibos markets

The market for organic, ethnic and health foods, of which Rooibos teas are a part, is large and growing and in particular the demand for fair-trade certified and labelled products is growing. Competition in the production of organic Rooibos is restricted because of the limited area surrounding the Cedarberg Mountains where it can be grown. The company specialises in organic and fair-trade products, which puts it in a strong position and limits new large-scale entries to the market. Bulk exports of Rooibos represent the majority of the business, with local and international retail sales being new and growing.

The first blended teas in retail packs were launched in 2009 and the full range was introduced in 2011 with improved recipes and packaging.

The business grew quickly allowing the company to appoint a national distributor in 2012. The company offers 12 flavoured teas, all of which are based on Rooibos and blended with other teas, or medicinal, health or flavouring ingredients (e.g. lemongrass and Honeybush). The tea is sold in simple but colourful 50g packs, which clearly identify the tea as certified organically farmed and certified as a Fairtrade supplier by FLO-CERT GmbH for the production of herbs, herbal teas and spices. The company has recently been listed by Pick 'n Pay, one of the big South African retail chains. A simple but attractive website acts as an online advert and contact source and the company gains publicity through the industry press (recently through Fairtrade South Africa), on-shelf displays and word of mouth. It attends BioFach, the worlds largest Fairtrade, organic food and agriculture show, to maintain its visibility.

Fig. 3.1.5. Hibiscus calyces (Courtesy of Popperipopp)

Box 3.1.17. Hibiscus tea production in Senegal

Hibiscus flowers have a vibrant red colour, a floral aroma and a pleasant tart taste and are used in teas and cold drinks. Hibiscus production has been part of the Senegalese economy for many years but the crop was seen as secondary and low margin: drying methods were unhygienic and quality control was lacking. From 2004, the Agribusiness in Sustainable Natural African Plant Products project has worked to improve standards and expand the export market. Yields have been improved by improved cultivation methods using organic compost and prices have improved by 40%. Over 5000 farmers in cooperative groups now grow hibiscus, producing more than 700 MT p.a. and contracts have been secured with soft drinks companies in South Africa, France and California. The project also acquired organic certification for the growers and intends to gain Fair Trade certification as well as continuing to develop market linkages to sustain the enterprises. Over 16,000 farmers in 136 villages have benefited from the project through training, market expansion, mentoring and extension services. The partnership has led to organic certification of 355 ha of land used to produce organic hibiscus for the US and European markets at a 30% premium price over average market prices (Hanson, 2008).

Herbal tea	Price	Cost ($/kg)
Ginger mint	£1.13/20 bags	56.50
Acaí Mango Zinger Herbal Tea	$2.99/20 bags	99.66
Organic ginger tea	$4.99/16 bags	208.00
Mango	$6.00/15 bags	266.67
Dr. TeaTM herbal combination	$46.00/60 bags	511.00
Caribbean Dreams Ginger Tea	$3.50/24 bags	97.22
Diabetic Cinnamon Mint Tea with Stevia leaves	$7.05/20 bags	235.00

Table 3.1.5. Retail value of selected herbal teas (assuming 1.5g tea per tea bag). (From Dalgety, 2013; Celestial Seasonings, 2013; Traditional Medicinals, 2013; Adagio Teas, 2013; Dr. Tea™, 2013; Jamaican Teas, 2013; Foods Caribbean, 2013)

Notes: Retail prices are at March 2013. Currency conversions: £1 = $1.5. Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers. For comparison: 'ordinary' green tea = $17.75/120 bags (Bigelow Tea, 2013) or $98.60/kg.

Processing

Herbal teas must be dried to a moisture content of 6-8% to stabilise them. Sun or solar drying is not recommended as it results in colour loss and other chemical changes that negatively affect the tea quality. Also the slow rate of drying allows the growth of moulds, with the potential for aflatoxin contamination. Small indirectly heated cabinet tray driers (Fig. 3.1.6) may be built locally (Axtell & Bush, 1991 and Axtell, 2002) using working drawings from Practical Action (PA, 2013).

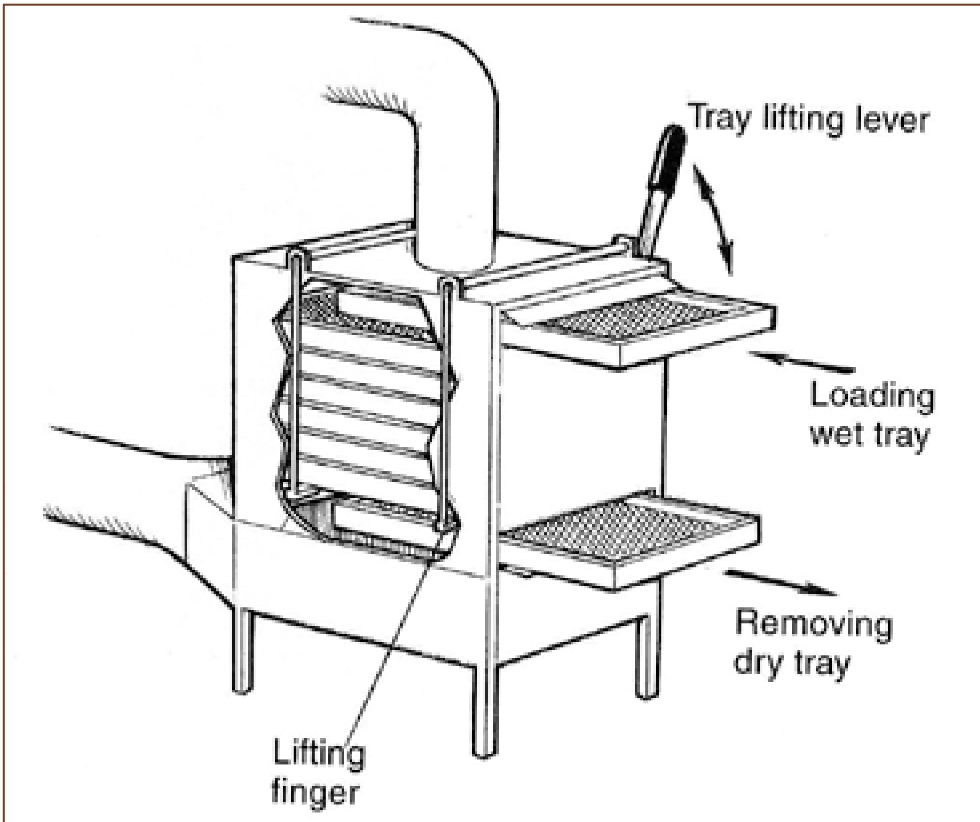

Fig. 3.1.6. Semi continuous tray dryer (Courtesy of Practical Action)

Considerable value is added by packing teas into tea bags: small, fully-automatic machines are able to pack >150 teabags/min (MAI S.A., 2013) but they are relatively expensive. The machines form and fill the bag, attach a drawstring and label, and count a pre-set number of filled bags for packing into cartons.

Box 3.1.18. Adding value to herbal tea

Brand building, niche marketing, product differentiation, cost leadership, and customer focus were the most prominent strategies adopted by the firm to supply herbal teas. Opening up new markets abroad, fair trade, environmental sustainability and faster delivery were identified as important strategies that differentiated them from competitors and placed them among the market leaders (Herath and De Silva, 2011).

Fig 3.1.7. Herbal tea ready for distribution (Courtesy of Joseph Hounhouigan)

Quality assurance

The main quality assurance factors that need to be taken into account by small-scale herbal tea producers concern good agricultural practices during tea cultivation and harvesting. Contaminants, such as pesticides, toxic heavy metals and micro-organisms should be prevented by correct application of fertilisers and pesticides, and avoiding the use of fresh manures. Harvesting and processing methods should ensure that foreign materials do not contaminate the plants and that drying is sufficiently rapid to prevent mould growth and aflatoxin production. Details are described in WHO, 2003, WHO, 2007 and WHO, 1998. There may also be requirements by buyers for specified levels of active ingredients, essential oil content etc., but analyses for these are beyond the scope of small-scale processors and samples should be sent to an authorised pharmaceutical laboratory for analysis. A description of HACCP procedures for blended teas is given by the European Tea Committee, 2012. The following two case studies of producers who take quality assurance seriously demonstrate its importance for international markets.

Box 3.1.19. Quality assurance of herbal teas for export markets

The small-scale farmers who are the major suppliers of raw materials apply the controls required by the organic certifying agent. The blending and packing subcontractor is GAP certified and complies with internationally accredited food safety standards. He is introducing HACCP and is organically certified. All exported teas are inspected and certified by the Perishable Products Export Board to comply with Notice NoR 707 of the Agricultural Products Standards Act.

Processing lemongrass tea has a traceability system to control quality. The company buys unblended tea from tea companies whose entire production facilities are ISO 22000 accredited (a food safety management system - see section 4.2). Although the company does not have much control over oil extraction procedures, the lemongrass oil is checked to ensure a high standard. Inspection begins at delivery of the oil and the company employs a quality officer who conducts simple tests to ensure that it has the required quality features, absence of contaminants and minimal variation in quality. In-house processing and blending is strictly monitored to prevent contamination by foreign materials such as stones, string etc. that may not have been identified during inspections on delivery. In general, since the bulk of products are for the export market, there are QA control points throughout the whole process including packing and transport to the point of exporting. Mr W. comments: "Our entire production facility is ISO 9001 accredited and blending is carried out in accordance with the company procedures, legislative standards, export licensing requirements, and phyto-sanitary documentation required by North America and EU buyers". Examples of procedures include:

- Checking unblended tea and lemongrass oil on reception.
- Blending tea and oil to the product specification and following the company's procedures.
- Testing to ensure that the blend meets product specifications for flavour.
- Monitoring process control points to confirm that the product meets specifications.
- Monitoring equipment to confirm correct operating conditions.

- Ensuring that out-of-specification product, process parameters and equipment performance are identified, reported and rectified.
- Ensuring that the blend contains a certain percentage of lemongrass oil and has a distinctive taste profile that conforms with the label depiction on the packaging.
- Ensuring that the blended tea is packed in conformity with national, US and EU standard specifications

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3.1.3. Herbs, spices, spice mixes and pastes

Herbs and spices may be grouped into four categories depending on their use:
1. Fresh and dried culinary herbs and spices
2. Medicinal herbs and spices (section 3.2)
3. Herbs and spices used to produce essential oils and oleoresins (section 3.2.2)
4. Decorative and fragrant herbs and spices (e.g. air- or carpet-fresheners).

Dried herbs and spices are also used to make a variety of teas (section 3.1.2). The focus of this section is herbs and spices used for cooking, herb and spice blends and different types of culinary pastes and sauces that are used for flavouring, colouring and imparting aromas to foods.

Fig 3.1.8. Spices (Courtesy of heydrienne)

Herbs and spices are produced from hundreds of different types of plant leaves, seeds, barks, fruits, stems, flowers, buds, roots, rhizomes and resins. More than 50 herbs and spices have been traded globally for centuries, but there are hundreds more that are used in traditional cooking and healthcare and are traded locally or regionally by processors in ACP countries (Table 3.1.6).

Allspice (Pimenta dioica)
Alligator pepper (Aframomum danielli, A. citratum, A. exscapum)
Allspice (Pimenta dioica)
Anise (Pimpinella anisum)
Annatto (Bixa orellana)
Asafoetida (Ferula assafoetida)
Avocado leaf (Peresea americana)
Basil, sweet (Ocimum basilicum), lemon (O. citriodorum), Thai (O. basilicum var. thyrsiflora), Holy (O. tenuiflorum)
Bay leaf (Laurus nobilis), Indonesian bay leaf (Syzygium polyanthum)
Caraway (Carum carvi)
Cardamom (Elettaria cardamomum), Ethiopian cardamom, false cardamom (Aframomum corrorima, Lippia adoensis), black cardamom (Amomum subulatum, A. costatum)
Cassia (Cinnamomum aromaticum)
Chilli pepper (Capsicum spp.), Cayenne pepper (C. annuum)
Chives (Allium schoenoprasum)
Coriander (Coriandrum sativum), Cinnamon (Cinnamomum burmannii), white (Canella winterana
Clove (Syzygium aromaticum)
Culantro, long coriander (Eryngium foetidum)
Cumin (Cuminum cyminum), Black cumin (Bunium persicum)
Curry leaf (Murraya koenigii)
Curry plant (Helichrysum italicum)
Dill seed, leaf (Anethum graveolens)
Fenugreek (Trigonella foenum-graecum)
Garlic (Allium sativum), elephant (A. ampeloprasum var. ampeloprasum), Ginger (Zingiber officinale)
Grains of paradise (Aframomum melegueta)
Grains of Selim, Kani pepper (Xylopia aethiopica)
Kaffir lime leaves, Makrud lime leaves (Citrus hystrix)
Kawakawa seeds (Macropiper excelsum)
Kokam seed (Garcinia indica)
Lemon balm (Melissa officinalis)
Lemongrass (Cymbopogon citratus, C. flexuosus)
Liquorice (Glycyrrhiza glabra)
Lime flower, linden flower (Tilia spp.)
Mace (Myristica fragrans)
Mahlab, St. Lucie cherry (Prunus mahaleb)
Mint (Mentha spp.) 25 species, hundreds of varieties
Mustard, black seed (Brassica nigra), brown seed (B. juncea), white seed (Sinapis alba), yellow seed (Brassica hirta)
Nigella, kalonji, black caraway, black onion seed (Nigella sativa)
Nutmeg (Myristica fragrans)
Oregano (Origanum vulgare, O. heracleoticum)
Paprika (Capsicum annuum)
Pepper: black, white, and green (Piper nigrum), Pepper, Dorrigo (Tasmannia stipitata), Pepper, long (Piper longum), Cubeb pepper (Piper cubeba), Pepper, mountain, Cornish pepper leaf (Tasmannia lanceolata),
Peppermint (Mentha piperata),
Rosemary (Rosmarinus officinalis)
Safflower (Carthamus tinctorius)
Saffron (Crocus sativus)
Sage (Salvia officinalis)
Sassafras (Sassafras albidum)
Sorrel (Rumex acetosa),

sheep sorrel (Rumex acetosella) Spearmint (Mentha spicata) Star anise (Illicium verum) Sumac (Rhus coriaria) Szechuan pepper, Sichuan pepper (Zanthoxylum piperitum)	Tarragon (Artemisia dracunculus) Thyme (Thymus vulgaris), lemon thyme (Thymus citriodorus) Turmeric (Curcuma longa) Vanilla (Vanilla planifolia) Wasabi (Wasabia japonica)	Wattleseed (120 spp. of Acacia) Wild betel (Piper sarmentosum)

Table 3.1.6. A selection of the more important culinary herbs and spices (Adapted from Anon, 2013a, 2013b) (Additional herbs and spices are described by Frontier, 2013a)

Nearly all herbs and spices are considered to be high-value products and they have good potential for profitable production by small-scale processors, provided that suitable planting materials are available, growing conditions are favourable and there is sufficient demand for the products. Further information is given by Matthews and Jack, 2011. Many culinary herbs originate in temperate or Mediterranean climates and do not currently have a high demand in many ACP countries, but increasing tourism has resulted in requirements by hotels and restaurants for local herb production to substitute for imports, provided that the price and quality from local producers are acceptable.

Individual herbs and spices are usually sold dried, either whole or ground. In recent years fresh and frozen herbs have been perceived by consumers, mostly in industrialised countries, to have higher quality and as a result these have increased in popularity. Individual spices may also be made into pastes (e.g. mustard or garlic) or mixed spices are formulated for specific applications (see Table 3.1.10). The range of this last group of products has dramatically increased in recent years and there are now many ways in which pre-prepared spice mixtures are marketed - each adding further value to the individual herbs and spices.

Box 3.1.20. Organic production

Organic standards specify the period required for transition to organic status; permitted fertilizer and pesticide inputs and restrictions on their use. Crop rotation, inter-planting and composts are used for fertility management. Insect pests are controlled by naturally derived insecticides such as pyrethrum, by predators and parasitic organisms (e.g. *Bacillus thuringensis*). Control of fungal crop diseases is permitted using copper and sulphur sprays and organisms such as *Trichoderma* sp. Seeds and planting materials must be certified organic. Record keeping is required for traceability and audit purposes and management procedures are required to ensure compliance with standards covering hygiene, labelling and packaging materials (Douglas et al, 2005).

Production and consumption of herbs and spices

The main spice producing countries are India (1,525,000 MT in 2011), Bangladesh (127,725 MT), Turkey (113,783 MT), China (97,311 MT) and Pakistan (53,620 MT) (FAOSTAT, 2013). In comparison, ACP countries produce much smaller amounts, but some have significant international trade in spices (Table 3.1.7).

Producing country	Amount (MT)
Burkina Faso	5,766
Niger	4,838
Nigeria	4,650
Congo (DRC)	3,879
Zambia	2,778
Ethiopia	2,203
Sierra Leone	1,726
Kenya	1,154
Jamaica	1,053
Côte d Ivoire	719
Malawi	690
St. Vincent & Grenadines	590
Zimbabwe	539
Papua New Guinea	269
Togo	255
Tonga	229
Mauritius	201
Solomon Islands	200

Table 3.1.7. Production of spices in ACP countries in 2011 (From FAOSTAT, 2013) (For comparison, total world production = 2,072,422 MT)

Dried chillies and peppers		**Cinnamon**		**Cloves**		**Ginger**		**Nutmeg, mace and cardamom**		**Vanilla**	
Country	**MT**	**Country**	**MT**	**Country**	**MT**	**Country**	**MT**	**Country**	**MT**	**Country**	**MT**
Top three producers											
India	1,445,950	Indonesia	92,900	Indonesia	75,700	India	702,000	Guatemala	23,929	Indonesia	3,500
China	282,342	China	67,123	Madagascar	6,817	China	426,032	Indonesia	22,100	Madagascar	1,587
Pakistan	202,934	Vietnam	20,258	Tanzania	6,750	Nepal	216,289	India	16,501	China	1,385
Other ACP producers											
Ghana	88,000	Madagascar	894	Comoros	2,386	Nigeria	160,000	Tanzania	679	Tonga	202
Nigeria	65,221	Timor	105	Kenya	1,041	Cameroon	40,300	Grenada	573		
Congo (DRC)	39,456	Grenada	100			Côte d' Ivoire	8,139	Trinidad & Tobago	290		
Benin	28,000					Fiji	2,338	St. Vincent / Grenadines	204		
Côte d'Ivoire	27,759							Malawi	100		
Cameroon	24,398										
South Africa	15,000										
Jamaica	13,293										
Zimbabwe	9,500										
Tanzania	7,000										
Senegal	5,500										
Mali	5,136										
Sierra Leone	4,789										
Togo	3,913										
Kenya	2,832										
Uganda	2,152										

Table 3.1.8. Production of selected spices in 2011 (FAOSTAT, 2013)

Dried peppers and chillies are the most important spices traded internationally (Table 3.1.8), mostly from Asia, but with significant amounts produced by some ACP countries in West Africa, especially Ghana and Nigeria. Likewise, cinnamon, cloves, ginger and vanilla are mainly produced in south and south-east Asia, but Madagascar and Tanzania (Zanzibar) are major clove producing countries and Nigeria is a significant producer of ginger. Zanzibar and some Caribbean islands are important producers of nutmeg, mace and cardamom and some Pacific islands are noted for vanilla and ginger production.

In ACP countries that do not produce significant amounts of herbs and spices, small-scale processors can often compete successfully with imported products in local markets, provided that cultivation conditions are suitable and high quality products can be achieved.

The main spice importing countries are the USA, countries in the Middle East and Europe (Table 3.1.9) and also spice producing countries where demand is high (e.g. Iran, Sri Lanka, Turkey etc.). There has been an increase in spice imports to Western industrialised countries that has resulted from greater consumer interest in a wide range of international and ethnic dishes. This has resulted from increased foreign travel, the establishment of a range of ethnic restaurants and immigrant-owned retail outlets selling their national foods, as well as supermarkets selling authentic ethnic foods that are convenient to prepare.

Country	Amount (MT)
USA	26,792
United Arab Emirates	24,634
Saudi Arabia	24,170
UK	18,424
Germany	14,625
Netherlands	12,630
Iran	10,008
Malaysia	9,357
France	8,218
Canada	7,345
Belgium	6,951
Japan	6,682
South Africa	6,607
Sri Lanka	6,573
Singapore	6,439
Bangladesh	5,793
Turkey	5,601
India	5,086

Table 3.1.9. Main spice importing countries in 2010 (FAOSTAT, 2013)

The distribution structure in the herb and spice trade supplies three broad market sectors: industrial, catering and retail (Fig. 3.1.9). The most direct route is for producers to supply the industrial sector, although this does not necessarily yield the highest profits. Most ACP spice processors supply export agents and brokers, who arrange the export paperwork (section 2.3.2) and deal with import agents or processing companies in the importing countries. In a few cases, processors have established direct relationships with processors in industrialised countries, often through family connections. Fair trade organisations can act as buying agents, exporters and processing companies and for many processors these have become the preferred buyers because (as the name implies) of their fairer trading terms and conditions (see section 2.4).

Box 3.1.21. Selling a range of spice products

Mr. S.A., who is commonly called 'Madawa' gave this name to his business, a well-known local spice company in Zanzibar when he established it in 1990. The enterprise processes spices and herbs for food, cosmetics and medicine. His products are pure spices and herbs, masala mixes, essential oils, spiced honey, flavoured vinegar, teas and coffee. The non-food products include herbal massage oils, creams, soap, ointments and lotions. The Zanzibar masalas include: Pilau mix, fish masala, chicken masala, nyama choma masala, birian masala and vegetable masala. Others are Zanzibar curry powder, mild curry powder, Alghassaney spice mix and hot curry powder. There is also a range of Zanzibar herbal teas, including masala chai, spice tea, vanilla tea, hibiscus tea, thyme tea, cinnamon tea, cardamom tea, herbal tea and slimming tea.

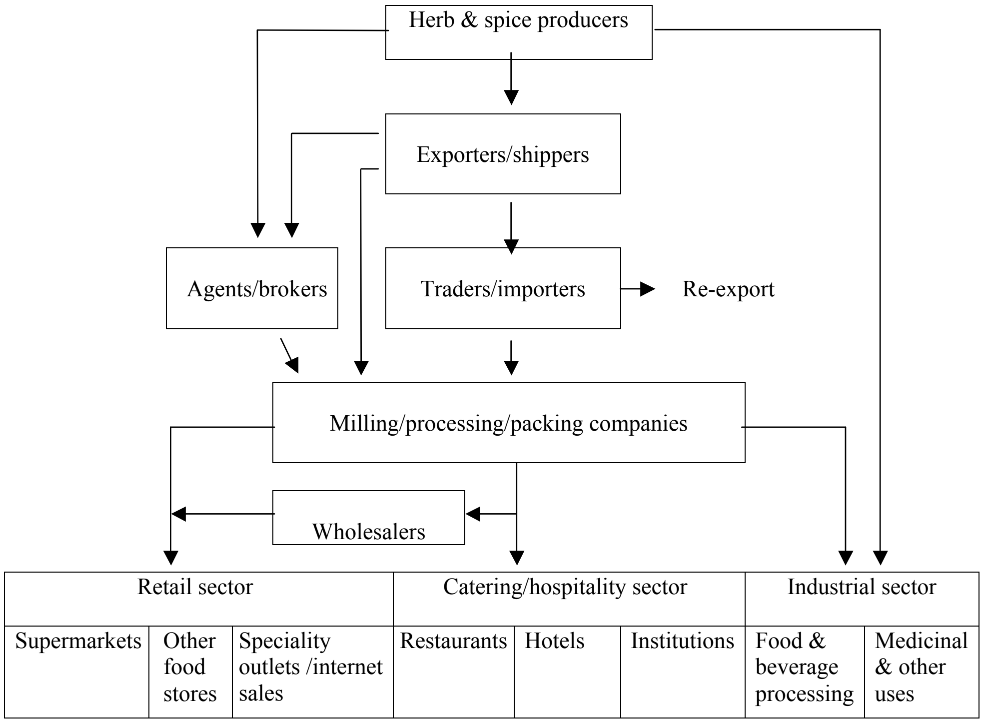

Fig. 3.1.9. Trade distribution structure for spices and spice products (Adapted from Douglas et al, 2005)

Adding value to herbs and spices

Dried herbs and spices

Most herbs and spices are traded in their dried form, which provides a long shelf life and reduces both their weight and their susceptibility to damage during transport. Sun drying is feasible in areas that have a suitable climate, but for many herbs and spices the process causes the loss of characteristic aromas (which give them their value) and also loss of colour and texture. All herbs and spices should be dried at relatively low temperatures (50-60°C) with a high air flowrate and low air humidity to give rapid drying. Ideally, drying should take place under controlled conditions in a forced-air drying cabinet. Freezing (below) and freeze drying are alternative processes to better retain the quality and value of herbs, but freeze drying in particular is a significantly more expensive process.

The relative values of different dried herbs and spices are shown in Table 3.1.10.

Product description	Unit retail price	Cost ($ per kg)
Allspice, Ground	£1.88/36g	78.33
Basil	£1.23/10g	184.50
Bay Leaves	£1.11/6g	277.50
Pepper Black Peppercorns	£2.20/35g	94.28
Ground Black Pepper	£2.20/33g	100.00
Organic Black Peppercorns, Smoked	$6.59/1.76oz	191.80
Gourmet Organic Smoked Peppercorn Blend	$7.49/1.76oz	149.80
Mixed Peppercorns	£2.34/43g	81.62
Exotic Organic Peppercorn Blend	$7.59/1.69oz	158.45
Szechuan Pepper	£2.02/15g	202.00
Gourmet Sichuan Pepper	$6.99/0.78 oz	316.15
White Organic peppercorns	$7.59/2.08oz	128.71
Bouquet Garni (marjoram, basil, oregano, thyme, bay leaves)	£1.11/5g	333.00
Cardamom Pods	£2.60/26g	150.00
Chilli Pepper Cayenne	£1.55/26g	89.42
Chilli Powder Hot	£1.82/38g	71.84
Birds Eye Chillies	£1.82/11g	248.18
Chillies Crushed	£1.82/29g	94.14
Chives	£1.73/10g	259.50
Cinnamon Sticks	£1.55/13g	178.85
Ground	£1.55/33g	70.45
Cloves Whole	£2.60/22g	177.27
Ground	£2.60/35g	111.43
Coriander Seed	£1.88/20g	141.00
Ground	£1.55/24g	96.87
Leaf	£1.68/7g	360.00

Cumin Seed	£1.82/35g	78.00
Ground	£1.55/28g	83.03
Dill	£1.81/10g	271.50
Garlic Granules	£1.73/47g	55.21
Herbes de Provence (rosemary (28%), savoury, thyme (18%), marjoram, oregano)	£1.81/11g	246.81
Italian Herb Seasoning (oregano (70%), thyme, basil (5%), parsley, sage, black pepper (3%), bay leaves).	£1.81/11g	246.81
Mace, Ground	£4.27/29g	220.86
Marjoram	£1.66/8g	311.25
Mulled Wine Spice (allspice, cassia (20%), cloves, nutmeg)	£1.59/18g	132.50
Nutmeg Whole	£1.88/25g	112.80
Ground	£1.59/32g	74.53
Oregano	£1.23/7g	263.57
Paprika	£1.55/34g	68.38
Hot Paprika	£1.82/34g	80.29
Smoked Paprika	£1.82/40g	68.25
Rosemary	£1.23/18g	102.50
Saffron	£5.34/0.4g	20,025.00
Thyme	£1.23/11g	167.72
Turmeric	£1.59/31g	76.93
Vanilla Pod	£2.58/2g	1935.00

Table 3.1.10. Comparison of the value of different dried herbs and spices, illustrated using retail prices in 2013 (From Swartz, 2013 and Frontier, 2013b)

Note: Currency conversions: £1 = \$1.5, €1 = \$1.3. Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Notes on Table 3.1.10:

There are a number of value-added aspects that can be noted from the table:

1) The average retail price of herbs and spices is \$139/kg, excluding saffron and vanilla.
2) The range of values for all except these two spices is \$55 to \$360 per kg. The two exceptions, vanilla pods (\$1935/kg) and saffron (\$20,025/kg), have such high values because of their highly labour-intensive and time-consuming production and processing.

3) Value is added by specifying the type of herb or spice (e.g. Sichuan (or Szechuan) pepper is $202/kg compared to black pepper at $100/kg); Birds Eye chillies are $248/kg compared to ordinary crushed chillies at $94/kg).
4) Additional processing may add further value (e.g. smoking increases the value of black peppercorns from $94/kg to $191/kg). However, grinding whole spices may not always add value (e.g. cinnamon, cloves, coriander and nutmeg are all more valuable whole than as ground spices). This is because the volatile components that make these spices valuable are more likely to be reduced in the ground spice. Additionally, some buyers prefer whole spices because the risk of contamination and adulteration is lower than in ground spices. However, black pepper and cumin both show a small increase in value when ground.
5) Describing high quality herbs and spices as 'gourmet' or sourcing organic herbs and spices both increase their value (e.g. Szechuan pepper is $202/kg and gourmet Sichuan pepper is $316/kg; mixed peppercorns are $81/kg and exotic organic peppercorn blend is $158).
6) Creating well-established herb and spice mixes (e.g. Bouquet Garni, Herbes de Provence, mulled wine spice) increases the value of the component herbs.

Box 3.1.22. Markets for herbs, spices and spice mixes

Mr. S.A. believes that his success is based on his sound knowledge of processing spices and herbs that he has gathered throughout his career, together with research that he and other partners did to come up with the products he sells. In addition, he believes that his products have assured sales and a high income because the market has confidence in his skills and the quality of his products. These form the core strengths of his business. His spices and herbs are a major attraction for tourists and important outlets are tourist shops and groceries. About 60% of products are sold through a mainland company located in Dar-es-Salaam, with the remainder sold at his own retail outlets in Zanzibar or exported. The export market is mainly for medicinal and body-care products. Mr. S.A. also owns an herbal clinic in Zanzibar where he practices his skills in herbalism and also promotes the food spices and herbs. Other promotions for his products are through company brochures, participation in local and international trade fairs and exhibitions, and through his website.

Fresh herbs

Fresh culinary herbs, including basil, cilantro, mint, rosemary, thyme, tarragon, lemon balm, sage and parsley, may be supplied, still growing, in individual pots or they may be harvested, washed and packed. They are sold in their pots to supermarkets or to restaurants or specialty shops, typically retailing for $2-3 for a small pot (2013 prices). Fresh cut herbs are highly perishable and it is important to have established local markets and to liaise closely with buyers over the types of produce, timing and amounts that they require in order to supply them fresh and having a high quality. Post-harvest handling is critical to successful fresh-market herb production. Herbs should be harvested and cooled quickly and they must be handled gently to prevent bruising. If the herb is washed, it also has to be air-dried. Herbs must be packaged in suitable boxes to prevent damage during distribution. However, fresh-market herb production is essentially an agricultural activity, with only minimal processing and it is not considered in detail in this book. Further information is given by Davis, 1993.

Frozen herbs

The main advantages of producing frozen herbs are their high quality, similar in taste and aroma to fresh herbs, and their shelf life of ≈24 months. The main disadvantage is the higher investment needed for a frozen distribution and storage chain, especially in countries where processors do not yet have such facilities. The relatively high operating costs of freezing and frozen storage also results in increased production costs of frozen herbs. Frozen herbs are found in two forms: either individually quick frozen (IQF) herbs that are chopped, free-flowing and ready to use; or herbs that are made into a purée or paste and frozen into small cubes. Demand for frozen herbs comes mainly from three sectors: food manufacturing (50-60%); the food service sector (30-40%); and the retail sector (10-15%) (Salah, 2012). Some suppliers (e.g. Rosemary, 2013) supply frozen herbs that are chopped to different sizes depending on buyers' needs.

Herbs that are commonly IQF frozen in industrialised countries include: basil, bay leaf (whole or chopped), chervil, chives, coriander leaves, curry leaves, dill, fenugreek, lemongrass, marjoram, mint, parsley, rosemary, sage, savory, sorrel, mustard leaves, tarragon and thyme. Typical 2013 retail prices are $63-66/kg (Farmer's Choice, 2013; Daregal, 2013), or up to $90/kg (White-Toque, 2013), which is still considerably lower than the dried equivalents, reflecting the higher moisture content in these products.

The production of IQF herbs cannot be achieved using a domestic freezer because the rate of freezing is too low. This results in damage to the herb cells, with browning and an unacceptable loss of texture during storage that reduces the quality and makes the product unsaleable. The two methods used to rapidly freeze IQF herbs are air-blast freezing and liquid nitrogen freezing, both of which have substantially higher capital costs than domestic-type freezers. Additionally, for liquid nitrogen freezing, there should be a readily available and affordable source of the gas, which may not be the case in some ACP countries.

Box 3.1.23. Icy Herbs

'Icy Herbs' in South Africa produces frozen organic herbs. Flip and Riana Minaars primary business was the production of herbs for extracting essential oils and freezing herbs for export presented a challenge:
using blast freezing would have cost around $8 million, so after some experimentation they chose liquid nitrogen, which is faster and produces a better quality product. A liquid nitrogen freezing tunnel has a temperature of -196° C, which freezes the herbs within three minutes. The farm has produced up to 300 tons per annum of herbs for sale; 60% basil and the remainder parsley, thyme, coriander, fennel, rosemary, oregano, tarragon, chives, garlic chives, sage, spearmint, dill, rocket and marjoram. The high quality products are sold in both the South African and EU markets. (From Cambray, 2006).

Opportunities exist for small-scale processors in ACP countries to produce frozen herb pastes or purées because the slower freezing in domestic-type freezers has less effect on the quality of the frozen product (the texture is already broken down by pulping). Herb pastes may be produced using a liquidizer and then frozen in ice-cube trays. Low-cost packaging, such as polythene bags, is suitable for containing the cubes during frozen storage and distribution. However, the product should be sold within a few weeks of production to avoid loss in quality caused by slow changes to the colour and/or flavour. Frozen coriander, parsley, dill and basil cubes are sold to retailers in 20-cube trays of individual 3.5g pop-out cubes, 70g per tray and 20 trays per box. Products for food service and industrial buyers are sold as 125-gram cubes, 4 cubes per unit and 20 units per box (Tibulim, 2013). The most suitable opportunities for small-scale processors are likely to be sales of frozen herb pastes to local hotels and restaurants, using either a refrigerated vehicle or insulated cold boxes for distribution.

Pre-prepared dry spice mixes

Value can also be added to herbs and spices by producing combinations of dried spices and/or herbs that are marketed as mixes to sprinkle over foods, to make marinades, or to use as ‘recipe mixes’ that are added to foods before cooking. Examples are given in Table 3.1.11 and others include fajita spice blend, herb and spice blends for lamb, pork, salmon, steak, Chinese 5-spice blend, Italian garlic herb blend, tandoori spices, Thai 7-spice blend and a range of spice blends having a reduced salt content. A more recent development is a cook-in sachet (or ‘oven bag’) that contains the prepared spice mix for a particular meal. The consumer places fresh meat or fish and other ingredients into the bag that contains the seasoning and bakes or roasts the meal in an oven. This concept has good potential to be adapted to provide convenient traditional meals in ACP countries, but the oven-proof packaging is relatively expensive and would need to be imported.

Name of spice mix	Spice ingredients	Unit retail price	Cost ($ per kg)
Cajun Marinade Mix	Smoked paprika, dried garlic, yellow mustard seed, oregano, parsley, coriander seed, dried chillies, allspice, roasted ginger pieces, black and white pepper, cumin, celery seed, paprika extract	£1.29/25g	77.40
Extra Spicy Cajun Herb & Spice Blend	Chilli pepper, cumin, oregano, garlic, cayenne pepper, ground coriander, garlic powder, ginger, black pepper, white pepper, allspice, mustard flour, thyme, fennel seed	£1.82/42g	65.00
Fish Herb & Spice Blend	Parsley, dill, black pepper, dill seed	£1.63/55g	44.45
Hot Curry Powder	Coriander seed, cayenne pepper, cumin, allspice, mustard seed, black pepper, garlic powder, ginger, turmeric, bay leaves, paprika	£1.44/85g	25.41
Jamaican Jerk Herb & Spice Blend	Ground allspice, chilli pepper, cumin, salt, oregano, garlic, thyme, black pepper, dried garlic, paprika, cayenne pepper, turmeric, bay leaves	£1.82/51g	53.53
Korma Curry Spices	Garlic powder, ginger, roasted cumin, roasted ground coriander, cardamom, nutmeg, chilli pepper, cumin, oregano, garlic, turmeric, coriander leaf, ground cinnamon, cloves	£1.82/90g	30.33
Madras Curry Spices	Cayenne pepper, ginger, turmeric, cinnamon, black pepper, cardamom, cloves, roasted spices (cumin, coriander seed, fenugreek), brown mustard seed, garlic powder, curry leaves	£1.82/90g	30.33
Mojito Lime Marinade Mix	Dried garlic, paprika, dried onion, cumin, black pepper, mint, cayenne pepper, oregano, parsley	£1.29/30g	64.50
Moroccan Herb & Spice Blend	Roasted spices (cumin, coriander seed), paprika, dried garlic, black pepper, mint, parsley, cinnamon, coriander leaf, yellow mustard seed, coriander seed, cayenne pepper	£1.82/40g	68.25
Organic Balti Curry Seasoning	N/A	$5.15/1.8oz	100.98
Organic Poultry Seasoning Blend	N/A	$4.79/1.2oz	140.88
Smokey Texan Marinade Mix	Dried garlic, cayenne pepper, dried onion, black pepper, parsley, paprika extract	£1.29/30g	64.50

Tray-baked Piri Piri Chicken Recipe Inspirations Kit	White pepper, black pepper, garlic powder, garlic granules, paprika, ground coriander, crushed chillies, coriander leaf	£0.69/12g	86.25
Wild West BBQ	Dried garlic, black pepper, oregano, parsley, rosemary, basil, cayenne pepper, paprika, cumin	£1.99/65g	45.92

Table 3.1.11. Retail prices for different types of spice mixes (From Swartz, 2013 and Frontier, 2013b)

Notes: Retail prices at March 2013. Currency conversions: £1 = \$1.5, €1 = \$1.3. Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers. N/A = formulation not available. The retail prices for the mixes are lower than the prices for individual herbs and spices in Table 3.1.10, but the amounts of herbs and spices in each mix are comparatively small.

3

If small-scale processors wish to consider entering the market for pre-prepared spice mixes, it is essential that they either have the necessary culinary skills and abilities to formulate attractive recipes or they have access to experienced chefs to develop such mixes on their behalf. This also requires a product development budget and access to test-kitchen facilities (see section 2.2.2).

When developing a dried spice mix, the spices are first prepared by drying and, if necessary, by grinding to the required degree of fineness using a manual or motorised spice mill (or using a pestle and mortar in a test-kitchen). Product development requires the accurate measurement of small amounts of spices but scales that are capable of accurately weighing a few grams are expensive. If they are not affordable, sets of cheap measuring cups and spoons are available that cover a range of volumes from one cup (250ml) to 1/8th of a teaspoon (0.625 ml). However, it is important to note that variations in the bulk density of powdered spices can occur, depending on how compacted the powders are in the measuring cups/spoons. This can lead to significant variation in the weight of spice that is measured and it is preferable to use weighing scales (with an accuracy of +/- 0.01g). It is also essential that all weights or volumes of added spices are recorded so that the formulation can be exactly reproduced. Once a blend has been produced and customer acceptance trials have shown it to be satisfactory, the formulation is scaled-up to the standard batch weights to be used in production. The final product should ideally be packed in aluminium foil laminate pouches, which exclude light and provide a good barrier to moisture and oxygen.

Ras el hanout A North African blend that may contain up to 15 ingredients: 2 ½ tbsp cumin seeds 2 tbsp coriander seeds 1 tbsp ground cinnamon 2 tsp ground ginger 2 tsp black peppercorns#1 tsp turmeric powder Seeds from 10 cardamom pods A pinch of saffron	Garam masala A spice mix commonly used in Indian cooking: 2 tbsp coriander seeds 1 tbsp cumin seeds 2 tsp black peppercorns 2 tsp ground cinnamon Seeds of 20 cardamom pods 1 tsp fennel seeds ½ tsp whole cloves 4 dry bay leaves
Caribbean Jerk Seasoning Mix Common in the Caribbean (very hot de-seeded dried Scotch Bonnet peppers may be added): 2 tbsp ground cinnamon 2 tbsp black peppercorns 1 tbsp dry thyme 2 tsp allspice berries 1 ½ tsp cayenne pepper ½ tsp ground nutmeg Very hot chilli pepper to taste	Chinese 5 spice mix Widely used in Chinese cuisine: 2 tbsp cinnamon powder 1 tbsp fennel seeds 6 complete star anise pods 2 tsp Sichuan peppercorns 1 tsp whole cloves

Table 3.1.12. Examples of spice bends (adapted from BBC, 2013)

Note: most published recipes use teaspoon (tsp) or tablespoon (tbsp) measures and it is necessary to convert these to weights for use in product development.

Pastes and sauces

There are a large number of prepared pastes and sauces that contain herbs and spices, from the relatively simple garlic purée that contains 55% garlic, oil and salt, through different types of mustards and pesto (a sauce made from fresh basil leaves, olive oil, parmesan cheese, garlic and pine nuts) to more complex cooking pastes and sauces that have carefully formulated mixtures of herbs and spices, flours or starches, sugar, fruit or vegetable concentrates or powders and oils (Table 3.1.13). All products are moist and contain either water, or a ground or puréed vegetable (e.g. red peppers, onions or horseradish), as the main ingredient.

Mustard pastes are used as condiments and as marinades for meats and fish. Brown *(Brassica juncea)* and white *(Sinapis alba)* mustard seeds are used to make English mustard. Some companies soak mustard seeds in water, wine or vinegar for a few hours to several days to soften the seeds and make the hulls easier to remove. The two types of seeds are milled separately in a roller mill, often with several passes through the mill to obtain the required degree of fineness, and then sieved to remove the bran. The two mustard flours are then blended to produce the required product characteristics. Mustard pastes are made by mixing the flour with water, vinegar or wine plus added sugar. American mustard is milder, made with white seeds and coloured yellow with turmeric. Dijon mustard contains mustard seeds with both white wine and burgundy wine. The paste may be pasteurised and some types are also 'aged' before they are bottled. The composition, flavour, colour and texture of mustard pastes can be adjusted by adding other ingredients, including chilli, garlic, paprika, salt, lemon, honey, horseradish and/or whole mustard seeds to produce high-value speciality or gourmet mustards. Details of mustard recipes are given by Perrott and Weir, 2010.

Cooking pastes and sauces are made by blending the correct proportions of ingredients using a mixer. They are stored at ambient temperature and therefore require preservation by either adding a chemical preservative (e.g. potassium metabisulphite or benzoic acid), by pasteurisation, by lowering the pH to below 4 by adding lemon juice or citric acid, or by adjusting the water activity to prevent the growth of moulds and bacteria. They should be cooked and consumed within a few hours of opening the pack. Manufacturers may recommend that a part-used pack should be stored in a refrigerator and used within a few days. The prices of these products are lower than individual herbs and spices (Table 3.1.10), but the mixtures of ingredients contain relatively small amounts of herbs or spices.

Fig. 3.1.10 a, b. Gourmet spice mixes (Courtesy of Seasoned Pioneers)

Name of paste or sauce	Ingredients	Unit retail price	Cost ($/kg or litre)
Dijon mustard	Water, mustard seeds (27%), spirit vinegar, salt, citric acid, preservative (potassium metabisulphite).	£1.49/215g	10.39
English mustard	Water, mustard flour, sugar, salt, wheat flour, spice, citric acid, stabiliser (xanthan gum).	£0.94/100g	14.10
Five Spice paste	Water, onion, muscovado sugar, Chinese five spices (10%), spices (star anise, cinnamon, fennel, cloves, black pepper, ginger), onion powder, garlic powder, soy sauce, salt, molasses, malt vinegar, malt extract, ginger purée, spirit vinegar, cornflour.	£1.99/100g	29.85
Garlic purée	Garlic (55%), Sunflower oil, salt, preservative (potassium metabisulphite).	£0.72/90g	12.00
Harissa paste	Red pepper (65%), rapeseed oil, dried red bell pepper (4%), chilli purée, concentrated lemon juice, dried crushed chilli, salt, smoked paprika, garlic purée, rose petal (1%), paprika extract, smoked chilli, cumin, coriander, caraway seed, clove.	£1.50/90g	25.00
Hoisin & garlic stir-fry sauce	Water, sugar, glucose-fructose syrup, soy sauce light (6%), sugar, salt, acidity regulator: acetic acid, soya bean paste (5%), spirit vinegar, cornflour, soya bean (3%), colour: caramel, sesame oil, tomato paste, garlic purée, onion powder, ginger purée, salt, coriander powder, cinnamon, fennel, aniseed, ginger, clove, acidity regulator: citric acid; chilli powder.	£0.55/120g	6.87
Jerk paste	Onion purée (26%), lime juice from concentrate, garlic purée (10%), rapeseed oil, white wine vinegar, light soy sauce, sugar, dried chilli flakes (4%), thyme, sugar, coriander leaf, ginger purée (3%), sea salt, dried red bell pepper, chilli powder (2%), onion powder, cornflour, nutmeg, cinnamon, pimento, black pepper.	£1.65/90g	27.50
Madras cooking sauce	Water, tomato, onion, mustard, vegetable oil, modified corn starch, sugar, concentrated tomato puree, lemon juice, garlic, salt, acetic acid, cumin seeds, curry leaf, dried crushed chilli, mustard seeds, dried coriander leaf.	£1.76/450ml	5.86

Madras curry paste	Water, vegetable oil, coriander, cumin (5%), turmeric, chilli (4%), salt, maize flour, ground ginger, tamarind, acetic acid, mustard, garlic powder, citric acid, lactic acid.	£2.02/283g	10.70
Sacla classic pesto	Sunflower seed oil, Italian basil (36%), Grana Padano PDO cheese, cashew nuts, sea salt, glucose, Pecorino Romano PDO cheese, crushed pine kernels, extra virgin olive oil, flavourings, potato flakes, acidity regulator: lactic acid.	£2.20/190g	17.40
Rogan josh cooking sauce	Water, onion (18%), tomato (18%), concentrated tomato puree (3%), vegetable oil, modified maize starch, sugar, mustard, garlic, salt, ginger, paprika, acetic acid, cardamom, paprika extract, citric acid, dried coriander leaf.	£1.76/450g	5.87
Rogan josh curry paste	Water, vegetable oil, concentrated tomato puree (9%), coriander, paprika (7%), salt, turmeric, lemon juice, cumin, onion powder, sugar, acetic acid, black pepper, fenugreek, garlic, cinnamon, cloves, mustard.	£2.02/283g	10.70
Wasabi paste	Horseradish (31.7%), humectant: e420, rice bran oil, salt, dextrin, wasabi japonica (4.5%), potato starch, water, flavouring, turmeric, acid: e330, thickener: e415, colouring: e133.	£1.50/43g	52.32

Table 3.1.13. Examples of retail prices for different types of spice pastes and cooking sauces (From Patak, 2013 and Sainsbury, 2013)

Notes: Retail prices at March 2013. Currency conversions: £1 = $1.5. PDO = Protected Designation of Origin (in the EU). Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

The recent rapid development of herb and spice mixes, cooking sauces and pastes has arisen in Western industrialised countries because of a requirement by consumers for greater convenience in food preparation and a demand for a wider range of tastes and flavours in prepared meals. Similar trends are taking place among more affluent, professional groups in many ACP countries, especially in urban areas. Where both adult family members are working, they have less time for food preparation and high urban rents mean that they often have fewer domestic staff available to prepare the spices needed for traditional dishes. There are therefore almost limitless possibilities for small-scale processors in ACP countries to prepare herb and spice mixes, pastes and cooking sauces that can be substituted for freshly prepared spices in domestic cooking (e.g. see Box 3.1.21 and Baronhall, 2013 for an example of an ACP producer making a range of these products). Similarly, hotels and restaurants may value the reduced preparation times, convenience and range of flavours that pre-prepared spice mixes can offer.

Note on use of cooking pastes

Some cooking pastes have a warning on the label that they must be eaten only after cooking. The warning is to prevent consumers preparing a dish with uncooked paste for consumption on subsequent days. This is necessary because these pastes are made using fresh unheated spices that have a stronger and more natural flavour, but may be contaminated with yeasts, moulds and/or bacterial spores. The formulation ensures that the water activity is sufficiently low to prevent spores germinating during storage. However, once the uncooked paste is mixed with other foods, the water activity is increased and spores can germinate, allowing any spoilage or food poisoning micro-organisms to multiply. They must therefore be cooked with meat or vegetables and eaten while hot to prevent any risk of food poisoning.

Standards for herbs and spices, mixes, pastes and sauces

Depending on the cultivation and processing conditions under which they are produced, herbs and spices risk contamination by micro-organisms. The microbial load should be reduced before they can be safely incorporated into other food products. However, high temperature treatments such as pasteurisation can cause significant losses of volatile oils and hence the aroma. Herbs and spices were previously fumigated with ethylene oxide gas to destroy contaminating micro-organisms, but this is a carcinogen and was banned in 1991. Irradiation is used at a large scale in some countries and there have been developments to sterilise spices using ozone, but these are not available to small-scale processors.

Because dried herbs and spices are recognised as having particular risks of containing food poisoning micro-organisms and aflatoxins, the Codex Alimentarius Commission has produced a Code of Hygienic Practice for Spice and Dried Aromatic Plants (CAC/RCP 42-1995), which details product specifications and hygienic requirements in production, harvesting, processing, design of facilities and personnel hygiene (Codex, 1995). This is used by international traders and other buyers to ensure the quality of herbs and spices. The International Pepper Community (IPC, 2013) has produced a ‘Code of Hygienic Practice for Pepper and Other Spices’, which details quality standards for pepper and hygiene requirements for production, harvest and processing. IPC also produces a CD ‘Pepper Production Guide for Asia and the Pacific’. There are separate standards for organic certification. Methods to apply HACCP procedures to herb and spice production (Table 3.1.14) and quality standards for individual herbs and spices are described by ISO (ISO, 2013), the American Spice Trade Association (ASTA, 2013), the European Spice Association (ESA, 2013), together with details of analytical methods and procedures to determine contamination caused by insects, animal excreta and extraneous matter. The Spices Board, India also lists the quality requirements of importing countries, including risk of contamination by pests, herbicides and foreign matter (Spices Board, 2013).

Box 3.1.24. Microbial contamination of herbs and spices

A US Food and Drug Administration study of 20 000 herb and spice shipments found that 7% were contaminated with Salmonella sp. including high levels found in basil, 15% of coriander samples, 12% of oregano samples and 4% of peppercorn samples. Contamination was also found in sesame seeds, cumin and curry powders. Simple changes were made by working with farmers to improve post-harvest handling: peppercorns are now quickly dipped in boiling water to not only reduce the microbial load but also make it easier to dehull the seeds and shorten drying times to produce more evenly coloured peppercorns. Drying on plastic sheets minimises contamination from soil and dung, and fine nets hung above the crop minimise contamination by bird-droppings. (Adapted from Harris, 2013)

Processing companies and retailers that buy herbs and spices have their own commercial standards that cover the flavour and colour of spices, particle size specifications etc. and individual companies also have internal standards or the quality and composition of spice mixes, pastes and sauces, but no international standards have been found for these.

Hazard	Level of Risk	Action Required
Banned pesticides/herbicides	Very High	Liaison with growers
High levels of permitted pesticides/ herbicides	Very High	Liaison with growers
Infestation by pests	High	Fumigation may be required
Foreign matter (e.g. stones, hair, excreta)	Medium	Removed by cleaning/ sorting
Poor microbiological quality	Medium	Improve harvesting, handling and washing
Mould growth after packaging	High	Dry to correct moisture content. Improve packaging

Table 3.1.14. Summary of HACCP procedures for herbs and spices

The British Retail Consortium standards are also used by some companies to indicate accredited facilities ('Produced at our own BRC-approved factories in France and the UK with a secondary BRC accredited production facility in India.') 'Our ingredients are sourced from accredited production facilities with whom we have long-standing relationships to ensure the best products and prices for our customers' (Rosemary, 2013).

Box 3.1.25. Spice quality assurance

Mr. S.A. has trained his staff in quality assurance using opportunities available from the Government for SMEs, and has through his own efforts secured additional training for himself from the USA, Germany and Switzerland on quality management of spices. This knowledge and acquired on-the-job skills help his firm to produce high quality, safe products. He also has strict conditions on quality in contracts with the raw material suppliers and he has trained them to produce the quality required by his company. Harvesting spices and herbs at the correct maturity, proper handling and storage, and proper drying are all of prime importance. For each export consignment, he has a test report that confirms the quality and safety. Products are air-freighted to ensure prompt delivery; all of which ensures that products reach consumers in good condition.

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3.2 Plant extracts

This section describes extracted plant components that have a high value. It includes flavoured oils, essential oils and oleoresins, natural flavourings and colourings. Pectin, gelatin and a variety of starches and modified starches are also extracted from plants and used as thickeners, but their production is dominated by large-scale producers and their value is relatively low. As a result it is considered that small-scale processors would find it difficult to compete in these markets.

A note on plant gums: Research was undertaken to include in this book a range of gums that are extracted from plants and used as thickening agents in foods. The findings indicated that these were not suitable for small-scale processors for the following reasons: natural gums obtained from seaweeds (agar, alginic acid, sodium alginate and carrageenan) are likely to have problems with raw material supplies in ACP countries; Gum Arabic, produced from the sap of Acacia trees, retailed in 2103 for approximately $30/kg and Locust Bean Gum, produced from seeds of the carob tree retailed at $90/kg. Both are capable of being produced in ACP countries where these trees grow, but the technology required to refine and standardise the gums for international markets is likely to be too expensive and difficult to use by small-scale processors. The local demand for partially refined gums is likely to be too small to make the investment worthwhile. Gum Ghatti, produced from the sap of Anogeissus trees is mostly produced in India where the tree grows; Gum Tragacanth, produced from the sap of Astragalus shrubs, although valuable ($240-480/kg), is mostly produced in China where the tree grows; Guar Gum ($56/kg) is produced from guar beans that grow in Mediterranean countries and North Africa and not ACP countries; Xanthan Gum, produced by bacterial fermentation, has a high technology requirement and relatively low value ($75/kg). (Prices are retail prices in 2013).

3.2.1 Flavoured oils

The oily flavour compounds in herbs and spices are soluble in cooking oils (known as 'base' oils), so when these materials are infused in an oil the flavour compounds are transferred to produce a flavoured oil (see also liqueurs in section 3.6). Flavoured oils are not used as cooking oils but as salad dressings, marinades or sauces, and as dipping or drizzling oils to add flavours to grilled vegetables, meat and fish. The main markets for flavoured oils produced in ACP countries are likely to be restaurants, hotels and high-income consumers. They may also be marketed as gifts, particularly if the infusing ingredient has a strong connection to the country (e.g. spices in Caribbean islands) and sold to tourists at hotels and airport shops. To achieve high value, the oil should be packaged in attractive glass bottles (Figs. 3.2.1 and 3.2.2).

Fig. 3.2.1. Herb-flavoured oil (Courtesy of Peter Fellows)

The method used to produce flavoured oils is very simple, but the extent of the value added lies in the producer's skill in combining flavours to complement each other. This skill depends in part on creating a product that suits the tastes of intended consumers and partly on creating a product that is significantly different to competing products. Herbs and spices may be used singly or in combination; some are pounded into a paste and left overnight to develop the flavours whereas others are infused as whole pieces. Examples of combinations of herbs, spices or other aromatics that have been successfully used to make flavoured oils include:

- Spicy pepper oil: dried pepper flakes with jalapeno, habanero, etc.
- Lemon and garlic
- Chipotle chilli
- Tarragon and chive
- Oregano, rosemary, thyme and basil
- Herbes de Provence (savory, marjoram, rosemary, oregano and thyme)
- Roast garlic and fennel
- Basil, red pepper flakes and peppercorns
- Cumin, coriander and pepper flakes
- Roast Cippolini onions and cilantro
- Garlic with ginger
- Bay leaf with peppercorn
- Rosemary with thyme
- Cardamom, star anise, cinnamon and cloves
- Strong-scented herbs such as tarragon, chives, dill, mint, or oregano, used singly or in different combinations.

Sprigs of dried herbs may also be placed in the bottles as decoration, particularly if the product is intended as a gift (Fig. 3.2.2). Typically flavoured oils can retail for three to four times the price of extra virgin olive oils (Table 3.2.1)

Fig. 3.2.2. Oil containing sprigs of herbs sold as a gift (Courtesy of Peter Fellows)

Product	Price	Cost ($/litre)
Harissa Pepper oil (smoked chilli peppers, garlic, caraway, coriander and cumin)	$10.00\200ml	50.00
Tuscan Herb olive oil (oregano, basil, garlic and rosemary)	$16.95/375ml	45.20
Manzanillo extra virgin olive oil (pepper)	$14.99/275 ml	54.51
For comparison, extra virgin organic olive oil	$6.65/500ml	13.30

Table 3.2.1. Examples of retail prices for different types of high-value oils (From Midtown Olive Press, 2013; The Olive Tap, 2013; The Crushed Olive, 2013; Colavita, 2013)

(Retail prices at May 2013. Currency conversion: £1 = $1.5).

Note: prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Production

The base oil is usually extra virgin olive oil, but any high quality light, tasteless culinary oil is suitable (e.g. safflower or rapeseed/canola). It is not recommended to use fresh ingredients to flavour oils because they introduce moisture into the oil that can support bacterial growth. The flavoured oil may be produced using one of two methods: in the cold-infusion method, dried herbs or spices are placed in bottles, filled with oil, capped and stored in a dark place to infuse for 3-4 weeks and allow the flavours to develop. They may be sold in this form or the herbs or spices may be removed and the oil strained before returning it to the bottles. In the hot infusion method, the oil is heated together with the selected aromatics to 60°C for ≈5 min. and then allowed to cool. It may be bottled after filtering through a fine metal strainer or cheesecloth to remove the flavouring materials or the materials may remain in the oil to allow the flavour to intensify during storage. In both methods, the flavoured oil may also be blended with unflavoured oils to obtain a standardised product from each batch.

If there is concern over the microbiological quality of the aromatic material (e.g. many spices are regarded as potential sources of food poisoning bacteria – see section 3.1.3), the oil may be heated to a higher temperature (e.g. 80-100°C for 15 min.) to both pasteurise the ingredients and remove any traces of moisture that would allow bacteria to grow in the oil. Alternatively, the flavoured oils may be stored under refrigeration, but this increases costs and may not be appropriate for sales in ACP countries. The shelf life of the flavoured oil depends on the type of base oil selected and the storage conditions: if high quality oil is used and the flavoured oil is stored in a cool place, away from direct sunlight, the shelf life should exceed several months and up to one year (see also Fellows and Axtell, 2012 for additional information on oil production, quality assurance and shelf life).

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3.2.2 Essential oils and oleoresins

The characteristic odour and flavour of many herbs, resins, barks, roots, spices and flowers is due to presence of a complex mixture of chemical compounds. The chemical 'fingerprint' of these components also depends on the sub-species, climate and cultivation conditions. Some of these components, known as 'essential oils', are volatile and may be separated by steam distillation. The chemical composition of other components, known as 'oleoresins' makes them too 'heavy' to steam distil and these are extracted by solvents (commonly alcohol (ethanol) or other solvents such as hexane). Some plants contain only essential oils, whereas others have a mixture of essential oils and oleoresins (e.g. ginger).

The production of oleoresins is more complex than essential oils because of the requirement to use solvents and solvent recovery equipment. For both types of product there is also a need to invest in skilled and highly trained staff to perform chemical analyses that ensure that products meet international standards. Finally, flavour chemists are required to standardise the products to ensure that they meet food manufacturers' requirements. Most small-scale producers do not make this investment and instead supply unstandardised essential oils and oleoresins to larger companies, which have the necessary technology to standardise and market these products.

Buyers of essential oils and oleoresins are often very conservative and are often resistant to dealing with new suppliers. In order to enter the market, new producers must be able to show that they can supply uniform quality materials at competitive prices and that they can assure continuity of supply. This section focuses on uses of essential oils and oleoresins in foods, but there is also a large market for these products for aromatherapy, toiletries, perfumes, cleaning products, aerosol sprays etc. There are also long-established large-scale suppliers of oleoresins and essential oils that a new producer would have to compete against in both quality and price. Therefore, although in principle, oleoresin production is feasible at a small scale, in practice the large investment required in processing and laboratory equipment, the requirement for highly skilled staff, and the competition from large, well-established companies, each makes these products more difficult to produce than many others described in this book.

Essential oils

Table 3.2.2 shows the main essential oils that are used in food products.

Basil Oil	Dill seed Oil	Nutmeg (Indonesia) Oil
Bay Oil	Dill weed Oil	Onion Oil
Caraway Seed Oil	Eucalyptus Oil	Origanum Oil
Cardamom Oil	Fennel Oil	Parsley Herb Oil
Cascarilla Bark Oil	Garlic Oil	Parsley Seed Oil
Cassia Oil	Ginger (Nigeria) Oil	Pepper Black Oil
Celery Seed Oil	Ginger (China) Oil	Peppermint Arvensis Oil
Celery Herb Oil	Ginger (Cochin) Oil	Peppermint Piperita Oil
Cinnamon Bark Oil	Garden mint Oil	Pimento Berry Oil
Cinnamon Leaf Oil	Juniper berry Oil	Pimento Leaf Oil
Clove Bud Oil	Laurel Oil	Rosemary Oil

Clove Stem Oil Clove Leaf Oil Coriander Seed Oil Coriander Herb (Cilantro) Oil Cumin Oil	Lemongrass Oil Lovage Leaf Oil Lovage Root Oil Mace Oil Marjoram (Egypt) Oil Marjoram (Spain) Oil	Sage Oil Spearmint Oil Tarragon Oil Thyme Red Oil Valerian Oil

Table 3.2.2. Essential oils (From Hitchen, 2013)

3

The main producing countries are Indonesia, Brazil, India, China, Sri Lanka and Jamaica and the main importing countries are the USA and those in the EU. Smaller amounts of essential oils are also produced in other ACP countries (e.g. Box 3.2.1). All essential oils are very high value products and examples of their uses in foods together with indicative prices are shown in Table 3.2.3.

Box 3.2.1. Essential oil producers

There are seven processing enterprises in Uganda that are involved in extraction of essential oils that are used mainly for aromatherapy, natural medicines, cosmetics, fragrances and flavourings/food ingredients. However, over 90% of the production is exported in its raw form for further processing in the importing country.

Spice oil	Source/Variety	Price/kg	Price ($/kg)	Notes
US Market				
Cinnamon bark	Madagascar	$165	165	Units of 10kg and more
Cinnamon bark	Madagascar	$230	230	25 litres minimum
Ginger	Madagascar	$240	240	Units of 10kg or more
Cardamom	Guatemala	$275	275	
Turmeric	Madagascar	$140	140	25 litres minimum
Clove bud	India	$35	35	
EU Markets				
Cinnamon bark	Sri Lanka	€155-230	201- 300	
Black pepper	Sri Lanka India	€60-70 €80	78 - 91 104	
Nutmeg	Indonesia	€60-70	78 - 91	1kg lots

Ginger	China India Sri Lanka	€20-25 €80 €130-140	26 - 32 104 169 - 182	1 ton lots
Pimento leaf	Jamaica	€75-90	97 - 244	1 ton lots
Pimento berry	Jamaica	€145-160	188 - 208	
Cardamom	Guatemala	€165-220	214 - 286	
Cumin seed	Iran & Egypt	€60-70	78 - 91	
Spearmint	India	€18-20	23 - 26	
Chamomile	Egypt	€550-600	715 - 780	
	Roman	€700-1,100	910 - 1430	

Table 3.2.3. Prices for essential oils (ITC, 2009)

Notes: Retail prices at June 2013. Currency conversions: €1 = $1.3.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

(Additionally, oils derived from flowers are high-value, often used in aromatherapy and room fresheners, for example: wholesale prices for lavender absolute extra oil (*Lavendula officinalis*) =$1,667/litre; angelica root oil (*Angelica Archangelica*) = $2,083/litre; peach tree leaf absolute oil (*Prunus persica* L.) = $3,888/litre; cardamom extra absolute oil (*Elletaria cardomum*) = $5,000/litre; and rose damask oil (*Rosa damascena* Mill.) = $11,112/litre (Lala, 2013)).

Production

Low-cost production of petal oils

Oils from flower petals are very sensitive to heat and the following low-cost technique, known as cold 'enfleurage' has been used to produce high-value petal oils: purify beef fat (lard), obtained from around the animal's kidneys, several times until it is pure white with no odour. Then melt the lard and pour it in a thin layer onto a large tray or plate of glass to cool and set. Cover the lard with petals and cover the petals with another thin layer of lard melted at the lowest possible temperature. Continue to build up alternate layers of petals and lard until the tray is filled. Leave for six months or more to allow the petal oil to diffuse into the lard. Alternatively, place the petals on a layer of fat for 1-3 days and then replace with fresh ones until the fat has reached the required degree of saturation with fragrance. Gently melt the lard at the lowest temperature and allow it to cool and harden. The petal oil remains at the surface and may be poured off. Alternatively, soak the enfleurage in alcohol and then separate it from the fat and allow it to evaporate, leaving behind the essence. The spent fat may used to make soaps as it still contains small amounts of essence.

The equipment needed to distil essential oils is a still fitted with a curved outlet at the top (known as a 'gooseneck'), a condenser to cool the condensed steam/oil mixture, and a 'Florentine' flask to separate the essential oil from condensed water. Simple 'country' stills are usually constructed from mild steel and are heated over a fire or other heat source. More sophisticated stills have an external boiler to provide steam. The ideal material for the construction of stills is stainless steel but this is expensive in most ACP countries. If the entire still cannot be made from stainless steel because of the expense, it should at least be used to make the gooseneck and condenser coil.
Both the material used to construct the still and its design, have a great influence on the final quality, value and marketability of the essential oil.

There are three methods of essential oil distillation:

1. Using water (or 'hydro-distillation'): This is used in country stills in which the 'charge' of raw material is totally immersed in water and heated, usually over an open fire. The disadvantages of this type of distillation include:
   - Variable distillation rates as the fire cannot be easily controlled.
   - Local burning of the charge at the bottom of the still, which results in poor quality oil.
   - The need to heat large volumes of water results in high fuel costs.
   - Stills must be allowed to cool before the spent charge can be removed by hand.

The quality of essential oils that are distilled in country stills may be improved by re-distillation of the oil in a small glass or stainless steel still. For example, bay oil produced in a country still in the Caribbean, which was almost black in colour, was re-distilled to produce a slightly yellow oil of higher quality and value (Dann, 2012).

Box 3.2.2. Investment in essential oil production

Essential oils are made by a simple water distillation method: fresh plant material is immersed in water in a locally fabricated, airtight still, similar to a pressure cooker, and boiled. The oil forms a layer on top of the water and is separated. However, to commence commercial production, the company will need to invest in machinery and equipment to increase the capacity and to refine the crude extract into a standardised product, which requires a capital investment of between US$ 100,000-250,000.

Water and steam distillation: The still has a slightly more sophisticated design in which the charge is supported on a grid, or contained in a mesh basket above boiling water. There is less chance of burning the charge and the basket can be quickly removed after distillation. The charge must be packed evenly and not too tightly to avoid backpressure or the formation of ‘rat holes’ as the steam makes channels in the charge. An advantage of water/steam distillation over water distillation is lower fuel costs as less water is boiled.

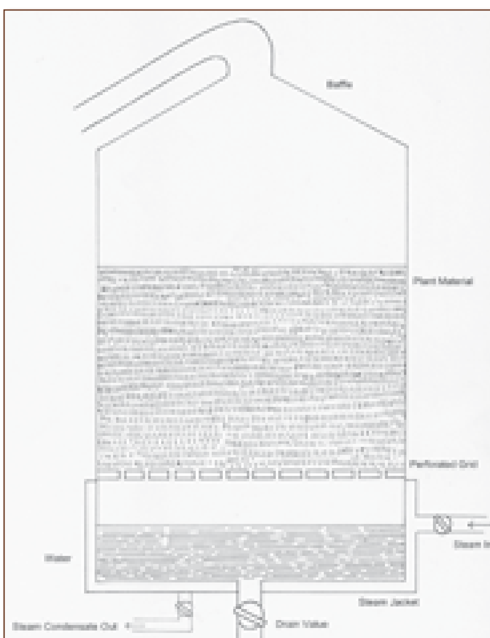
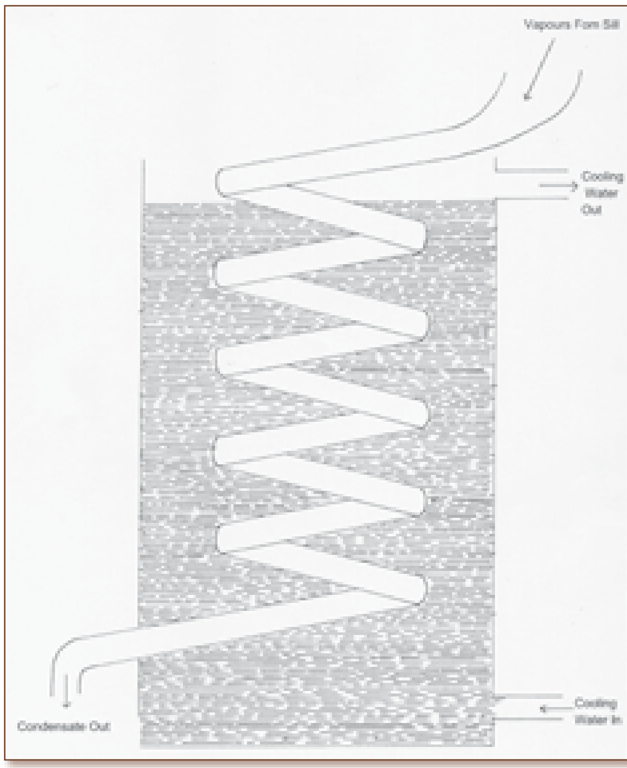


Fig. 3.2.3. Schematic diagrams of essential oil distillation:

a) a still; b) a condenser (Dipika Hopkins)

Steam distillation: This is the most advanced technology in which live steam from an external boiler passes through a perforated coil situated below the grid supporting the charge (or a basket may be used for easier emptying). The advantages of this equipment are shorter distillation times, resulting in less heat damage to the oils, and lower fuel consumption. However, there is an additional cost of an external boiler.



Florentine flasks

The cooled liquid leaving the condenser is mainly water but also contains tiny droplets of essential oil. Most essential oils are lighter than water and float to the surface, but some components, particularly ones that are produced in the later stages of distillation, may be heavier than water and sink. Therefore two types of Florentine flasks are needed for light and heavy oils (Fig. 3.2.4). The Florentines must also be large enough to allow time for the droplets of oil to separate.

As shown in Fig. 3.2.4, the oil either rises to the surface or sinks to the bottom of the flask allowing the water to be siphoned off. In some cases, separation is difficult and the water leaving the flask, still containing small amounts of oil, is returned to the still (a process known as 'cohabation'). It is important that the Florentines are made from a material that does not react with the oil; stainless steel or glass are ideal, but copper or tinned copper are also widely used.

It is essential that essential oils are free of water and they may be filtered through plugs of cotton wool to remove the final traces of water. In addition, contact with plastic or rubber must be avoided to prevent contamination of the oil by off-flavours. Essential oils lose their quality through exposure to light and air and the ideal containers are either glass bottles, or at larger scale, epoxy-resin-coated metal drums.

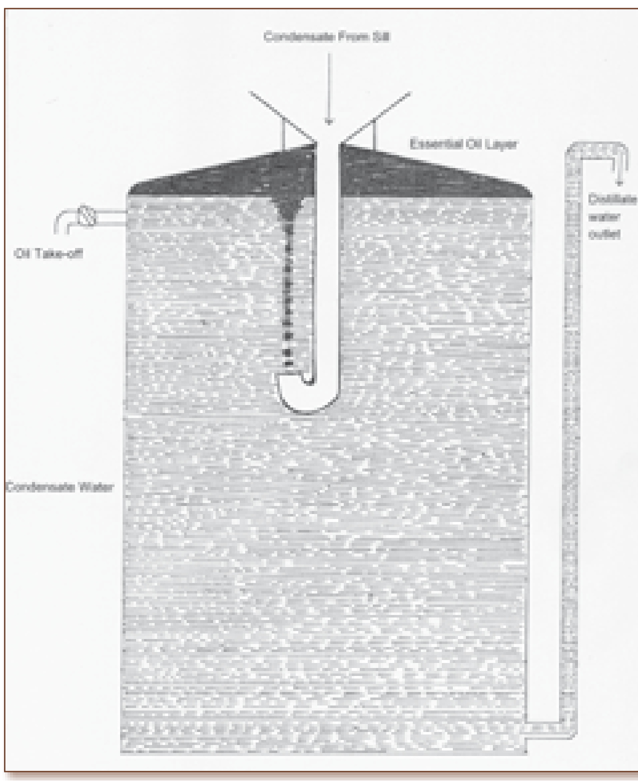
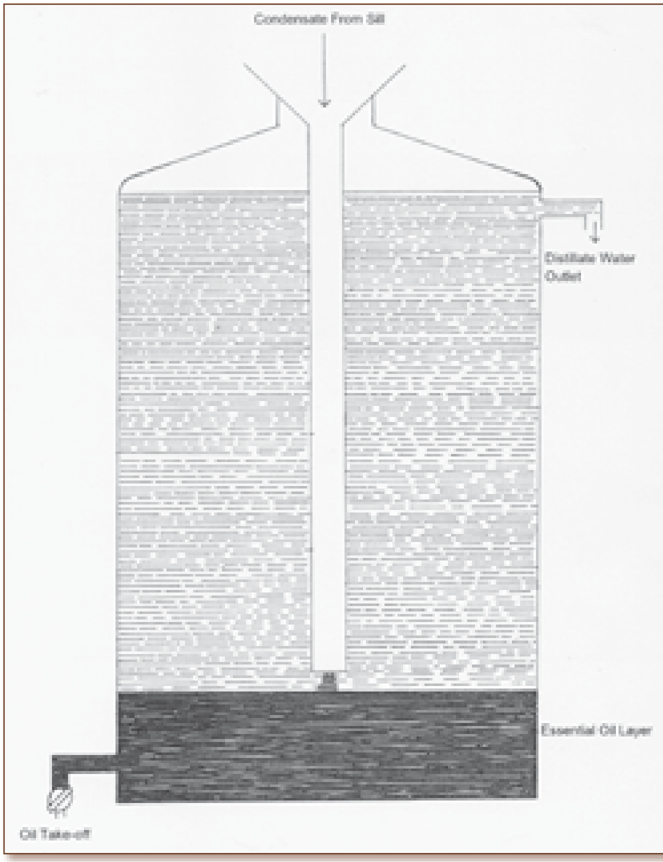


Fig. 3.2.4. Florentine flasks: a) for oils that are lighter than water; b) for oils that are denser than water (Dipika Hopkins)



Oleoresins

Oleoresins are the concentrated liquid form of a spice that contain both the volatile and non-volatile constituents. They therefore have the complete flavour profile of the spice and can replace whole or ground spices without changing the flavour and aroma characteristics of the processed food. They have a number of other advantages for food processors, compared to fresh or dried spices: their concentrated form is easy to store and transport; they are more stable when heated; they are more economical to use; they have more uniform quality; they are cleaner in use than ground spices and free from contamination; and they have a longer shelf life due to minimal oxidative degradation or loss of flavour. The main oleoresins that are produced for use in foods are shown in Table 3.2.4.

Basil	Fenugreek	Onion Green
Basil	Fennel	Onion Roasted
Birdseye Chilli	Garlic Green	Paprika (40,000cu)
Capsicum (6%)	Garlic Roasted	Paprika (100,000cu)
Caraway	Ginger (Jamaican)	Parsley
Cardamom	Ginger (Nigerian)	Pepper Black
Cassia/Cinnamon	Ginger (Cochin)	Pepper White
Celery Seed	Green Bell Pepper	Pimento/Allspice
Celery Leaf	Guajillo Chilli	Rosemary
Chipotle Chilli	Habanero Chilli	Sage
Clove	Jalapeno Chilli	Savory
Coriander Seed	Lemongrass	Spearmint
Coriander Herb	Lovage Leaf	Star Anise
Cumin	Mace	Tarragon
Cumin Roasted	Marjoram	Thyme
Dillseed	Nutmeg	Turmeric
Dillweed	Oregano	Vanilla

Table 3.2.4. Types of oleoresins for food applications (Adapted from Hitchen, 2013 and Ungerer, 2013)

Oleoresins are produced by extraction with one or more non-aqueous solvents in combination or sequence, followed by removal of the solvents to limits described by residual solvent regulations (e.g. maximum limits of 0.003% for acetone and isopropanol, 0.005% for methanol and 0.0025% for hexane).

Alternatively oleoresins may be produced by removal of the volatile portion of the spice by distillation, followed by extraction of the non-volatile portion. After solvent removal the volatile portion is recombined with the non-volatile portion. Each type of oleoresin is flavour-balanced and standardised to ensure that it has a uniform quality.

Oleoresin	Essential oil	Price	Price ($/litre)
Black Pepper Oleoresin 18 % VOC (Piper nigrum)		$14/100ml	140.00
	Black Pepper oil Black Pepper oil - Certified Organic Black Pepper oil, wild-crafted	$16.41/50ml $11.91/50ml $19.45/50ml	328.20 238.20 389.00
Capsicum oleoresin (CP) - 6% capsaicin (Capsicum annum)		$10.40/100ml	104.00

Cardamom oleoresin 40% VOC (Elettaria cardamomum)		$26.39/50ml	527.80
	Cardamom oil	$22.22/50ml	444.40
Coriander oleoresin (Roasted) 1% VOC (Coriandrum sativum)		$6.07/100ml	60.70
Cumin Seed oleoresin 10% VOC (Cuminum cyminum)		$7.80/100ml	78.00
Garlic oleoresin (Trigonella foenum-graecum)		$10.42/50ml	208.40
Ginger oleoresin 30% VOC (Zingiber Officinalis)		$8.50/50ml	170.00
	Ginger oil - Certified Organic Ginger oil Ginger oil, wild-crafted	$15.52/50ml $18.30/50ml $12.50/50ml	310.40 366.00 250.00
Nutmeg oleoresin 30% VOC (Myristica Fragrans)		$8.67/100ml	86.70
	Nutmeg oil - Certified Organic Nutmeg oil	$8.33/50ml $11.38/50ml	166.70 227.60
Onion oleoresin (Allium cepa)		$8.33/50ml	166.70
Turmeric oleoresin 35% (Curcumin curcuma longa l)		$6.93/100ml	69.30
Vanilla Extract (Vanilla planifolia Andr.)		$21.54/50ml	430.80
	Vanilla Absolute Oil	$22.22/10ml	222.20
White Pepper oleoresin (Piper nigrum)		$8.33/50ml	166.70

Table 3.2.5. Prices for oleoresins (From Lala, 2013)

Notes: Wholesale prices at October 2013. Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Notes on Table 3.2.5:

VOC = Volatile Organic Compounds (part of the oil specification, which partly determines the value of the oil).

With the exception of cardamom and vanilla, oleoresins are approximately half the price of essential oils. Organic and wild-crafted essential oils do not display a premium over conventional essential oils.

Oleoresins may have added food-grade diluents, preservatives and antioxidants, but they must be declared on the label in accordance with national regulations. There are additional specifications on the volatile oil content for each type of oleoresin. They should be stored in a cool place in completely full, preferably glass or glass-lined containers that are protected from light (Codex, 2003).

Suitability for small-scale production

A report by the Market News Service (ITC, 2009) on the distillation and extraction industry in Africa identified that it is relatively small and localised away from North African centres of Egypt and Morocco, and Southern Africa (South Africa, Swaziland). New entrants to the industry can find it hard to identify suppliers of stainless steel equipment (stills, condensers, extraction vessels etc.), steam boilers and other materials (drums, filter papers etc.). It lists existing manufacturers based in East Africa in 2009, noting that the development of the industry in Africa would benefit from greater information sharing on suppliers, and the concentration of orders to particular suppliers would encourage the development of skills and expertise, particularly in fabrication of stainless steel vessels and condensers.

Box 3.2.3. Case study of organic essential oil production in Zambia

Arulussa Ltd. was established in 1996 to grow and process essential oils and plant fragrances for the aromatherapy and natural body care trade in Europe and South Africa. Shareholders were interested in investing in an enterprise that offered an opportunity to export products that had a relatively high value in relation to volume. At this time concessional financing was being offered by various donors to support and diversify Zambia's agricultural exports. The shareholders had no experience in the extremely complex and secretive essential oil and fragrance industry. A prototype extractor was manufactured and 28 hectares of 'Damask' and 'Alba' roses were established. The extraction plant suffered a number of technical problems including low throughput and solvent leakages and the unit proved too expensive and complicated to operate. There were also severe red spider mite pest pressures on the roses, but equally importantly the products had a different chemical signature to those accustomed by the trade and interest was minimal. Modest sales to some aromatherapy companies were achieved but after 4 years of experimentation the project was shelved.

In 2002, the company was approached to grow organically certified Tea tree by Earthoil Ltd. Arulussa invested in a steam plant and nine hectares of Tea trees. Distillation continues with yields of 250 kg of oil/ha. The company also experimented with a number of alternative essential oil crops including sweet marjoram, lemongrass, sweet basil, lavender and Bourbon geraniums. Only Tea tree and marjoram proved viable in terms of suitability to the local climate, marketability and profitability. In 2003, the company decided to produce soaps and other body care products for sale in local supermarket outlets. Small areas of lemongrass, lavender and geranium are maintained to support this activity, which has proved moderately successful.

Their experience to date can be summarised as: essential oil production should never be engaged in as a greenfield stand-alone activity. Zambia had no previous experience of growing essential oil crops and all R&D had to be done in-house at considerable expense. Market opportunities should be exhaustively researched before any substantial investment is made. In Zambia there are many conventional farming enterprises that can out-perform the production of essential oils. Traders in general are not interested in supporting producers, preferring to purchase oils from the cheapest sources. Many also have longstanding agreements with historical suppliers and disfavour new entrants. This is understandable as the industry is littered with growers who for numerous reasons have failed to deliver (From Aagaard, 2009).

Box 3.2.4. Essential oil production in Zambia (2)

In 1999, the Organic Producers and Processors Association of Zambia was established with donor funding to develop opportunities for the production of organically certified crops including essential oils. In the beginning emphasis was placed on encouraging satellite production by small-scale farmers linked to commercial growers, mostly well-established commercial farmers. Success has been limited; the conversion of small-scale farmers to certified organic production is extremely difficult. The production of essential oil crops by smallholders is virtually impossible due to the condition of roads in rural areas, the logistics required to deliver fresh material for central distillation and the risks involved for both the out-growers and processors. Smallholders have to be paid cash on delivery whereas the processor/exporter has to wait up to six months to be paid and absorb any risks arising from fluctuating market prices. In 2000 there were four small-scale essential oil producers in the country and today there is only Arulussa Ltd. OPPAZ still depends on donor funding as membership subscriptions are inadequate to finance the operating costs of the association (From Aagaard, 2009).

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3.2.3 Natural flavourings

Introduction

Flavours are extracted from a wide range of plant materials to produce concentrated extracts that are then added to a many types of processed foods (e.g. ice creams, bakery products and confectionery). The majority of natural flavourings are available as colourless concentrated liquids that are used in very small amounts (e.g. a dose rate of ≈0.15% or 1.5g per 1kg of product). Examples include almond, banana, Birdseye chilli, blackcurrant, blueberry, butterscotch, cheese, cherry, cola, cranberry, ginger, honey, lemon, lime, malt, orange, peach, raspberry, strawberry, toffee and vanilla.

Note: uses of the word 'flavouring'.
The term 'flavouring' may be used to describe any flavouring whether it is natural or synthetic. A 'natural flavouring' is derived from natural sources, but where less than 95% is derived from the actual named flavour source (e.g. strawberry). 'Natural X flavouring' (e.g. 'Natural strawberry flavouring') can only be used when at least 95% of the flavouring component is derived from the actual source (e.g. strawberry) and the remaining 5% must also be natural. A declaration of for example 'natural strawberry flavouring with other natural flavouring' is permitted when the flavouring component is less than 95% (Foodie Flavours, 2013). EU regulations on flavourings are described in EU, 2008.

Natural flavours can be extracted from foods by macerating the material in a mixture of alcohol and water and then separating the solvents to leave the concentrated flavouring. This is then standardised according to the individual chemical parameters for the particular flavour. Two more advanced technologies have been introduced to produce flavourings: 1) the spinning cone column is a type of distillation (or stripping) column in which steam removes volatile compounds from liquids or slurries under vacuum; 2) a 'supercritical' fluid extraction method uses CO_2 as a solvent in a two-stage process: first the flavours are dissolved in CO_2 that is above its critical temperature and critical pressure (31°C and 74 bar). The extracted flavouring is then precipitated from the CO_2 in a separator at lower pressure and temperature. This produces a highly concentrated, pure extract that is alcohol-free and is virtually identical to the flavour profile of the original material. Both technologies are expensive and require a high investment, not only for the equipment, but also for highly qualified operators and experienced flavour chemists to standardise the products. These methods are therefore not likely to be suitable products for small-scale processors.

This section uses vanilla as an example of a flavouring that may be processed at a small scale in ACP countries. The method used to cure the beans is long and complex, but it adds considerable value to the beans. Some ACP companies also process vanilla extract to achieve higher added-value.

Vanilla

V*anilla planifolia* is used in many industries to produce vanilla flavouring for foods, beverages, pharmaceuticals, cosmetics and tobacco. Other species are *Vanilla fragans*, cultivated in the Bourbon islands, Indonesia, México and Tonga, which has a full aftertaste and the most complete aroma profile of all vanilla extracts, so has the highest demand for all industries. *Vanilla tahitensis* is grown exclusively the islands of Tahiti and Moorea and has a flavour that has high demand in French and Italian markets, mainly for ice cream manufacture.

Note: 'Bourbon' is the term that the world market uses to describe high-quality vanilla. However, vanilla originating from the Indian Ocean region (including Madagascar, Comoros, and Reunion Island - formerly the Bourbon Islands) is also referred to as bourbon and the name is also commonly given to the curing process used in that region.

Vanilla vine cultivation requires a temperature range of 21 - 32 °C, an evenly distributed annual rainfall of 1500 mm or more, 80% relative humidity at altitudes of up to 600 m above sea level.
Soils should be rich and have good drainage with a depth of 40 cm or more. The vanilla plant climbs through trees and shrubs and its cultivation is a long, labour- and knowledge-intensive process; the plant takes 3-4 years before it begins to blossom. Artificial pollination is then undertaken by farm workers and between 6-9 months after blossoming the ripe yellow fruits containing the vanilla capsules are harvested. A detailed account of vanilla cultivation and processing is given by Bianchessi, 2012.

Fig 3.2.5. a) Vanilla plant (Courtesy of Botanischer Garten TU Darmstadt), b) unripe vanilla pods (Courtesy of B. Navez)

World trade in vanilla

Data on world trade in vanilla in 2010-2011 (Table 3.2.6) shows Madagascar as the main ACP producer, together with significant production in the Pacific Islands and East Africa. Madagascar is also the main exporter of vanilla (about 40% of production) followed by Uganda. However, the international trade is complex and the data also shows significant amounts of re-exporting by countries in Europe and Southern Africa to markets in the Middle East and Europe. For example, Malawi, Kenya and Zimbabwe are important producers but have no recorded exports, whereas Tanzania and South Africa are not significant producers but are among the top 25 importing and exporting countries. The data for Uganda appears to show that it exports around ten times more vanilla than it produces.

Country	Production (MT)	Exporting country	Amount (MT)	Importing country	Amount (MT)
Indonesia	3,500	**Madagascar**	**668**	Austria	23
Madagascar	**1,587**	France	610	Spain	22
China	1,385	Indonesia	342	Bahrain	20
Mexico	362	Germany	306	Qatar	20
Turkey	287	Canada	242	**Nigeria**	**19**
Tonga	**202**	**Uganda**	**230**	Poland	17
French Polynesia	**60**	Turkey	212	Iran	16

Comoros	**42**	India	203	Philippines	16
Uganda	**24**	**Papua New Guinea**	**153**	**South Africa**	**14**
Malawi	**20**	Australia	150	**Botswana**	**12**
Guadeloupe	11	Ireland	129	Cuba	10
Kenya	**10**	USA	121	**Namibia**	**10**
Zimbabwe	**10**	Saudi Arabia	97	Armenia	9
Réunion	8	Netherlands	87	**Tanzania**	**9**
		Belgium	85		
		Jamaica	**80**		
		UK	77		
		Comoros	**56**		
		Latvia	47		
		Mexico	47		
		South Africa	**25**		
		Philippines	22		
		El Salvador	17		
		Tanzania	**15**		
		French Polynesia	**13**		
		United Arab Emirates	13		

Table 3.2.6. World vanilla production in 2011, exports and imports in 2010 (FAOSTAT, 2013)

Note: ACP countries highlighted.

Box 3.2.5. Markets for vanilla

In 2001, Mr M. decided to focus on exports of gourmet cured vanilla rather than deal with the complexities of industrial processing of vanilla into vanilla extracts for food flavours. There was a low demand from the domestic confectionery industry for vanilla products, whereas exports offered volumes that were easy to handle, had high added-value and easier logistics and airfreight requirements compared to other perishable horticultural products. He therefore adopted a strategy that focused on a niche export market for gourmet organic cured vanilla pods to France and the USA.

He characterises the vanilla market, both at local and world levels, as a narrow market with volatile prices comprising high peaks and prolonged troughs of relatively low prices. The fluctuations are mainly caused by events in Madagascar (e.g. cyclones in 2000 and 2004 that damaged vanilla-growing areas and coup attempts in 2001 and 2002), which triggered a prolonged escalation of world vanilla prices. His sales turnover from cured vanilla hit the roof at about US$170,000 during 2002- 2006 when world vanilla prices skyrocketed from US$20/kg to US$400/kg. Uganda exported 200 MT of cured vanilla in 2006 while production in 2007 doubled to 400 MT albeit at a collapsed world price of US$8/kg. By 2012, the company's organic vanilla market share reached 7% of the total market size but later plummeted to insignificant levels due to the collapse in prices. The fall in farm-gate prices for green pods, from US$50/kg in 2002-2003 to US$1.6/kg in 2012, led many farmers to abandon vanilla cultivation and Mr M.'s sales plummeted to very low levels so he suspended exports. Nevertheless, he believes he can consistently deliver premium quality beans, estimating that about 40% of Uganda's beans are rated as gourmet quality.

Box 3.2.6. Selling vanilla

The route taken by vanilla as it moves from producer and local exporter to the consumer comprises a system of intermediaries and facilitators, all of whom help to direct it to its end-market. Confronted with an array of different distribution channels, depending on who the final buyer will be, Mr M. selected intermediary importers, distributors and re-packers. He describes the difficulties in selling directly to foodservice buyers, processors or conventional retailers: "The margins on exports directly to processors and retailers are higher than those to intermediaries; however it requires heavy investment in promotion and branding to capture such customers".

He sells vanilla to re-packers who are often fair trade organisations that guarantee fair prices and purchase vanilla at times of glut. They sort vanilla according to its size and quality and re-pack it before selling it to processors and gourmet chefs. Mr. M. believes that these processes are part of the value-added activities that should be done at source and further erode the negotiating power of the exporter to get higher prices.

Box 3.2.7. Operating a vanilla business

With over 20 years' experience in financial accounting, management and marketing acquired in exporting fresh fruits and vegetables, Mr. M. was aware of the much higher prices for value-added products compared to unprocessed produce in export markets. He was appalled by the low earnings of local farmers selling their produce to middlemen who then exported it. "Using my experience in conducting market studies, I undertook a study of how to increase produce prices and raise farmers' incomes. I concluded that value-added activities were the only solution and I was convinced of the market opportunities for organic products". He explored products that he could add value to and zeroed in on cured vanilla.

He assessed this as requiring minimum capital outlay and, at that time, required less-stringent measures in terms of inspections, traceability and standards. He believed vanilla production was a very promising on-farm activity in central Uganda and he embarked on adding value, at least to a semi-processed level, through curing it. Currently, he employs ten permanent staff and has more than 60 out-growers who supply the company with vanilla.

Mr M. believes that the strengths of his company lie in its ability to organise farmers to provide organic-certified vanilla pods for the export market. However, the long drying process ties up the company's working capital as work-in-progress stocks for a long period of time. So far he has been unsuccessful in identifying appropriate machinery and equipment to expand activities into vanilla extraction and processing that could improve on returns compared to cured pods.

Small-scale processing

Vanilla beans are ready for harvest six to nine months after pollination. They are harvested one by one when they are fully-grown and begin to ripen, as shown by a change in colour from dark to light green. Immature beans produce an inferior product and over-ripe beans can split, so it is necessary to harvest them two or three times per week during the harvest season in order to pick beans at the correct stage of maturity.

Box 3.2.8. Sourcing vanilla

Mr B. sources 20% of the organic green vanilla pods from the company's own farm and 80% from vanilla farmers located in four neighbouring districts. He buys about 40-50kg green vanilla per day from contracted out-grower farmers who have received training at the company's own vanilla farm. Buying is strictly by the company's trained staff after inspecting farmers' pods. The average vanilla yield from the company farm are 1kg of cured vanilla from 5kg of vanilla pods, whereas the out-grower farmers have a lower ratio of about 7:1, which is attributed to many farmers not taking the standards seriously.

Box 3.2.9. Challenges to vanilla supplies

The 2006-2007 collapse in prices caused many farmers to leave their vanilla plants unattended and growing wild and the supply from farmers remains low due to the low prices. According to the owner, other problems in the supply of vanilla include increasingly low yields due to soil depletion; rampant theft of vanilla pods during periods of high prices, which reduced supplies from contracted farmers; and a proliferation of fungal diseases and pests such as beetles that attack vanilla plants and cannot be dealt with using organic pesticides as these are too expensive in the local markets.

Post-harvest processing and curing of vanilla beans should take place within a week of harvest. Processing requires experience and sound knowledge of the traditional, superior Bourbon method of curing in order to add the highest value. Meticulous care is needed during the curing process to prevent quality deterioration due to fungal, bacterial or insect damage. Processing vanilla pods is also time-consuming and labour-intensive.

The first stage is sorting and grading by the length and appearance of the pods, which have a direct relationship to their vanillin content and hence the aroma. They are sorted by length into Grade I: >15cm; Grade II: 10-15cm; Grade III: 10cm; and Grade IV: split, cut and damaged beans. The graded beans are washed in clean water and transferred to bamboo baskets immersed in water at ≈60-70°C to 'kill' the beans (for 5 min for Grade I, 4 min for Grade II, 2 min for Grade II and 1.5 min for Grade IV) (Krishna Moorthy and Krishna Moorthy, 2008).

The beans are then transferred immediately to wooden boxes lined with blankets to 'sweat' for 36-48 hours at 48-50°C. This causes the start of the development of the characteristic aroma. They are then sun dried on black blankets so that the temperature of the beans increases to ≈50°C. The bundles are transferred to sweating boxes for different periods of time depending on the grade (sun drying and sweating for 12-14 days for Grade I; 7-10 days for Grade II; and 5-7 days for Grades III and IV). By the end of this process, the beans have lost half of their initial weight, have turned to a glossy dark brown colour and have developed their characteristic aroma.

The next stage involves slow-drying the beans on racks in well-ventilated rooms at ≈35°C with a relative humidity of 70%. Again the duration of drying depends on the grade (20-35 days for Grade I; 10-20 days for Grade II; 3-10 days for Grade III and 2-8 days for Grade IV). At the end of this stage, the pods are supple and wrinkled, with a lustrous brown/black colour and a moisture content of ≈30-35%. The pods are then repeatedly stretched and smoothed over four days using pieces of polished wood. Then the first three grades are tied in bundles, each containing 50-70 pods (100-150g), wrapped in waxed paper and conditioned for two to nine months inside wooden or metal boxes lined with wax paper. This causes a further loss of 3-4% moisture and the development of the full aroma.

Fig 3.2.6a. Curing vanilla pods (Courtesy of Sunil Elias), b) cured pods (Courtesy of Suma Foods)

After drying, the vanilla pods are separated into split pods and intact pods. The intact vanilla is sorted into four quality grades:

- 1st Grade: Oily, dark chocolate brown colour referred in the industry as 'black', perfectly formed and devoid of any blemishes.
- 2nd Grade: Oily, dark brown but thinner pods with minor defects (e.g. scars).
- 3rd Grade: lighter shades of brown with moderate thickness and uniformity, and with a higher moisture content (26-30%).
- 4th Grade: Thin thickness, less uniform, with a low moisture content and brittle.

After grading the vanilla is packaged in wax paper-lined cardboard boxes for transport to export buyers. Fourth grade vanilla is sealed into plastic bags weighing 5-10g for sale in local markets to be used by consumers as flavouring for foods or tea, or bought by hotels, restaurants or local micro- and small-scale bakery or confectionery industries.

Box 3.2.10. Vanilla processing

Although there is curing of green vanilla pods, vanilla processing is very much a fledgling industry in Uganda. Due to the complexities of industrial processing into vanilla extracts, fragrances etc., the company only focuses on post-harvest value addition by curing. The company uses a traditional labour-intensive slow curing process that takes five to seven months to complete. The proprietor explains that mature green vanilla pods have high moisture contents and in order to produce the highly aromatic, dark brown vanilla beans required by the export market, his process reduces the moisture content to 22-30%, depending on specifications given by export buyers. Vanilla curing requires knowledge and skill, extreme patience and close supervision; hence it is risky to abdicate control to small farmers. He does not allow vanilla curing by individual farmers but cures the vanilla at his factory to protect the company's image in the export market.

Quality assurance

Table 3.2.7 shows the vanilla quality characteristics that are required by importers, with minimum and maximum values agreed between importers and producers. Colour is an important quality factor, and the two main categories are chocolate brown vanilla (the most common type with 18-22% moisture content that is the most popular for vanilla extractors) and black vanilla, also known as 'Gourmet' vanilla that has very dark, almost black beans with a higher moisture content of 25-35%, which is mostly used in restaurants.

Other grading used in the trade includes Bourbon vanilla (rich, mature aroma, with up to 2.9% vanillin), Mexican vanilla (fine aroma, up to 1.8% vanillin), Tahiti vanilla (sweet, perfume-like aroma, up to 1.5% vanillin) and Indonesian vanilla (strong aroma, up to 2.7% vanillin).

Box 3.2.11. Importers' requirements

Buyers of bulk vanilla in the USA prefer the cured vanilla to be packed in paper-lined cardboard boxes, whereas European buyers prefer vanilla pods to be tied in bundles of 10 -12 capsules per bundle, packed in waxed paper lined cardboard boxes. The owner considers the USA market to be less demanding in terms of quality of packaging materials than the EU market. However, the prices received from EU buyers tend to be higher than those in the USA, reflecting more demanding quality requirements.

Quality characteristics	Minimum or maximum values
Taste and odour	Typical for variety, strong, aromatic
Purity	Free of foreign matter, i.e. sand, stones, shell, parts, insects etc.
Vanillin	min. 2.0%
Ash	max. 7.0%
Hydrochloric acid soluble ash	max. 0.5%
Micro-organisms	
Mould	max. 100,000 cfu/g
Escherichia coli	max. 10,000 cfu/g
Bacillus cereus	max. 10,000 cfu/g
Sulphite reducing Clostridium	max. 10,000 cfu/g
Staphylococcus aureus	max. 100 cfu/g
Salmonella sp.	Not measurable in 20g
Aflatoxin B1	max. 2 Sg/kg
Total aflatoxins B1, B2, G1, G.	max. 4 Sg/kg

Table 3.2.7. Quality characteristics of vanilla (Adapted from De La Cruz Medina et al, 2009)

Box 3.2.12. Quality assurance of vanilla

Vanilla quality is dictated by requirements of different export market buyers, some of which supersede national regulations. Mr. M. says that although the company could shorten the processing time, that could compromise achieving the best quality: "Our traditional methods of vanilla drying make Uganda's vanilla appreciated as a high-quality product in the export market. Rushing the process is equated to lower quality". Traditional curing methods maximise the unique flavour and aroma of the beans, brings out an appearance of white crystals on the cured vanilla beans, considered by many buyers as a sign of high vanillin content.

The company has a quality assurance system that conforms to international certification, with certifiable activities including: an internal control system to address quality issues at farms using trained field-staff who work with contracted farmers to translate export market requirements into practice;

and trained company staff who instruct farmers in handling vanilla during harvest. The company procurement staff only buy mature ripe vanilla pods, free of any foreign matter; they ensure high levels of hygiene during processing, with drying blankets not used for any other purpose. Drying surfaces and boxes are cleaned regularly and there is regular monitoring of both storage pests and the moisture content of the vanilla to prevent mould growth. There is full documentation of all incoming and outgoing lots.

Box 3.2.13. Challenges to quality assurance

Some farmers tend not to care much about the quality of their vanilla pods because they are mixed with other vanilla collected from distant areas that has inconsistent quality. Most farmers complain that the company's internal control system binds them to sell unprocessed vanilla, hence denying them the value-addition activities that would have earned them more money. Some retain green vanilla for curing at their farms and sales on the local market.

During periods of high prices, many traders buy vanilla from farmers, but they do not comply with traceability and quality requirements for organic products and the company refrains from buying vanilla from intermediaries.

When preparing export deliveries, packaging vanilla bundles in boxes that are not properly waxed results in beans absorbing moisture and becoming wet, which causes considerable losses to the company.

A note on natural vs. synthetic vanilla

Vanilla is a popular flavouring for ice creams, beverages, desserts, pastries, dairy products, chocolate and other confectionery products. Natural vanilla has competition from synthetic vanilla (vanillin): although natural vanilla contains several hundred more flavour components than vanillin, the difference in taste is hard to detect in most commercial applications. There was a period when there was an increase in vanillin usage because of the limited availability and extreme price increases of natural vanilla and developments in the technology of vanillin production. However, more recently consumer trends increasingly demand natural products and demand for natural vanilla has showed continuous growth, although this may be slowing because of increasingly price-conscious manufacturers and consumers. The demand for the natural vanilla remains strong in the gourmet market segment of both restaurants and high-income consumers.

Box 3.2.14. Competition from synthetic alternatives

"Whereas the global demand for our natural vanilla has declined due to price volatility, demand for synthetic vanilla has risen because of its suitability as a complete substitute and its price stability."

Natural vanilla extract

Vanilla extract is prepared by crushing the vanilla beans, extracting vanilla with an alcohol/water mixture and separating the residue from the liquid. The proportions of ethanol and water, the extraction time and temperature all affect the quality of the extract. One method involves circulating a 35-50% ethanol in water solution through the beans under vacuum for 48 - 72 hours. This process can produce a four-fold strength extract. Another method consists of pulverising the beans and circulating ethanol through the material under vacuum at ≈45°C for 8-9 days and then removing the excess alcohol by evaporation. This process produces an approximately ten-fold strength extract. Post-extraction processing involves clarification by centrifugation or filtration followed by aging the extract for one year. Commercially, natural vanilla extract is sold as 200g/litre (two-fold), 300g/litre (three-fold) or 400g/litre (four-fold) alcohol extracts.

Box 3.2.15. Adding value to vanilla

Two local enterprises have ventured into industrial value-addition to vanilla and produce vanilla extracts. One enterprise produces liquid vanilla extract in 30% alcohol, packed in 100ml plastic bottles. Mr M. believes that these are the real competitors for vanilla exporters and the extracts have a much higher value.

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3.2.4 Natural food colourants

There is a growing demand for natural food colours to replace synthetic colours, which is largely driven by consumer demand (see also section 2.1). For example, in 1994 the global market for natural food colours was estimated to be $250 million and by 2011 it had reached an estimated $600 million, demonstrating annual growth in excess of 7%. The food industry accounts for a 70% share of the natural food colours market and the use of natural colours in new product launches exceeds the use of synthetic colours by 2:1. European processors in particular have moved towards the use of more natural colours, using them in 85% of new product launches between 2009 and 2011. It is predicted that the trend towards greater use of natural colours will continue, especially within premium food and drink segments and in products positioned for children (Food Product Design, 2013).

There are three groups of food colourants:

- Natural colours extracted from edible plants, which are the focus of this section.
- Nature-identical pigments (e.g. beta-carotene), which are identical to the pigments found in natural products but have been synthesised, usually by a microbiological process.
- Synthetic pigments, which do not occur in nature and are made by chemical synthesis.

Common examples of pigments that are extracted from plants are curcumin (from turmeric), bixin and norbixin (from annatto seeds), hibiscus, betanin, chlorophyll, anthocyanins and carotenes. Paprika (section 3.1.3) is also used as a colourant and the production of paprika oleoresin is described in section 3.2.2. Other food colourants that are not considered in this book include cochineal and carmine (extracted from the cochineal insect) that are mainly produced in Peru, and saffron that is produced in temperature zones from Europe to China and the Americas.

The production of high-grade natural food colourants involves expensive, sophisticated technologies, including solvent extraction, vacuum distillation to remove solvents and ion exchange to separate components. In research for this book, specialist companies that market natural food colours have expressed the opinion that at present most small-scale ACP producers would find it difficult to produce the final products required by the food industry in industrialised countries. This is because of the high capital investment and complex processing required to produce purified and standardised colours that meet the complex raft of international legislation. However, they did point out that semi-processed colours, produced by drying, milling, screening and primary colour separation, could provide opportunities for small-scale processors to enter the market. These products would then be sold to large companies that are able to carry out final extraction, standardisation, testing and marketing. Some natural food colourants that may provide opportunities for ACP producers are shown in Table 3.2.8, followed by a summary of the methods used to process intermediate products.

Legislation related to food colourants is complex and varies in different countries. An ACP company that is considering production of these products should be able to address factors such as purity and contaminants, toxicology and the requirement to produce a standardised colour for buyers. Natural food colourants have a high value, up to $US 90/kg (Fast Colours, 2013a).

Colourant	e-number	Colour	Examples of product applications
Annatto	e160b	Yellow to orange/red	Bixin: margarine, butter, some types of cheeses (e.g., Red Leicester), salad dressings, desserts. Norbixin: soups, confectionery, sauces, ice creams, bakery products, breakfast cereals and snack foods, custard powder, bakery products, and breakfast cereals.
Betanin (red beet powder)	e160b	Red to purple	Confectionery, soups, dairy products, sauces, instant desserts, meat products, soft drinks.
Caramel	e150	Light to dark reddish brown	Beverages, yoghurts, soft drinks, confectionery, ice creams, sauces, soups, bakery products, chocolate products, jellies.
Chlorophyll/ chlorophyllin	e140/ e141	Green	Confectionery, ice cream, jellies, instant foods. soft drinks, soups, yoghurts and pickles.
Paprika	e160c	Pinkish yellow to orange	Sausages and other meat products, snackfoods, sauces.
Sorrel	e163	Red to purple (anthocyanins)	Acidic foods such as drinks and jams.
Turmeric	e100	Yellow to greenish yellow (lighter at higher pH)	Margarine, butter, salad dressing, bakery products, soft drinks, sauces, canned foods, confectionary.

Table 3.2.8. Natural food colourants

Annatto

The annatto tree (*Bixa orellana L.*) produces fruits that are reddish brown when mature and contain numerous dark red seeds that are used to produce the food colouring. The first harvest is obtained 18 months after planting and harvesting occurs over seven months with two peak harvest periods. Seed yields reach a peak when trees are around five to twelve years old and trees can remain productive for up to twenty years (Green, 1995). Individual trees can produce 0.5 - 4 kg of dried seed per year. The pericarp of the seeds contains the pigment bixin, which is oil-soluble. It can be saponified by treatment with alkali to norbixin, which is water-soluble. Higher amounts of norbixin give annatto a yellow colour, whereas a higher proportion of bixin gives it a more orange colour.


Fig 3.2.7. Annatto seeds (Courtesy of Arria Belli)

After harvesting, the seeds are removed, winnowed and dried as quickly as possible to a moisture content of 7 - 10% to prevent mould growth or germination. Care should be taken to avoid abrasion during winnowing and over-drying, both of which would result in a loss of the pigment. Sun drying takes 3 - 10 days or seeds may be dried in hot-air driers at 55-60°C for a few hours. The seeds are then placed in a caustic soda solution (pH = 11) in a stainless steel tank. The pigment dissolves in the solution, which is removed and the extraction is repeated several times. The caustic wash solutions are combined and the pH is then adjusted to ≈3 using sulphuric acid. This causes the pigment to clump into particles and settle out.

Warning: Both caustic soda and sulphuric acid are dangerous chemicals and workers should be properly trained and wear protective clothing, including rubber gloves and eye-protectors, when handling them.

The water is drawn off and the crude paste is filtered using a filter press and washed to remove any traces of acid. The paste is then dried in a forced-air drier at ≈70°C to a moisture content of 20%. It is then milled and returned to the drier until the moisture content falls to 7%. After a second milling the powder is packed in lightproof and moisture-proof tins (Jones, 1991).

3

The main markets for annatto are Japan, the USA and European countries. Japanese importers mainly source annatto seed and extracts from Kenya whereas the USA sources most of its requirements from Peru and the Caribbean region. In Europe, the UK and the Netherlands are the largest importers of annatto seed and extracts, mainly sourced from Peru. Other small-volume ACP producers and exporters include Jamaica, Costa Rica, Côte d'Ivoire and Angola. Reliable prices for extracts are not readily available but as a guide to relative values, if seed costs US$ 1.5/kg, bixin powder has a value of US$ 30/kg (Green, 1995). Annatto seed and extracts are mostly bought directly from producers by buyers from the processing companies and there is little involvement of intermediate brokers or dealers, although some smaller companies make up annatto formulations for onward sales. Some multinational food companies have bought local processing companies and export the extract to their factories.

The specifications for annatto seed extract are shown in Table 3.2.9 and cleanliness requirements are described in Codex, 1995 and ASTA, 2013.

Annatto	Oil soluble (1.5% Bixin)	Water soluble (1.5% Norbixin)
Ingredients	Clear solution of annatto seed extract in edible vegetable oil	Containing a water soluble base
Specific Gravity	0.91 - 0.93	1.0 - 1.02
Colour pigment	1.5 - 2.0%	1.5 - 2.0%
Colour strength	OD at 498 nm = 0.534-0.592 OD at 482 nm = 0.85-0.9	OD at 453 nm = 0.24
Copper	< 1 ppm	< 1 ppm
Arsenic	< 1 ppm	< 1 ppm
Lead	< 1 ppm	< 1 ppm

Table 3.2.9. Specifications for annatto seed extract (Adapted from Kolor Jet, 2013)
Note: OD = optical density (measured using a spectrophotometer).

Quality is also defined by buyers using their company standards. The most important quality criterion is the bixin content, which mostly determines the price paid and this should be at least 2%. Annatto powders or pastes should contain 20-40% nor-bixin pigments.

Betanin

Betanin, obtained from the roots of beetroot (*Beta vulgaris*), is used industrially as a red food colourant to improve the colour and flavour of for example tomato paste, desserts, jams and jellies, ice cream and breakfast cereals. It contains betalains, which are a group of red and yellow pigments, and the colour of betanin depends on which betalains are extracted. A common extraction method involves blanching, followed by a series of grinding processes to produce a paste that is then filter-pressed and either the paste or the expressed liquid is vacuum concentrated to 60-65% solids. Betalains are available in two forms: dried beet powder and beet juice, which can also be spray dried into a powder with maltodextrin added as a carrier to prevent stickiness. The pigment is water soluble and relatively stable to light. Betanin does not change hue as much as anthocyanins in response to differences in the pH of foods and beverages: at pH 4 - 5, it is bluish-red and at higher pH values it becomes blue-violet, and in alkaline conditions it breaks down to a yellow-brown colour. The optimum conditions are between pH 4 and 7. The extract is sensitive to heat, surviving pasteurisation temperatures but not canning when used in high-sugar products. It is also susceptible to oxidation, with colour loss greatest in products that have a high water activity or those containing iron and copper. The use of ascorbic acid may slow down oxidation. The spray-dried form is very stable even in the presence of oxygen. Beet colourants are used successfully with short shelf-life products (e.g. ice cream, cake icings, yoghurt), dry products (e.g. dessert powders, fruit confectionery, gravy powder) and foods that are packaged to reduce exposure to light, oxygen and humidity (e.g. foil pouched soups or health drinks). It is sold on the basis of the betanin content, which can vary from 0.3 - 1% in the liquid and about half this amount in the powder (Nutra, 2013) and the price varies between US$ 2 - 200/kg (Alibaba, 2013).

Caramels

Caramels are made by heating sugar to different extents to produce a range of colours from reddish brown to almost black. They impart both colour and flavour to foods and are perhaps the most widely used food colourant. Concentrated sugar syrup is gently simmered for several hours with constant stirring. The process may be speeded up by the addition of alkalis, such as ammonium and sodium bisulphites or carbonates. The UN Joint Food and Agriculture Organization/World Health Organization Expert Committee on Food Additives (JECFA, 2014) recognises four classes of caramel colour, determined by the chemicals used in their manufacture (Table 3.2.10).

e- number	Description	Restrictions on preparation	Applications
e150a	Plain caramel, caustic caramel, spirit caramel	No ammonium or sulphite compounds can be used	Whisky and other high proof spirits
e150b	Caustic sulphite caramel	In the presence of ammonium compounds but no sulphite compounds can be used	Cognac, sherry, some vinegars
e150c	Ammonia caramel, baker's caramel, confectioner's caramel, beer caramel		Beer, sauces, confectionery
e150d	Sulphite ammonia caramel, acid-proof caramel, soft-drink caramel	In the presence of both sulphite and ammonium compounds	Acidic soft drinks

Table 3.2.10. Types of caramel colourants (JECFA, 2014)

Heating is stopped when the desired colour has been achieved. After cooling the liquid caramel may be stored in sealed plastic or aluminium containers. Commercially, caramels are sold as either liquids or spray-dried powders, a process that requires a considerably higher capital investment. Dried caramel for industrial uses commands a high price (e.g. US$ 405/kg) (Fast Colours, 2013b), and liquid caramels that are sold for domestic baking and sugar confectionery production are also high-value products (e.g. £2.39 for a 25g tube of caramel or the equivalent of $US143/kg) (Rainbow Dust, 2013).

Specification	Caramel powder - double strength	Liquid caramel - double strength	Liquid caramel -single strength	Liquid caramel -Type III beer grade	Liquid caramel - plain, Scotch grade
Colour	Dark brown/ black	Dark brown	Dark brown	Light to dark reddish brown	Light to dark reddish brown
Consistency	Free-flowing powder	Free-flowing liquid	Free-flowing liquid	Free-flowing liquid	Free-flowing liquid

Density/S.G.	0.6-0.7	1.25	1.30	1.30	1.30
Colour strength [1] (at dilution 1:1000)	0.24 at OD 610 nm	0.26 at OD 610 nm	0.15 at OD 610 nm	0.27 at OD 540 nm	0.06 at OD 610 nm
pH	3.4	2.8 - 3.0	2.8 - 3.0	5.0 +/- 0.5	3.3
Solubility[2]	In water	Soluble in 65% alcohol v/v	Soluble in 65% alcohol v/v/	-	Soluble in 80% alcohol v/v
Copper (ppm or mg/kg)	3.9	3.8	3.8	4.0	4.0
Ash (%)	-	2-4	< 6	1.5	1.8
Arsenic (ppm or mg/kg)	-	Nil	Nil	<1	<1
Lead (ppm or mg/kg)	-	Nil	Nil	<1	<1
4 Methyl-imidazole [3] (ppm or mg/kg)	-	175	175	160	Nil

Table 3.2.11. Specifications for different grades of caramel (Adapted from Kolor Jet, 2013 and Sethness Roquette, 2013)

Notes:

S.G. = Specific Gravity

OD = Optical Density

[1] Colour intensity is the absorbance of light by a standardised caramel solution, measured using a spectrophotometer at a wavelength of 610 nanometers (or 560 nm for tinctorial power). The colour tone of caramel is also important: it is defined by the Linner Hue Index, which measures the spectra of red characteristics at different dilutions of the caramel colour using absorbance of light at wavelengths 510 and 610 nm.

[2] The alcohol concentration at which the caramel colour remains stable, which is important to distilleries and alcoholic beverage manufacturers.

[3] The presence of 4-Methylimidazole is a potential carcinogen and consuming 30 µg per day corresponds to a 1:100,000 risk of developing cancer. In caramel colourants it is allowed at up to 250 mg/kg (ppm) for every 0.1 units of colour absorbance of a 0.1% solution at 610nm.

Other tests on caramel include 1) a phosphoric acid test to ensure its stability in carbonated beverage concentrates where it is combined with phosphoric acid; 2) acid and/or neutral tannin tests, which relate to the compatibility of the caramel colour with the naturally occurring tannins in various flavour extracts.

Chlorophyll

Chlorophyll is the green pigment found in all plants that are capable of photosynthesis. Commercial materials that are used as sources of the pigment include grasses (e.g. fescue and alfalfa (lucerne)), spinach and nettles. The pigment is oil-soluble but is unstable to heat and changes in pH. It is therefore more commonly used as the water-soluble copper chlorophyllin pigment that is produced by alkaline hydrolysis of chlorophyll. The resulting pigment has a brighter green colour and is stable to light, acids and heat. It can be produced with range of shades from yellowish green to bluish green and is available as a liquid or powder. Copper chlorophyllin is permitted as a food colourant in the EU but its food use in the USA is limited to dried citrus beverages.
Note: copper chlorophyllin may also have anti-carcinogenic and antioxidant activities, although its mechanisms of action are not yet understood (Tumolo and Lanfer-Marquez, 2012). Chlorophyll and copper chlorophyllin are also sold as health foods in the form of liquid extracts for $35-40/litre or as tablets.

Paprika

In addition to its use as a spice and oleoresin, paprika (the dried and ground pods of sweet pepper (*Capsicum annum*) may be used as a yellow/orange food colourant. Paprika colour compounds can also be solvent-extracted to produce paprika oleoresin (section 3.2.2). The pigments found in paprika and its oleoresin are carotenoids, which are stable to heat but sensitive to light and alkaline conditions. The pigments are insoluble in water but colouring manufacturers emulsify them so that they can be used in both aqueous and lipid products. The oil soluble form of paprika oleoresin is commonly used for colouring. Prices for paprika are given in Table 3.1.10.

Sorrel (or Hibiscus)

Hibiscus (*Hibiscus subdariffa* L.) or sorrel or roselle, is widely cultivated throughout the tropics and subtropics and has 'flowers' that are red fleshy calyces that surrounded the seed pods, which contain a red anthocyanin pigment (see Fig. 3.1.5).

Fig. 3.2.8. Hibiscus powder from Burkina Faso (Courtesy of Sheabutter Cottage)

The calyces are removed in the field and rapidly transported for drying. They should not be sun-dried as this results in colour loss, but after thorough washing they should be dried at 60°C in a forced-air cabinet drier to a final moisture content below 8%. The dried sorrel is then milled to a powder to reduce its volume and shipping costs. The powder is hygroscopic and must be protected from moisture pick-up using hermetically-sealed tins. Roselle extract is rich in bright red anthocyanins, and as with anthocyanins from other sources, their colour stability depends on the pH, water activity and temperature of the food and the presence of oxygen and light. They also interact with other food components such as acids, sugars, metal ions and sulphur dioxide. Selim et al, undated, found that extracting the pigment using ethanol acidified with hydrochloric acid (ratio 85:15) had the greatest extraction efficiency and that extracts were most stable at low pH values (pH 1.5 - 3). They also report experiments to encapsulate the pigment to increase its stability.

Powdered calyces used as food colourings are exported to the USA and Europe, with Germany being the main importer. In the USA, the dried calyces are labelled 'Rosa' or 'Flor de Jamaica' in health food stores, and are used for making sorrel tea. Hibiscus powder is also sold via internet suppliers at $60-78/kg (Sheabutter Cottage, 2013; Simpli Special, 2013) and in the UK the calyces and ready-made sorrel syrup are available in Caribbean and Asian grocery stores. Flowers or syrup can also be found in markets in places where there are African, especially Senegalese, immigrant communities. In East Africa, a calyx infusion named 'Sudan tea' is used to relieve coughs. In Mali, Senegal, The Gambia, Burkina Faso and Benin, calyces are used to prepare cold, sweet drinks that are popular at social events, often mixed with mint leaves or fruit flavours, and in the Sahel region, roselle is used to make a sugary herbal tea that is sold on the street. On most Caribbean islands, sorrel tea is made from the 'Flower of Jamaica' plant and in Jamaica itself additional flavour is added

Fig. 3.2.9. Sorrel shandy (From Carib Brewery)

by brewing the tea with ginger and rum, or cinnamon, cloves and bay leaves in Trinidad and Tobago. There is also sorrel chutney and the Carib Brewery Trinidad Ltd. in Trinidad and Tobago produces a Sorrel Shandy (Fig 3.2.9) in which the tea is combined with beer (Carib Brewery, 2013).

Turmeric

Turmeric (*Curcuma longa*) is a perennial herbaceous plant that produces tubers bearing many rhizomes or 'fingers' that contain an aromatic yellow to orange-red pigment, curcumin, which is widely used in food products for both its colour and flavour characteristics. The colour is lemon yellow in acidic products to orange in alkaline products. The main producing area is India (82%) followed by China (8%), Myanmar (4%), Nigeria (3%) and Bangladesh (3%) (APEDA, 2013).

The rhizomes are either sun-dried for 10-15 days or dried in forced-air driers at 60-70°C to a final moisture content of 5%. The roots may be boiled in water for several hours which improves drying rates, but this also results in a loss of pigment. The dried rhizomes are mechanically 'polished' to remove the outer fibrous skin and then milled to a fine powder that will pass through a 300-micron sieve.

Fig 3.2.10. Dried turmeric rhizomes (Courtesy of Badagnani)

The pigment content is 2 - 7% and the rhizomes also contain a volatile oil; high quality turmeric has an equal ratio of oil to pigment (Green, 1995). Turmeric oleoresin is produced by solvent extraction (section 3.2.2). Food manufacturers use the oleoresin to a greater extent than the powdered spice. The volatile oil content can be reduced in processing the oleoresin and this reduces the aroma in applications where the colourant is required. Applications of the oleoresin and curcumin include sugar confectionery, ice cream, drinks and pickles.

Turmeric also has medicinal properties including anti-inflammatory, antiseptic and antibacterial properties; it has been shown to prevent or stop the growth of certain cancers and it has long been used in Chinese medicine as a treatment for depression. Turmeric powder and capsules retail for $35/kg (Naturesbest, 2013) compared to $0.78/kg for bulk-traded turmeric (Commodity Online, 2013). Quality and sanitation specifications for turmeric powder are designated in standards set by the European Spice Association (ESA) and the American Spice Trade Association (ASTA) and reported by APEDA, 2013.

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3.2.5 Aloe-vera

Aloe vera leaves (Fig. 3.2.11) are harvested during the rainy season when they are full of sap with harvests of four leaves at most from each plant taken three or four times per year. The leaves have three parts: 1) green peel, which is used to make aloe tea and vitamin supplements (in some communities in the Karamoja region of Uganda it is traditionally used for treatment of malaria and as rat poison); 2) a bitter yellow sap that has a pharmaceutical properties and is used for treatment of diabetes, high blood pressure and symptoms associated with AIDS; and 3) the white aloe gel, which is used in health supplements and cosmetic skincare products.

Fig. 3.2.11. Aloe-vera plant (Courtesy of Erin Silversmith)

Leaves are cut from the plant and placed in V-shaped plastic containers with the cut end downwards to allow the yellow sap to flow out and be collected. The collected sap is boiled to evaporate the water for around seven hours and impurities are removed as boiling continues. The thickened juice is poured into large pans and allowed to harden to a gum. The aloe gum is then cut into chunks and sold to local pharmaceutical companies.

Only hand-filleting the leaf can cleanly separate the gel from the rind and workers use sharp knives to remove the sharp spines located along the leaf margins. This is done on a very clean metal (aluminium or preferably stainless steel) table to remove the top rind, avoiding contamination of the fillet with yellow sap. The filleted gel is washed and then pulped in a blender. The gel is stabilised by pasteurisation at 70-80°C before packing it in plastic drums for export.

Box 3.2.16. Quality certification

Our aloe-vera is certified and meets the standards required by the National Bureau of Standards. It is organic by default and the company has certification from the International Aloe Science Council after an audit of the farmers' out-grower scheme and processing facilities. The certificate is only awarded to aloe-vera products made from specific species (mainly *A. barbadensis*) and must be produced by sustainable practices that do not harm the environment. The company's products are the first Ugandan aloe-vera products to receive a certificate. This authorises their sale in the USA, Europe and China who are the major consumers.

Mr S. reports that all trade in aloe vera fillets and yellow sap that is harvested from the wild is subjected to regulations of the Convention of International Trade in Endangered Species (CITES). Permits and phytosanitary certificates are also required for export of aloe vera products or its derivatives. Even though his products are commercially grown and not harvested from the wild, exporting to EU countries without CITES certification is difficult. Additionally, in Uganda the competent authority for aloe products and CITES certification must provide proof of a sustainable source. His is one of the few companies in Uganda that fully complies with CITES regulations.

Box 3.2.17. Control of raw material quality

The company employs four permanent field staff who inspect farms and provide advisory services in agronomics and post-harvest handling and processing. This ensures that good cultivation and post-harvest practices are followed.

Traditionally, aloe-vera has been used in ACP countries for treatment of stomach illnesses, malaria, headaches, burns and cuts, and in poultry for the treatment of Newcastle and coccodiosis diseases. In recent years there has been a proliferation of processed aloe-vera products, from health foods, such as aloe-vera juice to medicinal and cosmetic products that contain aloe-vera (see for example Forever Living Products, 2013).

Box 3.2.18. Aloe-vera products

The company's product mix includes sweetened aloe-vera juice, pure gel, aloe-vera syrup, fresh aloe-vera leaves and frozen fillets of aloe-vera. The company sells juice drinks and syrup on the local market and exports fresh leaves and frozen fillet pulp to Kenya, Europe and the USA. A small amount of gel is sold to local cosmetic manufacturers who process it into creams, lotions, shampoos and facial cleaners. However, export market prices are attractive and unprocessed aloe-vera constitutes about 95% of total sales value. The major importer is the USA.

The local demand for aloe-vera drinks is lower than aloe-vera based cosmetic products due to unacceptable or unfamiliar colours and low quality products made by farmers with inadequate packaging, hygiene and proper labelling. Also these products are marketed as healthy drinks rather than as products that quench thirst and consumers categorise aloe-based drinks as pharmaceutical products that are consumed according to medical prescriptions.

Mr S. estimates global trade in aloe-vera to be about $200 million. He says that of the 200 types of aloe species worldwide about 15 are endemic to Uganda. The climatic conditions are ideal for growing it but only two species are exploited commercially by local farmers. He believes that Uganda's potential has only been utilised by less than 1% because farmers face problems with processing and accessing markets and there is no industrial processing facility in the country. As a result his company is not in a position to handle the demand for both domestic and international markets.

The bulk of products on the local market are imported cosmetics such as shampoos, soap, gels, creams, lotions and healthcare products, as well as aloe-vera juice. Imported products are mainly from China, South Africa and the Middle East. In the export market, Mr S. concedes that Uganda is still insignificant despite the high potential and the export market is dominated by China and India.

Fig 3.2.12. Aloe-vera producers' logo (From Michael Lubowa)

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3.3 Coffee, cocoa and chocolate

For most small-scale processors in ACP countries, there are opportunities to roast coffee beans for local up-market outlets, especially hotels, cafés and restaurants that cater for higher income local consumers and tourists (see Box 3.3.1). These are also likely to be the main markets for gourmet chocolates, rather than mass-produced chocolates for retail sales, which have a much lower value. There are also international markets for part-processed 'green' coffee beans, especially via fair trade buyers. Markets for cocoa are most often chocolate manufacturers - either local or international. An outline of the production, markets, processing and quality standards is given in this section.

3.3.1 Coffee

The international trade in coffee has attracted attention from development agencies and fair trade organisations, partly because of the collapse of the International Coffee Agreement in the 1980s and the fall in world prices during the 1990s. They have criticised the role of multinational manufacturers and coffee retailers for 'inequitable' margins offered to producers. As a result, fair traded coffee is important in the international market (see also Borzoni and Poole, 2011, and Haggar et al, 2012 for further information on coffee production and trade). In coffee-producing countries, there are well-established routes to international markets via traders, exporters and direct sales to individual processing companies.

The most commercially important coffee trees are *Rubiaceae coffea* and examples of important varieties are Arabica, Robusta, Canephora and Liberica. The main producing and exporting countries are shown in Table 3.3.1.

Country	Production in 2011(MT)	Country	Exports in 2010 (MT)
Brazil	2,700,440	Brazil	1,791,064
Vietnam	1,167,900	Vietnam	1,217,868
Indonesia	634,000	Indonesia	432,781
Colombia	468,120	Colombia	410,493
Ethiopia	**370,569**	Germany	328,464
Peru	313,647	Guatemala	235,410
India	302,000	Peru	229,654
Honduras	282,361	Honduras	214,967
Guatemala	242,839	Belgium	214,298
Mexico	237,056	**Ethiopia**	**211,840**
Uganda	**191,371**	India	177,926
Nicaragua	103,664	**Uganda**	**151,715**
Côte d'Ivoire	**102,523**	Mexico	102,601
Costa Rica	99,909	Nicaragua	101,901
Philippines	88,526	**Côte d'Ivoire**	**96,446**
El Salvador	82,095	Costa Rica	74,218
Cameroon	**70,000**	El Salvador	64,425
Venezuela	69,138	Papua New Guinea	58,810
Tanzania	**60,575**	**Cameroon**	**47,942**
Madagascar	**52,813**	**Kenya**	**43,135**

Table 3.3.1. Twenty largest green (unprocessed) coffee producing and exporting countries (FAOSTAT, 2013) (ACP countries highlighted)

Notes on Table 3.3.1:
The largest producing countries are also the largest exporters, with the exception of Germany and Belgium, which import green beans and re-export them. In ACP countries, Uganda, Côte d'Ivoire and Cameroon export nearly all of their production (80%, 94% and 68% respectively), whereas Ethiopia and Madagascar have strong national markets (57% and 15% exported respectively) and Kenya produces 36,260 MT but exports 43,135 MT, suggesting that coffee from neighbouring countries is routed through Kenya.

The African Fine Coffees Association is a regional non-profit, membership association that represents coffee sectors in 11 member countries, Burundi, DR Congo, Ethiopia, Kenya, Malawi, Rwanda, South Africa, Tanzania, Uganda, Zambia and Zimbabwe (AFCA, 2013).

Markets for coffee beans

The largest importers of green coffee in 2010 were the USA (1.2 million MT) and Germany (1.1 million MT), followed by Italy, Japan, Belgium, Spain and France (each 0.25 to 0.5 million MT). However, trade in roasted coffee beans is much smaller, with exports of roasted coffee being miniscule in comparison to production of green coffee: the largest exporting countries in 2010 were Bahrain (23 MT), Venezuela (20 MT), Trinidad and Tobago (18 MT), Chile (17 MT), Ethiopia (12 MT) and Senegal (10 MT). The largest importers are France, Canada, USA, Germany and Netherlands, each importing more than 50,000 MT (FAOSTAT, 2013).

For small-scale processors who wish to enter the coffee market, the first consideration is to be able to access secure and reliable sources high-quality beans of the varieties that are in demand. If blended beans are used to make ground coffee, the blend of different beans and the processing conditions should be standardised to make a consistently uniform product. Exports of green coffee beans face competition from existing producers and export of roasted coffee beans requires sophisticated and relatively expensive packaging to protect the odour and flavour during distribution. Also there are relatively few commercial buyers of roasted coffee as most companies prefer to roast and pack beans in the importing country. Options for small-scale processors, in addition to local markets for roasted coffee beans, therefore include fair trade companies and organisations (section 2.4), which may offer improved prices and/or better trading terms than other commercial buyers, but require environmental and social standards, in addition to quality standards, which may place additional costs on producers (see Box 2.7, Starbucks, 2013 and Haggar et al, 2012 for further information).

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Box 3.3.1. Markets for coffee

Many hotels, cafés and restaurants buy raw coffee beans and roast and grind them, whereas others prefer to outsource processing. Her roasted, ground coffee is sold to hotels, cafés, restaurants and supermarkets. A basic requirement to be in the market is to keep the same taste and quality consistently. For new customers, she provides free samples and gets their feedback, which almost always results in an order. The company is not yet exporting the product and first aims to supply the local demand and then expand after building the capacity that is required for export markets.

Fast-growing markets are single variety speciality coffees and flavoured coffees (e.g. chocolate- or cinnamon-flavoured coffee). Examples of high-value flavoured coffees that are becoming popular in Western markets are shown in Table 3.3.2.

Product	Sale price	Value ($/kg)
Rwanda Maraba Bourbon - single origin coffee with flavour of red apple, white grape, candied orange and complex floral aromatics	£5.35/250g	32.10
Tarrazu (from Costa Rica). Sweet fruit undertones of mandarin, banana and watermelon	£7.50/250g	45.00
Sweet blueberry with orange citrus acidity. Flavour of orange, laced with red wine	£8.65/250g	51.90
Gourmet flavoured coffees (e.g. Blueberry Cobbler, Cinnamon Hazelnut, Hawaiian Macadamia Nut)	£8.35/312g	40.14
100% Organic Guatemala Maya Lake Coffee (Grown by villagers high above the shores of beautiful Lake Atitlan. Complex flavours with high grown acidity)	$10.59/0.75 lbs	31.20

100% Organic Nicaraguan Coffee (well-balanced and full-bodied with lively overtones, this unique coffee is grown exclusively on small, single-farm estates)	$10.59/0.75 lbs	31.20
Dean & DeLuca Mocha and Java Blend Coffee	$14\12.00 oz	41.30

Table 3.3.2. Examples of retail prices for high-value coffee products (From Union, 2013a; Glenfinlas Coffee, 2013; Gourmet Coffee, 2013; Dean and DeLuca, 2013)

Notes: Retail prices at May 2013. Currency conversions: £1 = $1.5.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers. For comparison, supermarket ground coffee is $18-24/kg.

Box 3.3.2. Single variety high-value coffee from Rwanda

Although Rwanda has grown coffee commercially since the early 1900's, it was not noted for producing beans of gourmet quality until an initiative by the USAID-funded PEARL project (now named SPREAD) in 2001. The coffee roasting company, Union, was an early partner with the producer cooperative, Abahuzamugambi Ba Kawa, developing a commercial relationship and bringing their coffee, 'Rwanda Maraba Bourbon', to the attention of the specialty coffee market. It is the first single-origin Rwandan coffee and the first Fairtrade produce from Rwanda. Rwanda Maraba Bourbon has been widely cited as the instrument of transformational change and Rwanda has become the 'new darling' for connoisseurs of speciality coffee. The beans are 100% Bourbon cultivars, which because of its lower yield, is a variety that is not widely produced commercially for the global coffee market. However, Bourbon is highly regarded for the sweet fruity flavour and rich silky body of the coffee.

The cooperative comprises 1200 farmers, and with family members, means around 6000 people benefit from coffee bean sales. The first washing station was set up in 2002 and the fourth was completed in 2007. These have enabled farmers to process fresh coffee cherries within a few hours of picking, which maintains their quality. The cherry processing station at Sovu has consistently produced coffee that has achieved 'Cup of Excellence' finalist awards. Support to farmers includes forward financing to ensure that cash is available to purchase essential supplies that directly affect coffee quality. The cooperative has purchased trucks to collect and deliver coffee cherries to washing stations, installed groundwater treatment facilities to ensure no contamination of the environment and constructed additional coffee washing stations to increase capacity and hence income. The project also includes capacity building and strengthening governance and leadership within the cooperative. The combined efforts have transformed the local district, building a clinic and bank, twice-weekly farmers markets, primary and secondary schooling, and the opening of six hairdressers and other ancillary shops and services. These have created a genuine sense of community where before there was only grinding poverty and despair (Union, 2013b).

Box 3.3.3. Sourcing high-value coffee

Union Hand Roasted Coffee is a speciality coffee roaster and retailer that buys green beans and processes them at its artisan roasting plant in London to produce fresh-roasted coffee. To achieve high quality coffee beans from its suppliers the company supports sustainable livelihoods of smallholder coffee farmers by engaging directly with them to develop long-term relationships and encourage them to improve their product quality. It also negotiates guaranteed sustainable prices, using a transparent price model, to recognise the value of the crop that they produce. The price is paid directly to farmers, independent of other supply chain costs. The company also assesses labour standards and living conditions for farm workers and agrees approaches for corrective actions where appropriate. It buys coffee either directly from producers or from specialised exporters, using a 'Direct Contact Trade Model'. This specifies:
Quality first, with scores greater than 84+ Q Grader Cupping Scale.
Verified prices at the farm-gate that are >25% above International Fair Trade (FLO) certified minimum price.
A quality price incentive, from $0.20/lb, 88+ Q Grader Scale.
Producers committed to a code of conduct on labour standards and sustainable environmental practices.
Visits to producers every 1 -2 years to monitor quality and discuss business goals.

The Direct Contact Trade Model was developed out of frustration at the failure to differentiate quality within the Fair Trade market, the unfairness of concessions made to large businesses using the Fairtrade logo, the cost burden of Fairtrade certification on small-scale farmers, and the marketing sales levy fees paid by the company that it believes could be more effectively targeted to farmers. The approach pays sustainable prices that meet the cost of production and allow for investment. The company establishes a link between cup quality and coffee value by paying an additional incentive premium to motivate farmers to improve their coffee quality, and escape the control of commodity markets by producing coffee with an intrinsically high value. The company also sets minimum purchasing commitments so that farmers can plan for the next harvest and it supports forward finance for smallholders who are most in need, either directly or by cooperating with specialised pre-finance agencies. (Further information at Union, 2013b)

It is apparent from the case studies in Boxes 3.3.1 to 3.3.3 and prices in Table 3.3.2 that, for small-scale coffee processors, the highest added-value comes from speciality or gourmet coffee beans, and the value can be further increased if the coffee is organic and Fair Trade.

Processing

The micro-climate in which coffee trees grow, the soil type, elevation, amount of sunshine or shade, rainfall and coffee varieties all contribute to the distinctive flavours and aromas of individual coffees. Coffee trees bear fruit after 3 - 4 years and the 'cherries' turn bright red when ripe. They are picked by hand, either by strip-picking in which all of the cherries are harvested at one time; or selectively picking ripe cherries every 8 - 10 days. Selective picking is more labour-intensive and expensive and is used mostly for high-value beans. An experienced picker can collect 45-90 kg of cherries per day, which produces 10 - 20 kg of coffee beans.

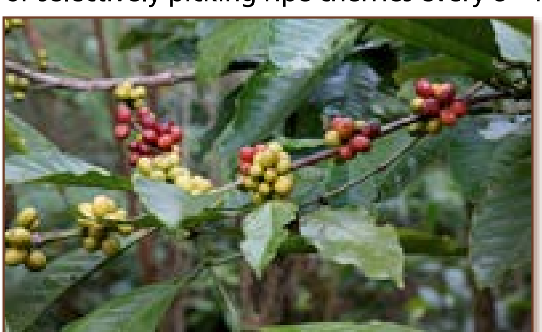

Fig. 3.3.1. Coffee cherries (Courtesy of Jmhullot)

The first stage in processing is to separate over-ripe and underdeveloped cherries, twigs and leaves, which all float in water, from ripe cherries and green cherries that sink. At a small scale, the berries are either piled, loaded into wooden crates or placed in large, water-filled fermentation tanks for 12 - 36 hours. This allows the pulp to undergo a natural fermentation by lactic acid bacteria, which increases the acidity of the pulp and contributes to the aroma, flavour and colour of the final product. The relative proportions of each type of bacteria, the fermentation time and temperature, each affect the final flavour and colour of the beans. This, together with the different varieties of coffee, gives rise to the very wide range of different coffees that are produced.

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Fig. 3.3.2. Coffee pulper (Courtesy of Takeaway)

At larger scales of operation, the beans are extracted from the cherries using a pulping machine, which also separates under-ripe green cherries from ripe cherries. Mechanically de-pulping and fermenting, or mechanically removing the mucilage from de-pulped coffee, is known as 'wet milling'.

The beans are sorted by density using water, with denser ripe beans sinking, and they are then passed through a series of rotating drum screens to sort them by size. These beans are referred to as 'parchment coffee' because they are still encased inside the parchment (the seed coat or testa). The parchment coffee is then either dried in the sun, in a mechanical dryer, or a combination of the two. In some cases, the drying stage takes place after dry milling, in which parchment coffee is hulled to remove the seed coat. Fair trade buyers may assess both dry- and wet-milling processes for best practices in water conservation, waste management and energy consumption. In more mechanised operations, the beans are first dried from ≈60% moisture to 15%

moisture in the sun (Fig. 3.3.3) and then for six hours at 40°C in rotary drum driers to 11-12%. In areas of high humidity, the entire drying process must take place in mechanical dryers at a maximum temperature of 45°C (at higher temperatures the germ is killed and the flavour potential of the coffee is lost).

Fig. 3.3.3. Sun drying coffee beans (Courtesy of Dirk van der Made)

The beans are precisely sorted by size and weight and evaluated for colour flaws or other imperfections such as insect damage or incompletely hulled beans. Defective beans are removed by hand as they pass on conveyor belts. This produces 'green coffee' that is the usual form in which coffee beans are shipped for export or transported to final processors. Roasting transforms green coffee into aromatic brown beans. Most roasting machines operate at 180-240°C and roast the beans for 8 - 15 minutes, depending on the degree of roast required, constantly moving the beans to prevent them burning. When the internal temperature of beans reaches ≈204°C, a series of chemical changes takes place, together with the release of 'caffeol' (or coffee oil) that produce the flavour and aroma of roasted coffee. In industrial processing, roasting is automatically controlled, but in smaller operations it depends on the judgement of the individual operator and is partly an art, partly science; if there is too much heat, the beans become too dark and caffeol is burned; not enough heat and insufficient caffeol is released.

For ground coffee, the grinding conditions should produce the highest amount of flavour, which also depends on the method used to brew the coffee: the finer the grind the more quickly the coffee should be prepared. For example, coffee ground for espresso machines is finer than coffee brewed in a drip system. The flavour of roasted beans and especially ground coffee can be damaged by moisture, light and oxygen. These products should therefore be packed in high-barrier laminated or co-extruded plastic packaging.

Fig.3.3.4. Coffee pack (Courtesy of Yeshiwas Ademe)

Quality standards

There are two aspects to the quality of green coffee beans:

1) Safety considerations, such as Maximum Residue Limits (MRLs) for pesticide residues and contamination with Ochratoxin A (a type of mycotoxin) standards, which are described by Codex, 2007 and Codex, 2009.

2) Organoleptic quality, which is decided by tasters (or cuppers) who work for the buyers. Aspects that are considered include for example: consistent bean size above a specified screen size, uniform green colour, no black, brown or mouldy beans, moisture content below 14%, no insect-damaged or broken beans, pods or other foreign matter. The cup flavour quality identifies defects such as 'ferment, faded, astringent, fruity, oniony, phenol, medicinal, musty and dirty' flavours (Starbucks, 2013) that result in a coffee being rejected.

Cupping

Buyer's agents test the coffee for quality and taste by 'cupping', which involves a taster (or 'cupper') first evaluating the beans for their overall appearance. A sample of beans is then test-roasted, ground and infused in boiling water at a carefully controlled temperature. The cupper smells the brew for its aroma and then tastes the coffee. Coffees are assessed to determine both their characteristics and the blends of different beans needed to achieve a consistent final product. An expert cupper can taste subtle differences between hundreds of samples of coffee each day. The 'Q Coffee System' (CQI, 2013) is a common language between buyers and sellers that draws attention to more specialty coffees and creates an infrastructure that gives producers greater opportunities to enter the marketplace and to increase their economic viability. A coffee that is verified as a Q Coffee™ has independently confirmed speciality quality. Green coffee samples are submitted to licensed Q Graders (professionally accredited cuppers) who score the coffee and if it meets the standards, issue a Q Certificate. If a coffee does not meet specialty standards, they give a technical report that explains why. A coffee that receives a score of 80 or above is considered a specialty coffee.

3.3.2. Cocoa

Cocoa trees (*Theobroma cacao*) rarely exceed 7.5 metres high and grow best in the shade of larger trees. They are either planted with coconut, plantains or bananas, or in clearings made between established tropical rainforest trees. They are native to Central and South America but are widely cultivated in plantations in West Africa and Indonesia (Table 3.3.3).

Country	Production (MT)
Côte d Ivoire	**1,350,320**
Indonesia	712,200
Ghana	**700,000**
Nigeria	**400,000**
Cameroon	**272,000**
Brazil	248,524
Ecuador	224,163
Togo	**100,000**
Peru	56,500
Dominican Republic	54,279
Colombia	44,241
Papua New Guinea	**39,400**

Table 3.3.3. Main cocoa producing countries in 2011 (FAOSTAT, 2013) (ACP countries are highlighted)

There are three varieties of cocoa: 'Forastero' produces beans having the strongest flavour and is widely grown in West Africa; 'Criollo' produces beans that have a mild chocolate flavour and are grown mostly in Indonesia, Central and South America but not widely in ACP countries; and 'Trinitario' are cultivated hybrids of the other two types and are grown mainly in the Caribbean, but also in Cameroon and Papua New Guinea. Overall, Forastero and Trinitario are the most important in ACP countries.

Cocoa is an important export crop for ACP countries, with six of the largest twelve producing countries in the ACP grouping and five of these in West Africa (Table 3.3.4).

Country	Cocoa beans (MT)	Country	Cocoa butter (MT)	Country	Cocoa powder /cake (MT)	Country	Cocoa paste (MT)	Country	Cocoa husk/shell (MT)
Netherlands	686,057	USA	102,878	USA	172,904	Germany	94,860	France	17,506
USA	402,061	Germany	88,713	Spain	56,068	Netherlands	60,067	Netherlands	12,434
Germany	341,273	Netherlands	70,529	Germany	54,056	France	59,205	Belgium	11,336
Malaysia	319,441	Belgium	65,336	France	53,861	Belgium	41,039	Poland	10,424
Belgium	160,235	France	57,639	Netherlands	45,047	Poland	31,154	UK	9,993
France	137,065	UK	50,639	Russia1	43,620	Russia[1]	31,042	Spain	Spain
Singapore	93,445	Switzerland	26,462	Canada	26,795	USA	29,709	Malaysia	4,574
Spain	91,954	Russia1	25,021	Italy	26,161	Canada	13,856	Indonesia	2,382
UK	89,364	Poland	22,678	Poland	23,665	Ukraine	13,168	Philippines	1,997
Italy	81,902	Italy	22,439	Belgium	20,820	Italy	12,478	Italy	1,634
Turkey	68,217	Canada	20,885	Malaysia	20,135	UK	10,073	Bulgaria	1,402
Russia1	54,350	Japan	19,365	Australia	20,130	Singapore	9,897	Slovakia	1,208
Total	2,525,364		572,584		563,262		406,548		79,764

Table 3.3.4. Main importing countries for cocoa products in 2010. (FAOSTAT, 2013)

[1] Russian Federation

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The table shows that imports of whole cocoa beans are 2.5 times greater than the components (cocoa butter and cocoa powder), indicating that most processing and added value takes place in the importing countries. The Netherlands is by far the largest importer of cocoa beans, importing twice the tonnage of other European countries. The USA imports cocoa products from South American producers, whereas European imports are from West Africa. For ACP producers, the EU and other East European countries are therefore the main target markets. As with other long-standing exported crops, sales of cocoa beans take place to well-established export agents or they are sold to directly to international buyers, in this case from chocolate processors. It is therefore likely to be difficult for new cocoa processors to enter the market and compete with the well-established trade, but as with coffee, there are new opportunities for organic and fair-traded cocoa and chocolate products. Perhaps the greatest added value to cocoa for small-scale processors can be obtained by making high-value chocolate products for local markets or regional export (section 3.3.3).

Fig. 3.3.5. Cocoa pods ripening on the tree (Courtesy of Mediacaster)

Processing

Cocoa trees produce fruit after three to four years, with 20-30 pods per year in two harvests. The pods grow out of the trunk and main branches and each ripe golden-orange pod contains 20-40 purple, 2cm long cocoa beans covered in a sweet white pulp.

Harvesting cocoa pods is labour-intensive because individual ripe pods are cut from the trees every few weeks during the harvest season. Each pod is split open using a machete to release the beans. Processing the beans produces cocoa powder and cocoa butter and involves seven stages as follows:

1) Fermentation. The beans are allowed to undergo a series of natural fermentations in which bacteria first liquefy the surrounding pulp, followed by lactic acid bacteria (including *Leuconostoc mesentroides, Lactobacillus brevis* and *L. plantarum*) that increase the acidity of the pulp and contribute to the aroma, flavour and colour of the final product. Fermentation methods vary, but the two basic methods use heaps or 'sweating boxes'. In West Africa, heaps of wet cocoa beans are left for 5-6 days, with regular mixing to ensure an even fermentation. In West Indian plantations, strong wooden boxes with drainage holes or slats in the base are used. The process takes 6-8 days, during which time the beans are mixed twice. Well-fermented cocoa beans should have a purple/blue colour when cut in half (known as the cut test).
2) Drying. After fermentation, the beans are usually sun-dried on mats. These 'cured' beans are packed into sacks for transport to processors or for export. Each batch of beans is assessed and an optimal blend of beans is prepared so that variations in their quality characteristics can be evened out before the beans are further processed. Alternatively, specific batches of the same beans are processed and a blend is made from the resulting cocoa liquor (below).
3) Cracking. At the processing factory, the beans are sorted, sieved to remove extraneous material and cracked to loosen the shells and obtain broken kernels (or 'nibs') - the small pieces of cocoa bean used to make chocolate. The nibs are sieved into a number of fractions for optimal separation during winnowing to remove the broken shell and strong magnets remove any iron contaminants.
4) Roasting. After sterilisation, the nibs can be roasted directly or first 'alkalised' (the 'Dutching process') by mixing them with a solution of potassium or sodium carbonate to modify the flavour and colour of the cocoa powder or cocoa liquor. The nibs are roasted in ovens at 105-120°C. This reduces the moisture content, develops the brown colour and further develops the characteristic chocolate flavour and aroma from flavour precursors that were formed during fermentation. There are a number of different types of small roasting machines: for example one design consists of a revolving shallow circular tray that contains the beans, heated directly or by hot air blown through a perforated base. A second design is a rotary roaster that comprises a steel drum fitted with internal flights and either

rotated over a fire or hot air from gas burners is blown into the drum. Beans are lifted by the flights and roasted as they fall through the hot air.

5) Grinding. The roasted nibs are then ground to release the cocoa butter using a sequence of stone mills. This produces a thick chocolate-coloured liquid, known as cocoa 'mass' or cocoa 'liquor', that solidifies on cooling. It contains 53-58% cocoa butter and suspended cocoa particles. Cocoa liquor is the basis of all chocolate and cocoa products and is stored for further processing or for shipping to chocolate manufacturers. Cocoa liquor has a value that is five times that of cocoa beans.
6) Extraction. The cocoa mass is pressed in hydraulic presses to separate cocoa butter and cocoa presscake. Control over the extraction conditions produces presscake with the required proportion of fat, which can vary from 10-24%. The cocoa butter is filtered and stored in tanks, or if required, it may be deodorized.
7) Milling. The presscake is broken into small pieces ('kibbled presscake') and ground to particles having defined levels of fineness for different applications. Different batches may be blended before grinding to obtain the desired type of cocoa powder. After milling, it is cooled to ensure that the fat remaining in the cocoa powder crystallises into its stable form.

Cocoa powder is used to make chocolate, in bakery products, drinking chocolate and in cooking. The value of cocoa butter and cocoa powder at this stage is ten times the value of cocoa beans.

Quality standards

Cocoa trade associations and national authorities produce standards for cocoa beans covering the size distribution of beans (bean count per 100g), the percentage of permitted faults such as mould, insect damage or foreign matter, absence of off-flavours, a moisture content of 7.5% and a limit on the free fatty acids in the beans (FCC, 2007). The International Standards Organization provides a specification for cocoa beans (ISO, 2013) and a method to measure their moisture content (ISO, 1980). The 'cut test' is used to assess the quality of cocoa beans, which involves cutting 300 beans lengthwise through the middle and examining them. The number of beans that are defective in terms of, for example, mould, insect damage or germination are counted and expressed as a percentage of the total. Bean counts are used as a measure of average bean size, and although there is no internationally accepted bean size classification, the method used by the Federation of Cocoa Commerce (FCC, 2007) involves counting the number of beans in a sample of 600g.

It is difficult to achieve consistency in the quality of cocoa mass when using one source of cocoa beans because of their natural variability, and different types and batches of beans are therefore blended. There is strict control over the roasting and alkalising conditions to produce standard quality products. Tests that are carried out by cocoa processors and chocolate manufacturers include the yield of nib and the amount of cocoa butter in the nib. Flavour assessment is carried out by panels of experienced tasters, who can detect off-flavours in roasted ground nib, either directly or after mixing with sugar and water to make a basic dark chocolate for tasting. Mouldy or smoky off-flavours and excessive bitterness is important as these cannot be removed during processing. Chocolate manufacturers also assess the quality of cocoa butter for its hardness, melting and solidification characteristics.

Fig. 3.3.6a,b. Speciality chocolates having different shapes (Courtesy of Barrie Axtell)

3.3.3. Chocolate

Considerable value can be added to cocoa by processing it into chocolate products, especially high-value, deluxe chocolates (Table 3.3.5). In general small-scale processors should aim to produce high quality, hand-made chocolate for celebrations, gifts or special occasions, rather than snacking chocolates (e.g. for children) that have much lower value. Other factors that increase the value of chocolate include: fair traded chocolate or organic certification of the cocoa; use of terms such as 'gourmet' and 'luxury' chocolates; specifically named ingredients (Box 3.3.4), attractive packaging and unusually shaped chocolates (Fig 3.3.6).

Type of chocolate	Price	Price ($/kg)
Continental Milk, White & Dark Collection	£19.99/685g	43.77
White Chocolate Owl Model	£3.99/80g	74.81
Milk Chocolate Charlie Chimp	£6.49/200g	48.68
Milk Chocolate Car	£6.99/250g	41.94
White Cherry Raisin Apricot Bark	$25.00/16 oz	55.06
Luxury Chocolate Gift Boxes	$125.00/2.4 lbs	114.68
Gourmet Chocolate Gift Box	$85.00 /1.4 lbs	133.65
Solid Dark Chocolate Bars	$70.00/2 lb.4oz.	67.63

Table 3.3.5. Examples of retail prices for high-value chocolate products (From Thorntons, 2013; Lake Champlain Chocolates, 2013; Godiva, 2013a)

Notes: Retail prices at May 2013. Currency conversion: £1 = $1.5.
Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Box 3.3.4. Descriptions used to add value to chocolates

The following are examples of product descriptions used by chocolate manufacturers:
White Chocolate - naturally dried apricots to plump raisins, tangy-sweet Michigan cherries, and white chocolate made from premium cocoa beans. This delectable treat arrives in a custom gift box tied with a satin ribbon.
Luxury Chocolate Gift Boxes - A quartet of fine handmade chocolates - luscious sea salt caramels, smooth milk chocolate peanut butter cups, fruity-sweet chocolate-dipped orange peels, or decadent almond butter crunch.
Gourmet Chocolate Gift Box - fresh-cut orange peels, candied and dipped in dark chocolate for a fruity-sweet and gourmet delight. A second gift box is filled with rich, creamy sea salt caramels, covered in semi-sweet dark chocolate and sprinkled with fine sea salt. And our peanut butter chocolate

cups are handmade with thick, velvety peanut butter nestled between layers of smooth milk chocolate. The new Temptations Trio with three chocolate superstars, it's a gift supreme.
Easy, breezy, and oh so refreshing! Our Summer Truffles Gift Box is filled with assorted truffles inspired by cocktails, ice cream and fruit. Includes our Chocolatini, Passion Fruit, Peach Bellini, Cookie Dough, Strawberry Tarte and Neapolitan truffles.
(Source: Godiva, 2013b)

Chocolate-like products

'Cocoa butter equivalents' are fats that have similar properties to cocoa butter and are permitted in chocolate at levels of up to 5% in many countries. 'Compound coatings' are made from other fats that do not require tempering (below) and they cannot legally be described as chocolate in most countries. The main ingredients in a compound coating are fat, sugar, corn syrup, flavourings, colourings and emulsifiers. They are used for example on cakes and frozen bakery products because the coating is softer and more flexible than chocolate and does not chip off at larger scales of operation. Chocolate 'crumb' is made by adding condensed milk and sugar to the cocoa mass to make a creamy chocolate liquid that is then evaporated to form a powder or 'crumb' (some manufacturers use dried milk powder, often mixed with whey powder, instead of condensed milk). The crumb may be stored for later use or sold. On arrival at the chocolate factory, the crumb is milled in a pin mill and mixed with cocoa liquor, cocoa butter, emulsifier and any flavourings that are required. The amount of added emulsifiers depends on the consistency required of the chocolate: thick chocolate is needed for moulded blocks, whereas a thinner consistency is used for assortments and for coating foods with chocolate.

Processing

There are a very large number of variables in the processing of cocoa beans that give rise to the hundreds of different types and qualities of chocolate that are produced. Processors need to both select the processing conditions that will produce the type of chocolate that they require and also control the conditions to consistently produce the same quality in every batch. It is this complexity of processing that has resulted in chocolate making being described as 'more of an art than a science'. Chocolate is made from various combinations of sugar, cocoa liquor, cocoa butter, cocoa solids, milk powder, vanilla or other flavours, with an optional emulsifying agent, such as lecithin or PGPR (polyglycerol polyricinoleate). The proportions of the different ingredients depend on the type of chocolate being made, but the two basic components of chocolate are cocoa powder and cocoa butter, which are compounded with the added ingredients to make 'couverture' (Table 3.3.6). This is the basic formulation used by chocolate makers and each manufacturer has an individual couverture formulation.

Ingredient	Weight (kg)
Cocoa powder	1.13
Powdered whole or skimmed milk	1.00
Sugar	1.72
Cocoa butter	1.30
Margarine or butter (cream may also be added)	0.25
Total batch weight	5.5

Table 3.3.6. Example of a basic couverture formulation

The couverture is refined to improve the texture of the chocolate by passing it through a series of rollers in a fine-grinding mill known as a 'conche' until a smooth paste is formed. Conching reduces the size of cocoa and sugar particles to produce the smooth product that does not taste gritty. Conching also helps to develop the flavour, remove unwanted volatile flavours and reduce the viscosity. After conching, the chocolate is stored in heated tanks that have close temperature control before it is 'tempered'.

Tempering chocolate

Tempering is the controlled crystallisation of cocoa fats to produce small cocoa butter crystals. Without tempering, unstable fat crystals would cause a number of quality problems in the chocolate: the surface would appear mottled with a greyish-white 'bloom'; the product would not have a surface sheen; it would have a gritty taste; and it would crumble rather than 'snap' when broken. Tempering machines are water-jacketed mixers that have accurate temperature control of the heating water. To temper dark chocolate it is first heated to 49-50°C to melt the cocoa fat crystals, then cooled to 28 - 29°C, which causes small fat crystals to form. It is then heated to 32-34°C to melt unstable crystals, leaving only the most stable type of small cocoa butter crystals. Milk chocolate is tempered at temperatures ≈ 2°C lower than those used for dark chocolate.

3

Tempered chocolate is used in a number of ways: it is formed into blocks of solid chocolate, including bars with optional added ingredients such as nuts and raisins (known as 'moulded' products). These are made by pouring warm chocolate into shaped moulds, cooling and then removing the solid bars for packaging.

Fig. 3.3.7a, b. Moulds for small moulded chocolate bars (Courtesy of Peter Fellows)

Tempered chocolate is also used for coating (or 'enrobing') or for chocolate fillings. At micro-scales of processing, coating is usually done by hand, by dipping the food into a container of warm chocolate, which is kept warm in hot water or using a Bain Marie. Two types of enrober are used at larger scales of operation to apply chocolate: in the 'submerger' type, food passes through the liquid chocolate on a stainless steel wire mesh conveyor and is held below the surface by a second mesh belt. In the second type, foods pass beneath a falling 'curtain' of chocolate (Fig 3.3.9). The thickness of the coating depends on the temperature of both the food and the chocolate, the viscosity of the chocolate and the rate of cooling.

Fig. 3.3.8. Chocolate enrober (courtesy of Prefamac NV)

After filling into moulds or enrobing, chocolate products are held at a constant temperature (e.g. at 22°C for 48 h) to allow cocoa fats to continue crystallisation. Finally they are cooled slowly to ≈14°C (not rapidly as this would produce a surface bloom on the chocolate).

'Shelling' involves depositing liquid chocolate into a mould to form a shell and the centre filling is then deposited in the shell and sealed. 'Easter eggs' are also made by shell moulding. Another process is 'panning', where nuts, pieces of biscuit, raisins or caramel are coated with chocolate in a revolving drum.

Small-scale artisan chocolate making

Artisan chocolate has a large market with middle- to high-income families in many ACP countries and high quality hand-crafted chocolates can have a very high value. The manufacture of high quality chocolates requires an understanding of the craft and science of chocolate making, artistic skills that must be combined with the imagination of the producer, experience and attention to detail, to produce distinctive products that have a wide local demand (Rios, 1998). It is strongly recommended that small-scale processors who are considering such products should employ a specialist chef/confectioner if they do not possess these skills themselves. The range of chocolate products that can be produced is then only limited by the chocolatier's imagination and skill.

Control of water - the 'enemy' of quality - is essential. Even a drop of water or steam in a batch of chocolate can spoil the surface sheen associated with a quality product, and every vessel or mould that is used must be absolutely dry. The first step is to heat the couverture in a double pan or Bain-Marie. The water used for heating in the outer pan or Bain-Marie should never be allowed to boil to avoid contaminating the couverture with steam; a suitable temperature is 70-80°C. The mixture should be heated to 50-55°C with constant stirring.

3

Some producers (Melting Pot, 2013) recommend the use of a microwave oven for melting chocolate as it avoids possible contamination by water or steam. A plastic bowl should be used as glass bowls retain too much heat. The bowl of chocolate is put in the microwave on full power for a maximum of 30 seconds, after which it is stirred and subjected to short, 15-second bursts of heating until fully melted.

For moulded chocolate, the next step is to rapidly cool the mixture by placing the bowl into cold water or pouring the mixture onto a cold marble slab to promote the formation of the correct fat crystal structure. It may be moulded when the temperature falls to 30°C, using plastic moulds that are available in different shapes (e.g. simple shapes or hearts, shells, animals etc.). After further cooling, the moulded chocolates should be kept in a cool, well-ventilated room for at least eight hours, after which they can be removed from the moulds and packed. The type of packaging should be matched to the intended market segment and attractive packaging and presentation of hand-crafted luxury chocolates can add enormous value in markets where there are high-income consumers.

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3.4. Tree nuts and nut products

Many edible tree nuts and the oils derived from them are high-value foods. Those that grow in ACP countries are highlighted in Table 3.4.1. Other tree nuts that grow only in non-ACP regions or those that are considered to have insufficient value are not included in this book. Nuts that are used to produce cooking oil are also described in an accompanying volume in this series (Fellows and Axtell, 2012).

Akee Almond **Baobab** Beech Betel Brazil nut Butternut (white walnut) **Cashew** Chestnut - Chinese Chestnut - Malabar Chestnut - sweet **Chilean hazelnut** Coconut Filbert/Hazelnut	**Gabon nut** Guarana Hickory Illipe **Irvingia (or Dika) nut** **Kola nut** **Kukui (Candlenut)** **Macadamia** Mamoncillo **Marula nut** Maya nut **Mongongo nut** **Moringa** **Nutmeg** (see section 3.1.3)	**Ogbono nut** Paradise nut Palm Pecan Pili nut Pine nut Pistachio Sandalwood Walnut Walnut - Black Walnut – English **Ximenia**

Table 3.4.1. Types of edible tree nuts
(High-value nuts that are grown in ACP countries are highlighted)

Tree nuts may be grouped into those that have long-established international trade and those that are traded more locally. International trade in exported edible nuts is substantial: in 2004, for example, exports amounted to $US 5.2 billion, with 56% of exports coming from developing countries (Malhotra, 2008). The most important internationally traded nuts, in terms of the amounts produced (but not necessarily processed) in ACP countries are shown in Table 3.4.2.

Nut	Area of production	Total worldwide production in 2009 (MT)
Coconut	Coastal regions of ACP countries	61,708,358
Palm nuts	Central and West Africa	12,949,000
Cashew nuts	East, Central and West Africa	3,350,929
Kola nuts	Central and West Africa	190,431
Macadamia nuts	South and East Africa	26,123 [1]

Table 3.4.2. Important internationally traded nuts from ACP countries (Production data from FAOSTAT, 2013, Bekker and Lee, 2009 and INC, 2012)

[1] 2008 data

For comparison, although not a tree nut, peanut production = 36,456,791 MT.

Cashew, macadamia and kola nuts are included in this section. Palm kernel production is very important in some ACP countries: Nigeria is the second largest world producer (813,023 MT in 2010) with Côte d'Ivoire and Guinea-Bissau producing significant quantities; and Tanzania, Mozambique, Benin, Ghana, Kenya, Senegal, Madagascar and Burkina Faso all among the top-twenty world producers (FAOSTAT, 2013). However, the unit price for palm oil, palm kernel oil and their derivatives is much lower than other oils described in this section and these oils are therefore not included. Similarly, coconut oil and other coconut products are important in coastal regions of ACP countries, but the products are not high value, compared to other nut products in this section and they are not included (coconut and palm kernel processing are described in Fellows and Axtell, 2012).

Other types of tree nuts are grown in ACP countries in smaller quantities and are processed using traditional methods at a small scale for local markets. These include Irvingia, marula, and mongongo nuts that are used for food and cooking oils. Although the nuts have relatively low value locally, some have recently found export markets, or oils or extracts from the nuts have found new markets in industrialised countries. These include baobab seed, Chilean hazelnut, Gabon nut, Kukui (candlenut), mongongo nut, moringa seed, trichilia nut and ximenia nut oils that are used for cosmetics, and baobab fruit, Irvingia nut, kola nut extract, marula fruit and nut oil, and moringa leaf and seed oil, that are used as health- or food-supplements.

A note on the botany of tree nuts

Nuts contain the seeds of trees, which can be grouped into three categories:
True, or botanical, nuts: these are dry, hard-shelled and do not split on maturity to release seeds (e.g. mongongo nuts, Kukui (candlenuts), chestnuts).
Drupes: these have fleshy fruit surrounding a stone, or pit, containing a seed (e.g. almonds, Gabon nut, bush mango).
Gymnosperm seeds: these are seeds that have no shell (e.g. pine nuts). This chapter first describes high-value nuts that are currently produced at a large scale in ACP countries, followed by other high-value nut products that have the potential for either larger scale production or supplying new markets.

A note on tree nut allergies

Tree nut allergy is a type of hypersensitivity that causes an overreaction of the immune system and may lead to symptoms that range from mild itching of the throat to anaphylaxis (rapid onset of throat swelling and low blood pressure that may cause death). Tree nuts that cause allergic reactions include almonds, Brazil nuts, cashews, chestnuts, hazelnuts, macadamia nuts, pecans, pine nuts, pistachios and walnuts. Guidance on labelling products that contain tree nuts is given by for example FSA, 2006.

Large-scale commercial nut production

This section describes three types of nuts that have well-established processing industries in ACP countries: cashew nuts, macadamia nuts and kola nuts. Cashew and macadamia nuts have long-established markets and international quality standards, and to compete successfully new processors require investment in equipment and staff expertise to meet the volumes and quality requirements of buyers – especially if processing final products for retail sale. Kola nuts have few international standards and the quality of the kola products is agreed between buyers and sellers. In each case, the main factors that influence entry to the markets by small-scale processors are the quality of the nuts in relation to those produced by existing processors, the volumes that are processed and hence the economies of scale, and the sale price - each of which must be competitive in order to succeed in these markets.

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3.4.1 Cashew nuts

Cashew nuts (*Anacardium occidentale*) have five components: the cashew apple, the nutshell, the kernel surrounded by a thin testa, and cashew nut shell liquid (CNSL).

Fig. 3.4.1. The cashew fruit and nut (Courtesy of Vinayaraj)

Cashew apple is an edible fruit attached to the nut by a stem (Fig. 3.4.1), but the fruit has an astringent taste that is not popular in many of the cashew producing areas, especially East Africa. However, in parts of West Africa it is regarded as a delicacy. The fruit is used at a micro-scale to make a range of fruit products (Axtell, 1991), but these have only a local demand and are not considered to be high-value foods in this book. Cashew apple juice is also fermented to produce wine, spirits or vinegar. Cashew wine is a popular drink in some countries in West Africa and a distilled cashew liquor, feni, is popular in parts of India (see also section 3.6), both of which have a higher value. However, it is difficult to use the fruit commercially because it ripens before the nut matures, and the nut is far more valuable. Cashew wine and liqueur are therefore not included in this book.

Cashew nuts, unlike other tree nuts, grow outside the fruit. They have a leathery shell that contains a kernel (the cashew 'nut'), which is the high-value part of the crop. Cashew kernels are a luxury nut alongside macadamia and pistachio and although the volumes traded are smaller than many other nuts, they are important in international trade. CNSL is a dark, viscous oil that is contained within a thin honeycomb structure between the outer skin of the nut and the harder inner shell. The CSNL content of raw nuts varies between 20-25% and is a valuable byproduct of cashew nut processing.

Three main cashew products are traded internationally: raw nuts, cashew kernels and CNSL. Whole roasted cashew kernels are the most valuable and ≈60% of production is consumed as snackfoods (roasted salted nuts, which may be coated with chilli, honey, rosemary and thyme, or wasabi - see Table 3.4.3). The remaining ≈40% is used in confectionery products, breakfast cereals and health foods. Broken nuts have a much lower value and the authors have witnessed processors gluing broken halves back together again – the investment in staff time being more than paid for by the value added to the kernels in this dishonest processing. Broken nuts are used for cheaper snack nuts, or in bakery products such as pastries, confectionery, ice cream and for oil or cashew butter production.

Cashew 'butter' is similar to peanut butter and is produced by stone-grinding cashew kernels that are not suitable for sale (e.g. different types of broken kernels in Table 3.4.5). The butter may be mixed with other ingredients (e.g. mulberry, pistachio, hazelnut, black buku raisins) and has a high retail value (Table 3.4.3). Cashew oil is produced by cold-pressing cashew kernels (methods to produce nut butters and nut oils are described in Fellows and Axtell, 2012). The oil is an excellent cooking oil. The high levels of unsaturated fatty acids and vitamin E also make cashew oil a valuable component of cosmetics including anti-wrinkle creams, skin care treatments, hair care products, hand or lip balms, massage oil and sun creams. Other products that have a high retail value in industrialised countries include cashew nut cream cheese and aged cashew cheese (often with added hempseed, algae or other nuts). Both of these products are vegan alternatives to the dairy equivalents that contain no gluten, casein and lactose (Dr Cow, 2013).

Product	Retail price	Value ($ per kg or litre)
Cashew oil	US$1000-1100/Ton (wholesale)	1.10 - 1.21
Cashew butter	$14 - 33 per 8 oz	61.67 - 145.37
Cashew nut cream cheese	$85.00 for six 70g cheeses	202.38
Cashew oil	US$25/250ml (retail)	100.00
Cashew phenol oil (made from CNSL)	US$ 900-1200/MT	0.90 - 1.20
CNSL	US$ 500-1000/Ton	0.55 - 1.10
Raw cashew nuts in shell from Benin	$975/MT	0.97
Whole dried kernels	$4,500 per tonne	4.50
Roasted cashew kernels as snack nuts	£2.60/125g	31.20
Organic cherry and cashew nut bars	$2.19/1.7oz bar	46.00

Table 3.4.3. Retail or wholesale prices of cashew products (From Ghosh Agri. Tech., 2010; MBendi, 2012; Black Jack Snacks, 2013; Africajou, 2013; The Raw Food World Store, 2013; Dr Cow, 2013; Phuong Nguyen Phat, 2013; Vncimex, 2013; Pure, 2013)

Notes: Retail prices at March 2013. Currency conversions: £1 = US$1.5.
Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Note on Table 3.4.3:
The price for cashew kernels in 2012 averaged $4,500 per tonne, compared with $500-$1000 per tonne for raw cashew nuts. Cashew quality is the most important factor to achieve sales in international markets and if supplies of nuts have variable quality, it results in price reductions of up to 30% (MBendi, 2012). The added value from processing can be clearly seen in Table 3.4.3: cashew nuts increase in value from $0.97/kg for raw nuts to $4.50/kg for dried nuts, $31.20/kg for roasted nuts, $145.37/kg for cashew butter and $202.38/kg for cashew cream cheese. Similarly cashew oil increases in value from $1.21/litre wholesale to $100/litre retail price. Research indicated that organic and fair traded cashew products were competitively priced and retail costs were similar to non-organic and commercially sourced equivalents.

In micro- and small-scale cashew processing, CNSL can be used as a fuel, but it is one of the few natural resins that is highly heat-resistant and this makes it a valuable raw material that should be sold to make cashew processing more profitable. There are more than 200 patents for industrial applications of CNSL and it is traded internationally for a wide variety of uses including: a binding resin that is used for brake and clutch linings; acid-resistant paints; lacquers; epoxy resins; electrical insulating varnishes; insecticides and fungicides (Kumaraswamy, 2013; Rehm and Espig, 1991; Deckers et al, 2001). The main markets for CNSL are in the US, the EU (mainly the UK), Japan and Korea, which account for over 90% of imports.

World production, processing and consumption

Country	Production (MT)
Vietnam	1,272,000
Nigeria[1]	**813,023**
India	674,600
Côte d'Ivoire[1]	**452,656**
Brazil	230,785
Philippines	133,388
Guinea-Bissau[1]	**128,684**
Indonesia	122,100
Tanzania[2]	**75,000**
Mozambique[1]	**72,263**
Benin[2]	**70,000**
Ghana[1]	**35,736**
Thailand	29,060
Kenya	**20,927**
Malaysia[1]	15,118
Guinea[1]	**8,458**
Senegal[1]	**6,996**
Sri Lanka	6,890
Madagascar[1]	**6,677**
Burkina Faso[1]	**5,876**
Total for Africa	1,391,700 (50.8%)

Table 3.4.4. Cashew nut (with shell) production in 2011 (FAOSTAT, 2013)
(ACP countries are highlighted)
[1] FAO data based on imputation methodology
[2] FAO estimate

In the early 1970s, most cashew production took place in Africa, particularly in Mozambique and Tanzania, but there then followed a fifteen-year decline during which production increased in Asian countries. India became the largest producer with ≈40% of world production, with Vietnam and Indonesia expanding their production capacities. Since the early 1990s, African production has recovered and has continued to steadily increase so that it now accounts for over 50% of world production, with Nigeria and Côte d'Ivoire being the main producers. (Table 3.4.4).

For comparison, the total for Asia = 1,239,300 (45.2% of world production) and the total for other countries = 108,700 (3.9%).

Although there was previously cashew processing capacity in Africa, it declined over 40 years from the 1970s and until recently only ≈10% of the African crop was processed on the continent. In India local cashew production was insufficient to meet processing requirements and Indian processors therefore established agents in Africa to buy raw cashew kernels or whole nuts. Imports from East Africa take place from December to May, which complements the Indian local harvest from May to July, allowing processors to operate over a longer part of the year without having to keep large stores of nuts. Processors in India and Vietnam benefit from the subsequent sale of higher value roasted kernels. Since the mid-2000s this situation has changed: new standards came into force for food products imported into the EU and some Indian processors stopped buying cashews from African producers. Instead, some Asian processors decided to invest in processing facilities in Africa. In 2011, a large Indian company established fully mechanised facilities in Ghana to process up to 50 MT of cashew nuts per day, with the intention of also setting up factories in Benin, Côte d'Ivoire, Mozambique and Tanzania. The company sees the benefits of local processing as saving the cost of transporting raw cashews to India; obtaining nuts more cheaply compared to buying from agents; improved farmers' incomes by dealing directly with farmers' cooperatives and paying farmers a higher price than agents do; reduced export costs of processed nuts to Europe compared to those from Asia; and using nut waste and other materials to generate electricity, thus reducing processing costs and earning an income from the electricity supply (The Economist, 2011).

Box 3.4.1. Development of a cashew processing business in Tanzania

In 1992, three members from the D. family started a mango farm a few kilometres south of Dar-es-Salaam and by 2000 the business was producing over 32 MT of mangoes, sold locally to prime hotels with some exported to the Middle East. They formed a company with two other family members co-opted and Ms F. acting as the Managing Director, but all as a part-time activity with the partners also employed elsewhere. In 2004, the farm became infested with fruit-fly disease that stopped the export trade and the enterprise began exporting rice, beans, grams and chillies. Since this business involved shipping instead of air-freighting fruit, the terms of payment were delayed and this affected the liquidity of the enterprise. There was a need to address business issues more aggressively, which led to running the business on a full-time basis and increasing the number of permanent employees from three to six. In 2006, the company started roasting cashew nuts for export and the number of shareholders increased to 39. This was a bid to raise investment and operational capital, then at TSh. 48 million. Today, the capital base is about TSh. 700 million and business has expanded into processing cashew nuts, groundnuts, pickles and fruit candies. The current markets are East African countries and the Middle East and total sales have grown from TSh. 91 million in 2006 to TSh. 392 million in 2011.

The development of African processing facilities has been assisted by the formation of cashew associations by both governments and development agencies. The African Cashew Alliance (ACA) was formed in 2005 as an association of African and international businesses with an interest in promoting a globally competitive African cashew industry. It has more than 160 member companies and it represents all aspects of the cashew value chain, including producers, processors, traders, and international buyers. ACA aims to increase processing on the continent to 35% of output by 2020 (ACA, 2012). In many individual African countries, development agencies and government departments promote local cashew processing to develop the export potential of processed nuts. For example, PROMEXA (Côte d'Ivoire's non-traditional agricultural export promotion association), ARECA (the regulatory authority of Côte d'Ivoire for cotton and cashew nuts) and APCAM (Mali's permanent assembly of chambers of agriculture) combined to produce an industrial development plan for processing cashew nuts, with financial support of PROINVEST, the EU-ACP partnership programme. This grouping is developing the sector under the name of ADEFICA (Association for the Development of the African Cashew Network). In Senegal and Guinea-Bissau, Enterprise Works, an American non-profit organisation, is also developing cashew processing and helping to train local businesses in production and marketing skills (ACA, 2012).

The African Cashew initiative (ACi) focuses on building a sustainable cashew value chain and on increasing the competitiveness of African cashew production and processing. Donors and private companies are working in ACi's five project countries: Benin, Burkina Faso, Côte d'Ivoire, Ghana and Mozambique (ACi, 2013).

The most important importing countries are the USA and Europe (especially UK, The Netherlands and France), which account for 75% of total imports. The USA imports mostly Brazilian cashews, which have lower transport costs than from Africa or Asia. India is an established supplier to the EU, with long-standing trading relationships built on the confidence that importers have in the product quality and timely deliveries. There are more than 150 Indian cashew shippers, many of whom have offices in Europe. South Africa and Kenya also import cashews to process for internal markets (Agbongiarhuoyi et al, 2008).

Cashew kernels are therefore a high-value luxury product that has a high international demand, which is growing at steady rate that is expected to continue. The markets in Europe and the US are not controlled, protected or organized into cartels, which produces good opportunities for new processors. Similarly, there is potential to enter markets for high-value cashew products, including cashew butter and cashew oil. In Africa, cashew harvesting and processing takes place at times of the year that do not conflict with peak labour requirements for other food crops and cashew therefore has the potential to increase earnings, create jobs, and increase export earnings. To do this, small-scale processors must be able to demonstrate that they can produce kernels having consistently high quality to be able to gain market share, supply the volumes required by commercial buyers and sell them at an acceptable price. Other important factors are the reliability of deliveries and acceptability of trading terms to buyers, which must match or exceed those of existing suppliers. To do this requires a skilled and experienced workforce and may require expenditure on processing technology.

Potential difficulties for new small-scale processors include a delay of up to seven years between the investment in planting cashew trees and the first harvest (Box 3.4.2); cashew yields are weather-dependent and changes in weather patterns have led to highly volatile international prices in the short-term. Each of these factors makes financial planning more difficult for processors and can adversely affect their cash-flow.

Box 3.4.2. Requirements for a secure supply of cashew nuts

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply nuts for making high-value cashew products:

Locations where they grow:	Tropical climates
Soil type(s) required:	Well-drained, sandy loam
Annual rainfall requirement:	890 - 3050 mm
Time from planting to first crop:	3-4 years, mature yield after 7 years
Typical annual yield of nuts per tree:	7-11 kg
Productive life of the tree:	15-20 years
Height of tree (for manual harvesting):	Not applicable - collected from ground

For most small-scale processors, the main selling route for processed kernels is via local agents who act for importers, middlemen, brokers and wholesalers. They sell nuts to international markets and control prices, quality requirements and the volumes sold. Most exports are bulk kernels, which are imported by large wholesalers in the consuming countries. These are then re-packaged after roasting and salting and sold to retailers. Opportunities exist for processors to penetrate the local retail markets for roasted products, but there may be difficulties in securing a supply of attractive packaging and competitive pricing with existing producers. It may also be possible to establish direct relationships with European food processors that pack and market cashew nuts. For other products (e.g. cashew butters, cashew oil), specialist niche markets for health foods or vegan foods may be accessible directly by sending samples to the retail companies or by dealing with import agents who supply ingredients to health food manufacturers. In principle, these products could also be sold directly to consumers in industrialised markets via the internet, but no evidence has been found of ACP processors engaging in this form of selling.

Processing

The high price of cashew kernels is due in part to the relatively complex processing and the investment required in equipment and skilled staff. There are both small-scale and large-scale processing options depending on the available investment. Traditionally, extraction of cashew kernels from the shells has been done manually and, although this can achieve high quality unbroken nuts, it is time-consuming and unpleasant work. Small-scale processors who are intending to produce significant amounts of export quality nuts should consider at least part-mechanisation of the process in order to achieve the volumes required.

In outline, the process involves sorting, conditioning and then roasting the nuts to loosen the kernels and release the CNSL. Once the kernels are removed from the shells, they are dried, the testas are removed and the kernels are packed. Sorting to remove foreign materials and substandard kernels and grading into size and colour categories takes place at several stages throughout the process. In general, processing should cause as little damage as possible: whole kernels are far more valuable than broken pieces and ivory coloured or white kernels are more valuable than discoloured pieces. The proportion of whole kernels depends on the processing method, the skill of operators and the quality controls that are in place within the factory. For an economical operation, the proportion of unbroken kernels should exceed 55% and in a well-managed factory with experienced operators it can be 85-90%.

Fig. 3.4.2. Processing cashew nuts in Côte d'Ivoire - employees at the Agri-Business Company, which received technical assistance from TechnoServe as part of the African Cashew Initiative (Courtesy of Nile Sprague/ TechnoServe)

Cashew nuts are collected from the ground and cashew apples and any foreign matter are removed using an aspirator. The lifting capacity of the aspirator fan can also be controlled to separate the nuts into different size categories. Alternatively, with higher investment the nuts pass through a size sorter to separate them into up to eight size grades. Soaking the nuts (or 'conditioning') increases their moisture content, which reduces the risk of kernels being scorched during roasting and makes them less likely to break. The simplest small-scale method is to soak the nuts in large drums of water for ten minutes and then drain off the water. The wet nuts are allowed to absorb the surface water over a period of at least four hours. Soaking is repeated three or four times until the moisture content reaches ≈9%.

At a larger scale (e.g. processing 2-10 tonnes of nuts per day) a 'trommel', which has two rotating concentric cylinders made from steel rods, is used to clean the nuts. Cleaned nuts are conditioned and passed over sizing grilles to separate them into size grades that are collected separately in bins (Azam-Ali and Judge, 2004). After conditioning, nuts are roasted using one of four methods, depending on the scale of operation: 1) Open pan roasting is an artisan method that produces kernels that are likely to be suitable for local markets. The only advantage of the method is its low cost. The large amounts of smoke and fumes make it unpleasant for operators and the CNSL by-product is lost. 2) A drum roaster (Fig. 3.4.3) has a perforated steel drum that is mounted over a furnace and rotated manually or mechanically. The duration of roasting is controlled by the speed of rotation and the roasted nuts are dowsed using a water spray to cool them as they leave the drum. The equipment has a chimney to remove smoke away from operators. Although this method is an improvement over pan roasting, it may damage some kernels due to overheating and again the CNSL is lost.

The following two methods are widely used at larger scales of operation: 3) Nuts are loaded into a vessel heated by a steam boiler and steamed at atmospheric pressure for ≈30 minutes. This softens the shells, preserves the colour of the cashew kernel and retains CNSL. 4) The 'hot-oil' method may be batch or continuous. The batch method involves heating the nuts, contained in a wire basket, in a tank of CNSL for ≈90 seconds at 185-190°C. Carbide or chromium steel should be used to construct the tank because mild steel would become pitted and distorted due to the hot CNSL. In continuous processing, the nuts are fed onto a conveyor that carries them through a hot bath of CNSL, heated either by a furnace or by pipes that contain hot oil or steam. The roasted nuts are discharged onto a cooling conveyor and may pass to a basket centrifuged to remove any remaining CNSL. Both steaming and hot-oil

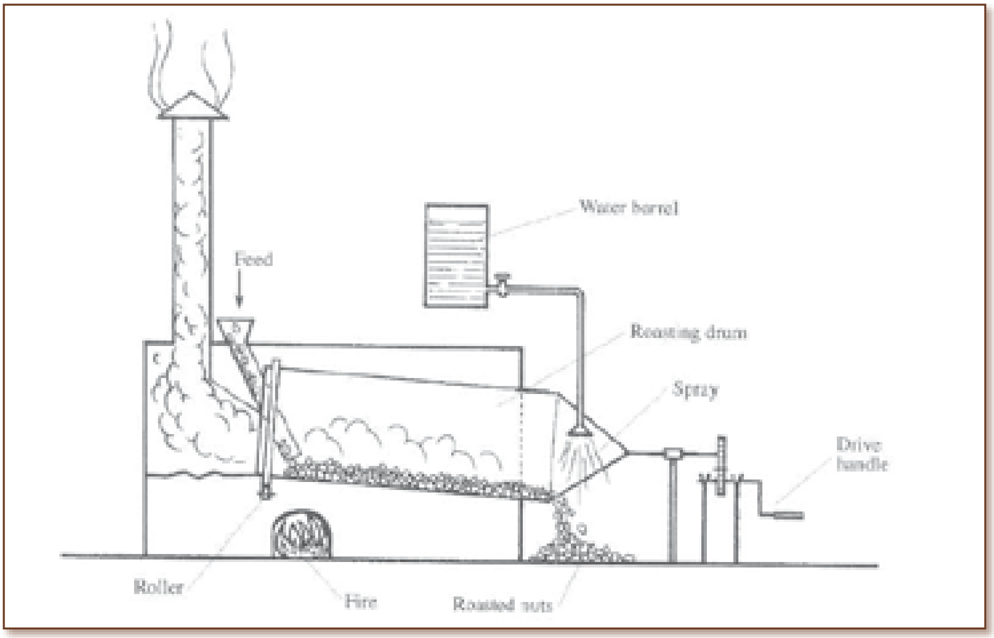


Fig.3.4.3. Drum roaster (Courtesy of Practical Action)

roasting methods have higher capital costs than pan- or drum-roasting but they produce high quality nuts and enable CNSL collection. Empty cashew shells that contain some CNSL are the most economical fuel in each type of processing. Further information on equipment options is available at Gayathri Industries (2013), equest (2013) and Oltremare (2011).

Recovering CNSL

When the nuts are heated, the production of steam within the shell assists the extraction of CNSL and on average the nuts lose about half of their CNSL content. This increases the volume of CNSL in the roasting tank, which both replenishes that lost when the nuts are removed and keeps the oil fresh. Excess oil is filtered to remove pieces of shell and debris, and then packed into drums for sale.

Removing kernels

After roasting, cashew kernels are removed from the shells to produce unbroken kernels that are not contaminated with CNSL. Artisan methods use manual shelling, which can produce high quality unbroken kernels, but requires highly skilled operators who must be protected against the corrosive CNSL. On average an experienced sheller can produce ≈ 5kg shelled kernels per day, with 90% whole kernels (Azam-Ali and Judge, 2004). In semi-mechanised shelling, operators work in pairs: the first cuts the nuts and the second opens them and removes the kernels; each pair can shell ≈15kg kernels per day.

There are a number of designs of mechanised shellers described by Azam-Ali and Judge, 2004, each of which gives a shelling rate of ≈70% with minimal breakage At larger scales of production, a mechanised shelling system (Anon, 2011) produces ≈75% unbroken kernels. The kernels and the shells are separated on a vibrating screen and/or using compressed air. Any small pieces of kernel that remain stuck to the shell are recovered manually.

The shelled kernels are dried from ≈6% to 3-4% moisture to assist removal of the testa by 'peeling'. Artificial hot-air drying for around six hours at 70-85°C is used to produce high quality nuts. The testa is removed by manual 'peeling', which at the smallest scales of production, involves gently scraping the kernel with a blunt knife; one operator can peel 10-12kg kernels per day. Mechanised peeling at higher production volumes uses one of three methods: rubber rollers; a drum peeler; or more commonly, compressed air. Whichever, method is used it should not cause significant breakage of kernels and it should peel most of the kernels in one pass.

Before kernels are packed, their moisture content is increased from 3% to ≈5% to make them less fragile and reduce the risk of breakage during transport, using conditioning rooms that have humid air. Stored kernels are vulnerable to insect infestation by ants, grain weevils and meal moths, mould growth and rodent attack and they should be stored in insect- and rodent-proof containers. Cashew kernels are hygroscopic and subject to rancidity and the packaging material for distribution should be impermeable to oxygen and moisture. Kernels are graded and vacuum-packed into multi-layer plastic bags and transported in 11.4 kg (25lb) or 23kg (50lb) net weight cardboard cartons. Alternatively in an older method, they are packed in 11.4 kg tins. The filled tins have the air removed using a vacuum pump and are then filled with carbon dioxide and sealed. Carbon dioxide kills any insect infestation and it is soluble in cashew oil. As the gas is absorbed by the cashew oil it reduces the internal pressure and the sides of the tin are drawn inwards. This holds the kernels tightly, preventing breakage during transport.

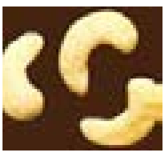
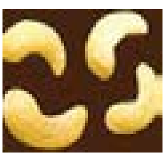
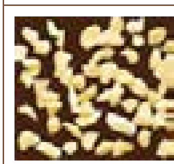
Quality standards and specifications

Cashew kernels have detailed quality specifications from the long-established trade and the inherent variability in raw material quality and different processing conditions. The ISO 6477 standard (ISO, 2013) contains specifications of requirements including moisture content, grading to 24 grades, sampling, methods of testing, packing and marking of cashew kernels. These quality standards are required by cashew buyers or exporters and the following are typical specifications:

- Kernels should be sufficiently developed and mature with the characteristic shape.
- They should be free from CNSL, testa and any foreign matter.
- They should be free from any deterioration likely to affect their shelf life or make them unfit for human consumption.
- They should be completely free of living or dead insects, moulds, rodent contamination and insect damage.
- They should have a natural smell and should be free of rancid or any other odours.
- They should have moisture content not greater than 5% by weight.

Two methods that are suitable for measuring the moisture content are a moisture meter (Lunkad, 2013) to determine electrical conductivity or the Dean Stark apparatus (You Tube 2013).

Buyers may use experienced inspectors to randomly test supplies to ensure their quality before they are delivered to the port. Kernels are graded by size and condition according to international standards, such as the 'American Standard', which is incorprated into quality criteria specified by importers and export agents. Peeled kernels can be classified into between 11 and 24 grades; Table 3.4.5 shows the groups divided into 20 grades.

Category	Name	Grade		Nº Kernels		Description
Whole Kernels				Per kg	Per lb	
 Whole	White Whole kernels	1	W180	265-395	120-180	Kernels should be white, pale ivory or light ash gray in colour, free from black or brown spots
		2	W210	395-465	200-210	
		3	W240	485-530	220-240	
		4	W280	575-620	260-280	
		5	W320	660-705	300-320	
		6	W400	770-880	350-400	
		7	W450	880-990	400-450	
		8	W500	990-1100	450-500	
 Scorched Wholes	Scorched Whole Kernels	9	SW240	485-530	220-240	As for white whole kernels but the colour is darker due to overheating in the process
		10	SW320	660-705	300-320	
		11	SW	-	-	
	Seconds	12	SSW	-	-	
 Dessert Kernel	Dessert Whole Kernels	13	DW	-	-	The kernels have the characteristic shape. A black spot or more scorched than above
Broken Kernels						
White Butts	Fancy Butts	14	FB	Kernels broken across the section		Same colour as whole white kernels
White Splits	Fancy Splits	15	FS	Kernels split lengthwise		
 Scorched Butts	Scorched Butts	16	SB	Scorched kernels broken crosswise		
 Scorched Splits	Scorched Splits	17	SS	Scorched split naturally lengthwise		

Large Pieces	Large White Pieces	18	LWP	Broken kernels do not pass through a sieve aperture of 4.75 mm	The cashew kernels are not homogenous in their colour and could have different colours
 Scorched Pieces	Scorched (or Dessert) Pieces	19	SSP	Broken scorched kernels pass through a sieve of aperture 4.75 mm, but not through 2.8 mm	
 Baby Bits	Baby Bits	20	BB	Small broken kernel pass through sieve of aperture 2.8 mm, but not through 1.7 mm	

Table 3.4.5. Grades of cashew kernels (Adapted from Ghosh Agri Tech, 2012 and USAID, 2013)

Note on Table 3.4.5:
Kernel grades are: W = whole, B = Broken, S = Split. Whole kernels additionally have numbers following the letters to show the size categories (or maximum number of kernels per pound (equivalent to 454 g), (e.g. W210 = whole cashew kernels with 210 kernels per pound). W320 (whole white kernels with 320 per pound) have the highest demand and are the reference price for other grades. Other size categories include Super Premium (W150), Premium (W210), Regular (W450) and Economy (SW450). A second classification is based on colour: whole cashews are graded into three colour categories: White Wholes (W) are white or pale ivory; Scorched Wholes (SW) are slightly reddish; and Scorched Wholes Seconds (SSW) are discoloured but otherwise sound. Dessert Wholes (DW) are whole kernels with a black spot or comparably more scorched than the above. In practice, most processors do not produce all of the different grades because some grades are produced in quantities that are uneconomical to collect separately. The most common grade for African kernels is W320, followed by W450, W240 and W210. (In Brazil the crop has a higher proportion of large kernels and another grade, W180, is available). Whole seconds and dessert types are not graded according to their count but are sorted by colour.

Broken kernels are graded according to the way in which they are broken into 'Natural Halves' (broken evenly into two parts) which are used in economy packs of snack nuts and for confectionery and pastries. 'Splits' are kernels that have broken naturally lengthways to form two cotyledons, while 'butts' are kernels broken crosswise. Splits are categorised as Fancy Splits (FS) and Scorched Splits (SS); and butts similarly as Fancy Butts (FB) and Scorched Butts (SB). Other pieces of kernels that have broken into more than two pieces are graded according to size: Large White Pieces (LWP), Scorched Pieces (SSP), and Scorched Pieces Seconds (SPS) and Baby Bits (BB). They are used for local consumption, cheaper markets, or for production of cashew butter or oil.

At most scales of operation, grading is done visually by highly trained staff. It is essential that graders work in well-lit conditions to enable them to properly grade the kernels. Grading tables are covered in blankets that provide a soft surface to reduce breakages and retain any dust from the kernels. One or two workers pick out the 210 and 240 count grades and others pick out the 450 count grade. All graders also pick out scorched kernels, broken pieces and those that are discoloured due to disease. Strict cleanliness should be observed during grading and workers must follow codes of hygiene and sanitation (see also HACCP in Section 4.2).
Mechanised size grading of kernels at a small scale uses powered sieves or a grader that has rubber rollers aligned at a diverging angle. In both, the kernels are graded into different size categories when they reach an aperture that is large enough to fall through.

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3

3.4.2 Kola nuts

The kola nut is obtained from two species of evergreen trees; *Cola acuminate* and *Cola nitida*. Kola pods are harvested by manually picking them from the tree. The pods of *C. nitida* contain two large cotyledons (the nuts) whereas *C. acuminata* has an average of three to six cotyledons, all contained in a white seed shell. The irregular nuts have a compressed triangular shape that varies from flat to oval to spherical (Fig. 3.4.4). The nuts vary in colour from dark red to creamy white, each produced by the same species and often occurring in the same pod (Atanda et al, 2011). Pink and white nuts have the highest value because of their sweeter taste and a higher caffeine content.

Fig. 3.4.4. Kola nuts (Courtesy of Marco Schmidt)

The nuts contain high levels of caffeine (2 - 3.5%) and are chewed as a non-addictive stimulant, and are also used ceremonially in many West African cultures. The majority of African kola nut production is consumed within the continent, particularly in sub-Saharan regions. For example, ≈90% of the kola nuts produced in Nigeria is consumed in the country and the remaining 10% is exported to other parts of Africa (Atanda, 2011). Kola is a stimulant that is allowed to Muslims and there is a long-established trade in kola nuts from tropical producing areas to the more arid northern parts of West African countries and the trans-Saharan trade to Sudan.

Fig. 3.4.5. Kola nut tincture (Courtesy of G. Baldwin & Co)

Kola nuts do not have a high-value in the areas of production, but kola products are increasingly important in industrialised markets, initially as a flavouring ingredient in cola and other soft drinks and also as herbal medicines or tonics. Kola nuts give a boost in energy and a decrease in appetite due to their caffeine content, and they have slight thermogenic properties (they increase body heat through metabolic stimulation). The nuts also contain theobromine (≈1%), a stimulant that is also found in chocolate and tea. Both caffeine and theobromine are psychoactive substances that stimulate the nervous system and muscles. This makes kola a common ingredient in energy drinks, diet supplements for weight control programmes, as pre-workout supplements for body-builders and formulated supplementary foods for other sports people (Mr Supplement, 2103).

Kola nut preparations are in the form of dried powder or liquid extracts in alcohol. One or two teaspoonfuls of powder are boiled in water to make a decoction that is taken two or three times a day. They are also used medicinally to treat a number of ailments, including migraine headaches because the caffeine and theobromine act as cerebral vasodilators which increase blood flow in the head; herbal preparations to relieve the symptoms of asthma because caffeine acts to expand the bronchial air passages; and extracts also help aid digestion, as they stimulate gastric acid production when taken before meals.

Product	Retail price	Price ($/kg or litre)
Kola powder	£6.54/50g	196.20/kg
Kola Nut Tincture 100ml (in 45% alcohol)	£7.99/100ml	119.85/litre
Kola Nut, Organic, in alcohol, 1 fl oz (30 ml)	£16.00 /30ml	800/litre
Kola Nut capsules	$7.49/(180x550mg)	75.66/kg
Kola nut and almond reed diffuser oil room freshener	£12.60/≈300ml	63.00/litre

Table 3.4.6. Retail prices of kola products (From Azarius, 2012a; Indigo, 2013; Amazon, 2013a; Amazon, 2013b; Swanson, 2013)

Notes: Retail prices at March 2013. Currency conversions: £1 = US$1.5.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

3

World production and consumption

There is little published information on the production of kola nuts, the volume of traded nuts and prices of nuts exported from sub-Saharan African or Caribbean countries, because kola is not regarded as an important national crop and there are few statistics kept by government agencies. FAO estimated global production of kola nuts in 2010 at 302,449 MT (FAO, 2012) and Atanda et al, 2011, report that in 2009, Nigeria produced ≈88% of the world's kola nuts, with an annual production of 200,000 MT (making the world total ≈ 250,000 MT - a significant volume of production in relation to other tree nuts). In kola producing regions there are markets that specialise in bulk trade of kola nuts by long distance wholesale traders, controlled by merchants who have the required transport and capital. Fresh nuts, dry nuts or kola powder are also exported to Europe and North America. No evidence has been found for the sale of kola extracts by producing countries. The most difficult aspect for small-scale processors who wish to enter the markets for kola powder or extracts is to identify the manufacturers who make diet, medicinal or bodybuilder/sports products and their procedures for buying the raw material. Processors who wish to produce retail products themselves may also find the markets highly specialised, where sales take place through specialist retailers or via the internet.

Processing

The requirements that need to be taken into account when planting kola trees are summarised in Box 3.4.3. The nuts are readily available in producing countries and the technology to produce dried nuts or nut powder is simple and relatively low-cost. The technology to produce nut extracts is also simple and straightforward, although a licence to handle ethanol used in the process may be required in some countries.

Box 3.4.3. Requirements to secure a supply of kola nuts

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply nuts for high-value kola products (Asogwa et al, 2006, 2012a):

Locations where they grow:	Central and West Africa between Sierra Leone and the Congo and were extensively planted in the Caribbean and Brazil by African slaves.
Soil type(s) required:	Deep, rich soils.
Annual rainfall requirement:	A hot humid climate and heavy and evenly distributed rainfall (but may be cultivated in drier areas where sufficient groundwater is available).
Time from planting to first crop:	Hybrid varieties, 5 years, traditional varieties 15-20 years.
Typical annual yield of nuts per tree:	2,000 from hybrid varieties and 250 from traditional varieties
Productive life of the tree:	70 - 100 years.
Height of tree (for manual harvesting):	12-25 m.

Processing kola nuts takes place manually on-farm and no mechanized kola nut processing has been identified. After sorting *Cola acuminata* to remove diseased pods or those infected with weevils, the pods are allowed to rot by soaking them in clean water for 24 hours. *Cola nitida* nuts are spread on the ground for 72 - 96 hours, covered with jute bags to keep them moist before soaking. The seed coats (or testas) of the nuts are then removed manually and nuts are rinsed in fresh water and allowed to drain in baskets for 72 hours. The nuts are then 'cured' for three days in shallow baskets, during which time they 'sweat' which reduces their moisture content. Any defective or infected nuts are removed and the remainder are graded into marketable sizes (12 - 15g per nut). The nuts are placed in polythene-lined baskets, with each layer interspersed with leaves of the Néré tree (*Parkia biglobosa*), which are believed to brighten the nuts and make them more attractive. The top layer of the nuts is covered with leaves of the Akoko (or African Border Tree, *Newbouldia laevis*), which together with a sheet of polythene prevents the nuts from drying out. Nuts are prone to sprout during storage and are therefore regularly inspected and any emerging shoots are removed. They may also be coated with a film of palm oil to slow down shoot emergence and splitting of the nuts. They are stored in a cool, dry place for up to 14 months and protected against attack by the kola weevil (*Balanogastris cola*) using insecticides (Asogwa, 2012b).

Powder is produced by milling the dried kola nuts. A liquid kola extract (or tincture) is made by mixing the powder with water, bringing it to a boil and simmering for 10-15 minutes. The liquid is then mixed with 60% alcohol in various proportions (e.g. a 1:1 extract or a 1:5 extract). Powdered kola nut and kola tinctures are stored in airtight containers away from direct light.

Quality standards and specifications

Kola nuts are graded by size and colour for storage, pricing and export. However, there is no international standard grading or pricing system and market transactions and pricing are based on mutual knowledge and understanding by the buyers and sellers (Sanusi and Ndubuaku, 2001). No international standards have been found for kola powder or extracts. This makes it difficult for small-scale processors to gain market recognition and buyers may require detailed chemical analyses of their products. If kola preparations are marketed in the EU or US, the kola should be obtained from a reputable source that observes stringent quality control procedures and industry-accepted good manufacturing practices for the hygienic production of nuts and nut products (Codex, 1972). In the US, products should have designations 'USP.' (U.S. Pharmacopeia) or 'NF' (National Formulary) on the label (USP, 2013). Herbal preparations prepared under USP or NF guidelines should meet nationally recognised strength, quality, purity, packaging, and labelling standards.

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3

3.4.3 Macadamia nuts

Of the nine species of macadamia tree (or ‘maroochi’ or ‘bauple’) only two, *Macadamia integrifolia* and *Macadamia tetraphylla*, are commercially important. The others have poisonous or inedible seeds. Macadamia nuts are spherical, ≈2.5 cm in diameter with green, fibrous outer husks and hard brown shells (pericarps) (Fig. 3.4.6). Inside the shell, the kernels (the macadamia ‘nuts’) are ivory-coloured and glistening.

Fig. 3.4.6. Macadamia nut and kernel (Courtesy of Macadamia Processing Co. Ltd)

Macadamia nuts are one of the most valuable luxury nuts and are usually sold as snack nuts or used in chocolate-covered confectionery. As with other nuts, macadamia whole kernels are more valuable than halves and pieces. Broken nuts may be used as an ingredient by ice cream manufacturers and the baking industry. Macadamia kernels contain up to 80% oil, which can be extracted by cold-pressing rejected or culled nuts. The oil, which is liquid at ambient temperatures, has a smoke point of 210°C, making it suitable for use as a frying oil. The refined oil is clear, slightly amber-coloured with a faint nutty odour that also makes it a desirable salad oil. The oil also has the highest amount of monounsaturated fats of any seed, containing 19 - 22% omega-7 palmitoleic acid. Some varieties contain approximately equal amounts of omega-6 and omega-3 fatty acids. This makes macadamia oil a highly valuable ingredient for use in the cosmetics industry, especially for use as an emollient in soaps, sunscreen creams and in hair creams, conditioners and shampoos (Table 3.4.7). Other derivatives of macadamia oil used in cosmetics include the emollient ethyl macadamiate and water soluble PEG-16 macadamia glycerides, which are used for clear gel formulations, including shower gels, hair gels and sun screen gels.

Macadamia butter (Table 3.4.7) is made by grinding roast nuts to a paste and blending in a small amount of coconut oil to make the butter spreadable, together with salt and/or honey to taste. It has a shelf life of two months under refrigeration.

Product	**Retail price**	**Price ($/kg or l)**
Whole snack nuts – raw	Aus $19.50/kg	17.94
Nuts (South African)	£9.99/500g	29.97
Broken nuts	£15.75/kg	23.62
Dry roasted nuts	$Aus 22/kg,	20.24
Honey roasted nuts	$Aus 24/kg	22.08
Nibbed nuts (4mm to 8mm in size)	£16/kg	24.00
Salad oil	$Aus 20/2.5litres	7.36
Organic salad oil	$13.99/16 fl.oz	29.58
Butter	£8.94/170g	78.88

Macadamia Natural Oil Healing Oil Treatment	£23.95/125ml	287.40
Macadamia Healing Oil Treatment	$68/10oz	239.86
Macadamia hair masque	$33.00/8.5oz	136.93

Table 3.4.7. Retail prices of macadamia products (From Healthy Supplies, 2013; International Macadamias Ltd., 2013; Ulta, 2013; Verbena Products, 2013; Natural Choice, 2013; Beautybay, 2013; Now Foods, 2013)

Notes: prices at March 2013. Currency conversions: £1 = US$1.5, Aus $1 -$0.92.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Comparing retail prices it is apparent that, in contrast to cashew nuts, broken macadamia nuts retain a considerable proportion of their value. Extracted macadamia oil has a much higher value when used as a cosmetic compared to its use as a salad or culinary oil, and organic certified oil is over four times as expensive as non-organic oil.

Macadamia kernels have a high demand in most countries and there is also potential to enter the markets for macadamia butter and oil. Small-scale processing equipment is relatively affordable by most processors and the level of skill required by operators is achievable in most areas. However, to gain a market share, small-scale processors must be able to demonstrate that they can process consistently high quality kernels. To compete successfully with established processors requires strict adherence to hygiene and quality standards, and development of a brand that is recognised for its quality, plus the ability to supply the volumes required. Other issues for new entrants are a delay of up to five years between planting macadamia trees and the first harvest; difficulties in harvesting and the absence of a harvest season, each of which adds to the costs of production. The established market connections of large-scale processors in Australia and South Africa may also make it difficult for smaller processors to enter the market. For most small-scale processors the main selling route for roasted macadamia kernels is either local high-value buyers (e.g. hotels, airport shops) or via local agents who act for importers. It may also be possible to establish direct relationships with US, Japanese or European processors that pack and market macadamia nuts. Exports of bulk kernels to large wholesalers in the consuming countries are also possible.

They re-package the nuts after roasting and salting and sell them to retailers. However, processors may achieve lower prices from wholesalers than sales of roasted nuts in local markets. Other products (macadamia butter and oil) that have specialist niche markets for health foods may be accessible directly by sending samples to the retail companies. Oil used for cosmetics is likely to be sold via specialist supply companies that standardise and grade the oil for cosmetic manufacturers. Other macadamia derivatives for cosmetics are not likely to be produced at a small scale.

World production and consumption

Australia is the largest producer of macadamia nuts, supplying ≈40% of the approximately 100,000 tonnes of nut in shell (NIS) produced worldwide each year. The total estimated world production of kernels is ≈30,000 MT, with the main ACP producer countries being South Africa, Kenya and Malawi (Table 3.4.8).

Country	**2008**	**2011 (Estimated)**
Australia	10500	8200
South Africa	**5600**	**8514**
USA (Hawaii)	3750	5000
Kenya	**2000**	**2400**
Malawi	**1523**	**2475**
Guatemala	1250	1427
Brazil	750	780
World Total	26123	29,265

Table 3.4.8. World macadamia kernel production (MT) - top seven producers (Bekker and Lee, 2009 and INC, 2012)

Annual production in South Africa grew on average by 17% from 1991 to 2008 and growth is predicted to continue (Bekker and Lee, 2009). There are ≈1000 farmers involved in growing macadamia nuts that are supplied to 12 cracking factories. A number of these growers have achieved GLOBALGAP accreditation and many of the cracking facilities are HACCP and/or ISO 9001 accredited (see Section 4.2).

The largest consumer of whole kernels is the US (51%) followed by Japan (15%) and Hong Kong, with significant imports to Netherlands, Belgium, Spain, UK, Germany, Luxembourg, China and Vietnam. However, the amounts are much smaller than other nuts: for example, the UK imports 700-800 tonnes of macadamias per year, compared with 60,000 tonnes of cashews.

Processing

3

Because macadamia nuts mature at different times, mechanised harvesting machines that dislodge nuts from trees cannot be used. Ripe and unripe nuts look identical, so producers wait until the fully ripened nuts fall to the ground and gather them by hand. The lack of mechanisation increases the cost of production, but in larger plantations, blowers may be used to blow the fallen nuts into windrows that can be collected by machine (Williams, 2010; Holmes, 2012).

Box 3.4.4. Requirements for a secure supply of macadamia nuts

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply nuts for high-value macadamia products:

Locations where they grow:	A hot subtropical climate without high humidity and temperatures that is frost-free.
Soil type(s) required:	Rich well drained soil
Annual rainfall requirement:	≈130 cm
Time from planting to first crop:	5-12 years
Typical annual yield of nuts per tree:	2kg at 5 years to 55kg at 25 years
Productive life of the tree:	40 years
Height of tree (for manual harvesting):	Not applicable, collect from ground.
Other considerations:	Trees are biennial, so alternate years produce light then heavy crops.

The macadamia kernel is surrounded by a husk and a shell (Fig. 3.4.6). The husks should be removed as soon as possible, within a day or two of harvest, to prevent mould development. The nuts are dehusked using rotating double rollers. Freshly harvested, dehusked nuts contain 20-25% moisture and must be dried slowly in the shade on wire frames for at least two weeks before storage. If fresh nuts are exposed to the sun or dried too quickly, the shells may crack and allow access by insects when the nuts are stored. To prevent mould growth, air must circulate freely between the drying frames or a fan may be used. When dried to ≈10% moisture, the kernel becomes loosened from the shell, which can be checked by shaking the nut to hear the kernel rattle (seeds that do not rattle have not dried sufficiently). Before storage, nuts are sorted to remove undersized nuts (<1 cm) and those that are discoloured or have cracks or worm holes. Before cracking the stored nuts are further dried in large containers through which warm air is circulated at 40-43°C for 2-3 days. This reduces the moisture content and makes the shell brittle and easier to crack. If drying is too rapid or the temperature is too high, the kernels may be unevenly dried, change colour or have brown centres when roasted. Lower temperatures also ensure less damage to the oils within the kernel. At some processing facilities, nuts are stored in cool rooms prior to cracking to maintain a high quality.

If nuts are sold in-shell to processors, the growers are paid according to the percentage kernel recovery, quality and weight, adjusted to 10% moisture with deductions made for immature, mouldy, insect damaged or germinated kernels (AMA, 2013). They are graded by calculating the 'crack out' as follows: a random sample of nuts is taken, weighed and cracked. The kernels are weighed and calculated as a percentage of the nut-in-shell weight (or 'crack-out') (GCMA, 2013). 'Premium' grade nuts have a crack out of 36% or higher, whereas 28-35% crack out are graded as 'Regulars'.

Macadamia nut shells are the hardest of all nut shells, requiring a pressure of 20 kg per cm^2 (300psi) to break them (AMA, 2013). At micro-scales of operation, the shell may be cracked using a vice or hammer: the shell is first compressed until it lightly fractures and then the nut is re-positioned to crack it along a different plane. At small- and medium-scale production, nuts are graded by size and cracked mechanically in a shelling machine, either between counter-rotating steel rollers or between a rotating roller and a fixed plate. The distance between the rollers or the roller/plate is carefully adjusted according to the size of the nuts, causing them to crack without damaging the kernels inside. The kernels and pieces of shell are separated using a series of blowers and trommels (size sorters), and kernels are graded into wholes and broken pieces (a video clip of the process is available at You Tube, 2008). Raw macadamia kernels are vacuum packed and should be stored in a cool, dry, well-ventilated area. Under these conditions, they have a shelf life of 16-18 months without any serious quality deterioration.

The kernels may be sold raw or further processed by frying in oil or dry-roasting. Dry roasting takes place on wire trays in an oven at 135°C for 20-30 min or until they reach the required golden colour. For salted nuts, the roasted kernels are lightly coated with salad oil and dusted with salt. Kernels are sorted and cleaned before and after roasting using hand-sorting, screens, tilt belts, magnets and aspirators. At larger scales of processing, automatic colour sorters and metal detectors are also used. Kernels are packed in foil laminate pouches that have been flushed with nitrogen or carbon dioxide to ensure the oxygen content is less than 1.5% and stored in cool storage (15-25°C). Gas-flushed packs or vacuum packed macadamias having a moisture content of 1.5% or less have a shelf life of 12-18 months at ambient temperature (up to 38°C), provided that the packaging material has a low oxygen transmission rate and a low water vapour transmission rate (e.g. laminates of biaxially oriented nylon, aluminium foil and linear low density polyethylene). The standard net weight used in international trade of 11.34 kg (25lb) of macadamia kernels can be contained in a pouch measuring 550 x 610 mm. When removed from the vacuum

Fig 3.4.7. Some products containing macadamia nuts (Courtesy of Macadamia Processing Company)

pouch, raw macadamia kernels maintain their freshness for at least 2 months if kept refrigerated in an airtight container. If kernels are stored at ambient temperatures unpackaged, or in packaging that has unsuitable barrier properties, quality deterioration in the form of off-odours and flavours may be detected after 3-4 weeks, after which the kernels become rancid.

Quality specifications

The international trade in macadamia nuts has quality standards for colour and whole or broken nuts. Whole kernels are sorted into four quality grades or 'styles', from style 0 (premium grade), to Style 4 (broken pieces). Another four styles (5-8) are used for broken kernels (Table 3.4.9). 'Wholes' are kernels that are not split or separated into halves, with not more than 25% of the kernel missing, provided that the kernel contour is not materially affected by the missing portion.

Grade	Quality characteristic
Style 0	Greater than 20mm with minimum 95% wholes
Style 1	16mm & 21mm with minimum 90% wholes
Style S1	13mm to 17mm 95% wholes
Style 2	Greater than 13mm with minimum 50% wholes and large pieces ranging in size from 13mm upwards
Style 3	Greater than 13mm with minimum 15% wholes
Style 4L	Greater than 13mm with minimum 90% halves
Style 4S	9-15mm with minimum 50% halves
Style 5	8-13mm large chips
Style 6	5-9mm chips and pieces
Style 7	3-6mm chips
Style 8 (Meal)	Less than 4 mm

Table 3.4.9. Quality grades for macadamia kernels (SAMAC, 2013)

Kernels are also graded by colour: light-coloured whole nuts are classified as Grade I or 'fancy' nuts, and darker-coloured nuts or those that are not within a standard size range are Grade II. Grade I nuts are used for roasted snack nuts and Grade II whole nuts, chips and half nuts are processed for other uses in which size and colour are less important. Quality standards for macadamia oil include colour, density, refractive index, rancidity (free fatty acids and peroxide value), hygiene (Coliforms and *E. Coli*), moisture content and an analysis of the free fatty acid composition (Olvea, 2013).

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Smaller scale tree nut production in ACP countries

In contrast to internationally traded tree nuts above, until recently the nuts and fruits described in this section (Table 3.4.10) have only been traded locally and have traditional uses as foods, medicines and cosmetic applications. There is now considerable interest by international consumers and manufacturers in many of the oils and other products that may be produced from these tree nuts and as a result they have a higher value than in local markets. Except where otherwise described, it is assumed that the majority of processing is undertaken by manual methods because little published information has been found. Most products have few published quality standards and these are agreed between individual buyers and producers according to their requirements.

Region	Trees
Africa	Baobab, Gabon, Irvingia, Kukui, Marula, Mongongo, Moringa, Trichilia, Ximenia
Caribbean	Kola, Nutmeg
Pacific	Chilean hazelnut, Kukui (Candlenut)

Table 3.4.10. ACP trees that may be harvested to produce high-value products

3

The World Health Organization (WHO, 2007) has developed Guidelines for Good Agriculture and Collection Practice of Medicinal and Aromatic Plants (GACP) that are applicable to these products. They provide quality standards to ensure that the microbiological load is reduced to a minimum and that negative effects on the plants are limited during cultivation, processing and storage. These control systems help the manufacturer to produce safe, high quality products and virtually all importers require them to be followed. Further details are given in section 4.2.

Other ACP tree nuts that are not included in this section are: Mamoncillo (only the fruit is used for jams and juices); Maya nut (mostly found in Latin America as a traditional food (see MNI, 2013)); and the Paradise nut, which is mostly found in Latin and South America (although it also flourishes in Trinidad) where the nuts are a traditional food and yield oil that is suitable for cooking.

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3.4.4 Baobab

There are eight species of baobab tree (*Adansonia* sp.); six are native to Madagascar and one each to mainland Africa and Australia. *Adansonia digitata* is widespread in arid areas of Africa, growing in savannahs in Angola, Namibia and East Africa and across the Sahelian region from Mauritania to Sudan. Their occurrence is very limited in central Africa.

Box 3.4.5. Requirements to secure a supply of baobab fruits

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply seeds for high-value baobab products:

Locations where they grow:	Mauritania to Sudan and south to southern Africa
Soil type(s) required:	Sandy
Annual rainfall requirement:	Low
Time from planting to first crop: years	16 - 25 years, mature at 60
Typical annual yield of fruits per tree:	160 – 250 fruits
Productive life of the tree:	>1000 years
Height of tree (for manual harvesting):	25-30 m

Baobabs are deciduous, shedding their leaves during the dry season and storing water inside the swollen trunks to survive droughts. Trees usually grow as solitary individuals and require harvesters to climb the trunk to reach the fruits. Baobab fruits are 15 - 20 cm long and weigh ≈1.4 kg. In Southern Africa they are harvested during the dry season from May to September and, where they are surplus to local requirements, they are processed from June to December. In West Africa fruits are collected in the January to May dry season.

Environmental note

In Sudan, Osman (2013) reports that over-use of baobab has become a significant problem due to high year-round demand for fruits. In cities, seeds are thrown away, so eliminating any chance of regeneration. As a result, tree stocks are decreasing and no provision has been made for replacing them. In the past baobab fruits were widely eaten by large animals that dispersed seeds, but because of habitat destruction and illegal killing, the natural regeneration of baobab has been adversely affected.

Fig. 3.4.8. a) Baobab fruit (Courtesy of Lu'u Ly), b) opened fruit (Courtesy of Rafael Medina)

Production and consumption

Although locally important as a food and medicine, baobab products are not considered particularly high-value in the countries of origin. Their value in industrialised countries comes from the nutritional value of the powdered fruit as a dietary supplement and the properties of baobab oil for use in cosmetics. Interest in baobab fruit powder as a high-value food has increased in Europe and the USA since the EU approved its use as a 'novel' food ingredient for consumer products in 2008 (FSA, 2008; EU, 2008) and the US Food and Drug Administration granted 'generally recognized as safe' (GRAS) status to dried baobab fruit pulp as a food ingredient in 2009 (FDA, 2009). The fruit is very high in fibre (a serving of 10g per day provides 30% of recommended daily intake) and contains high levels of calcium, antioxidants, vitamins and minerals that are not found together in other fruits. Since approval, it has been marketed as a 'superfruit' and in 2010 the potential international market value was estimated at US$1 billion per year (Lange, 2010). It is promoted as a '100% natural and organic' dietary supplement and as a healthy addition to diets for diabetics and people with coeliac disease. The marketing strength of baobab fruit powder is the combination of nutritional and health claims (few of which have been scientifically validated). Among the beneficial effects claimed for regularly eating baobab fruit powder are: a reduction of tiredness and fatigue; maintenance of normal blood pressure; normal function of digestive enzymes and the immune system; it helps to achieve and maintain a healthy weight; helps to protect cells from free radical damage and contributes to the normal formation of collagen in skin to maintain skin health and prevent ageing. Baobab is also claimed to have one of the highest antioxidant capacities of any food (Aduna, 2013). Baobab is also said to protect against inflammation-related conditions, including type 2 diabetes, arthritis and allergies, as well as heart disease and cancer (Wong, 2012). It is added to a wide range of foods and drinks, such as fruit 'smoothies', juices, cereals or yoghurts, to supplement the recommended daily allowances of soluble (prebiotic) and insoluble fibres, antioxidants, vitamins and minerals. It is also marketed as an ingredient for the production of fortified yoghurt, bread, cakes, biscuits and ice-creams (BFCS, 2013).

The commercialisation route taken by companies to bring baobab fruit products to markets in industrialised countries involves establishing local agents to buy the dried fruit and shipping it to Europe or the USA, where it is standardised, packaged and marketed. Examples of companies that are processing baobab include Aduna in the UK (Aduna, 2013), Baobab Foods, Inc. in the USA (Baobab Foods, 2013), and The Baobab Fruit Company in Senegal and Italy (Gruenwald and Galizia, 2005) - a leading producer of organic baobab products that processes over 1000 tons of fruit annually at the main production plant in Senegal. In Italy, the company manufactures dietary supplements as powders or pressed into tablets and cosmetic skin creams and skin tonics. Additionally, the leaves and seeds are processed into cosmetic products in Italy. The mother company markets products internationally, mainly in niche specialty stores but also in pharmacies. Another Italian company, Specchiasol (Italy), manufactures a 'symbiotic' health product from baobab fruit pulp. Gruenwald and Galizia, 2005 report that the health food market for baobab fruit pulp is not saturated and there are other potential sales are as a natural ingredient for the food industry.

Fig. 3.4.9. Baobab fruit products, a) juice, b) kernels, c) syrup (Courtesy of Joseph Hounhouigan) d) powder, e) capsules (Courtesy of Aduna)

For many companies, the core business model is to create demand in Western markets for under-utilised products from small-scale producers in Africa. Some have a developmental and/or environmental ethos along the lines of fair trade organisations: they return a proportion of the profits achieved by the added value to provide sustainable income streams to producers, or via foundations that support social innovation projects in the communities where products originate (Aduna, 2013). They may also work with partners and suppliers to use best-practice forestry techniques to ensure that a sustainable supply of baobab fruit is managed for the long-term. Placing a value on the baobab fruit encourages communities to protect their local trees and generates increased incomes from harvesting and selling fruits and/or seeds (Baobab Foods, 2013).

Box 3.4.6. Selling baobab products in local ACP markets

There is no competitor for his baobab products because the market is new. Most consumers call to get information on the therapeutic properties of the products. The enterprise produces pure baobab syrup and baobab fruit juice sold in supermarkets, at trade fairs and at its own shop. There are no competitors for baobab juice but three for the syrup. The enterprise improved the juice after consumers criticised it for being too sweet and not thick enough. Juice production is now up to 24,000 litres per year and that of pure baobab syrup up to 48,000 litres per year.

Mrs D's business produces different types of fruit juices and nectars (pineapple, mango, guava) and particularly baobab juice which has a high demand due to its unique taste. The quality of baobab juice is related to the proportion of baobab powder used to produce the juice: consumers like juice to have a sweet taste and consistent texture - not too thick and not too heavy. She sells the products in supermarkets, guest houses and restaurants as well as exhibiting products at trade fairs.

In Southern Africa, trade in baobab fruit pulp is overseen by PhytoTrade Africa, a trade association representing producers of natural products derived from indigenous plants in the region. It also has an office in London to advise on the European market. PhytoTrade Africa has committed to the principles of fair trade but is not a fair trade labelling organization and cannot certify its members' products as fair trade products. Members work with local authorities and institutions to educate rural communities in methods of sustainable harvesting. PhytoTrade Africa can help supply baobab products from nine member producers in five countries. It has trained its members in quality control and supply chain management and monitors the quality of products sent to customers (PhytoTrade Africa, 2013).

Currently (2013), retail and wholesale prices are relatively high but with growing competition among producers, it is expected that the price for baobab powder will fall. The prices are variable and are negotiated between individual buyers and sellers.

Product	Retail price	Price ($/kg) of baobab content
Baobab Superfruit Powder	£14.69/250g	89.70
Loose Baobab Fruit Pulp Powder	£17.99/170g	158.73
Baobab Superfruit Tablets	$25.99/(90 x 600mg fruit pulp)	481.30
Baobab Fruit Sachets	£24.99/(30 x 4.5g)	277.67
Baobab Fruit Capsules	£22.99/(90 x 500mg)	766.33
Baobab Fruit Capsules	£24.99/(60 x 500mg)	1249.50

Table 3.4.11. Retail prices for baobab fruit products (From Minvita, 2013; Aduna, 2013; Puritans' Pride, 2013; Revital, 2013; Health Spark, 2013)

Notes: Prices at March 2013. Currency conversions: £1 = US$1.5.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Note on Table 3.4.11:
Considerable value is added to baobab fruit powder by preparing it in sachets or capsules, or as tablets.

Other companies that produce ingredients for the pharmaceutical, food and cosmetic industries also process the fruit powder, including German companies that trade with manufacturers of natural raw materials, Denk (Denk, 2013) and Wild (Wild, 2013), New Food Industry S.P.A. (New Food, 2013) and Industria Alimentare Igea (Igea, 2103) in Italy, KUK (KUK, 2013) in Austria and Flavodor (Flavodor, 2013) in the Netherlands. Companies that trade in dried fruits and powders are potential customers for baobab fruit pulp, including the Swiss company Obipektin (Obipektin, 2013)and the German companies, Molda (Molda, 2013), which is a leading company in the drying sector, and Rabeler Fruchtchips GmbH (Rabeler Fruchtchips, 2013), which processes, packages and trades dried fruits and fruit or vegetable powders.

Processing

The ripe pulp is ivory-coloured with an acidic taste and a flavour reminiscent of grapefruit, pear and vanilla. The percentage of pulp varies from 12 - 16.5% of the total fruit weight; the shell is 45 - 48% and the seeds 38 - 40% (Gruenwald and Galizia, 2005). A detailed description of the chemical composition and nutritional value of baobab fruit powder is given by FSA, undated. Processing baobab fruit pulp has a number of advantages compared to other fruits: the fruits dry naturally on the tree to 10 - 12% moisture content and there are therefore no drying costs; processing pulp does not require expensive technology; and final products may be produced in the country of origin to return greater benefits for processors and collectors. Fruits are cracked open manually or using a small manually-operated machine and the pulp is removed by a machine that is specifically developed for this purpose; the seeds are removed and the dried fruit is ground to a powder; sieved and packaged. If stored in airtight containers it has a shelf life of 24-36 months, which is increased by the addition of sodium metabisulphite. The powder can also be frozen.

Baobab Seed Oil

Baobab seeds are extremely hard and are milled before being cold pressed to produce baobab oil. The oil is golden yellow with a slight nutty odour and high levels of vitamins A, D and E and Omega 3, 6 and 9 fatty acids. It is highly penetrating and is absorbed quickly to restore and moisturise the epidermis and hence softens dry skin. It helps skin retain its elasticity, and is claimed to relieve eczema and psoriasis, and help repair skin damage (Sallamander, 2013). It is used in moisturisers, lotions, creams and other skin care products, as an ingredient in suncare products, skin anti-ageing products, soaps and shower creams, lip balms and lipsticks. It is a base for bath oils and is used in shampoos where it helps add shine to the hair and protects hair fibres. It is also used in massage oils and as a carrier oil in aromatherapy.

Oil is exported to cosmetic manufacturers in Europe and South Africa. The official register for cosmetic ingredients is the INCI system (International Nomenclature of Cosmetic Ingredients) and most importing countries, including the USA, Australia, Japan and EU countries, require manufacturers to submit new cosmetic ingredients for registration in the INCI system. This identifies the ingredient for legal labelling requirements, but is not a guarantee of its quality or safety. A database of cosmetic ingredients in use in the EU is available at CosIng, 2013. The terms '*Adansonia digitata* fruit extract', '*Adansonia digitata* leaf extract', '*Adansonia digitata* seed extract' and '*Adansonia digitata* seed oil' are each registered as an INCI name. The INCI list can be obtained as a CD-ROM, book or website access to the Personal Care Products Council (PCPC, 2013)

Product	Retail price	Price ($/litre)
Pure baobab oil	£5.49/100ml	82.35
Baobab oil	$10.00/30ml	333.33
Organic baobab body oil	£33.74/100ml	506.10
Liquid keratin infused deep conditioning oil with argan and baobab oils	$29.00/2 fl.oz	517.85

Table 3.4.12. Retail prices for baobab oil (From The Aromatherapy Shop, 2013; AAA Shea Butter, 2013; Minvita, 2013; Beauty, 2013)

Notes: Prices at March 2013. Currency conversions: £1 = US$1.5.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Published information on the quality characteristics of baobab oil have not been found and it is likely that these are agreed between individual buyers and sellers.

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3.4.5 Chilean hazelnuts

Chilean hazelnut (*Gevuina avellana*) is an evergreen tree, native to southern Chile and Argentina, but two species also grow in New Guinea (*Gevuina papuana or Bleasdalea papuana*) and Fiji (*Turrillia* sp.). It grows well in temperate oceanic climates with cool temperatures and takes five years before the first nut harvest and up to eight years for a full crop. The tree grows up to 20m tall and produces small dark red nuts, similar to macadamia, that turn black as they mature. Nuts are harvested in March - April and are eaten raw, boiled or toasted. The nuts contain ≈50% oil that is extracted by cold-pressing. The oil is virtually odourless and has a pale yellow colour. It contains a high concentration of monounsaturated oils (80%) and is rich in antioxidants and vitamin E. It blocks harmful UV rays and is therefore used as an ingredient in some sunscreens. It is absorbed quickly into the skin and has moisturising qualities that make it useful as an ingredient in face creams, anti-wrinkle creams, anti-aging formulations, lip-care products, hair products, baby products and shaving creams. It is used as a carrier oil for massage oils, bath oils, soaps and cosmetics and it is also used to treat eczema, psoriasis and other skin conditions (Natural Sourcing, 2013). No evidence has been found of its production in New Guinea or Fiji, but Chilean hazelnut oil from Chile sells for $255/litre (Herbies Herbs, 2013).

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3.4.6 Gabon nuts

The *Coula edulis* tree has a number of names: African Walnut (it is not related botanically to the walnut, but the nuts are similar), Congowood, African nut, Bush Kola (Liberia) and Tigerwood (because the wood is yellow-brown with irregular dark lines). It is found growing wild in the Democratic Republic of

Congo and tropical West Africa from Sierra Leone to Angola, and the tree can also be grown on plantations. However, it has been listed as an endangered plant in Nigeria (Meregini, 2005) and Bonnéhin, (2000) has investigated the possibilities for domestication and on-farm propagation in Côte d'Ivoire. Information has not been found on the requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply nuts for high-value Gabon nut products.

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The nut is 3 - 4 cm long with green to mottled red flesh surrounding an extremely hard shell, which is 5-6 mm thick. The nuts have a taste resembling hazelnut or chestnut and contain 50% fat, of which 87% is oleic acid (Davidson, 2006; Tchiegang *et al*., 1998). Traditionally, the nuts are boiled, roasted and fermented and have wide local acceptability, sold by street hawkers and at rural and urban markets. They are also used to make cooking oil and nut flour. Although the nuts are not themselves high-value (≈$12/kg), the oil is incorporated into candles, which retail in Europe and the USA for $18 each (My Joy Candle Company, 2013). The nut is extremely hard and difficult to crack, but no information has been found on cracking methods or oil extraction equipment. It is assumed that manual methods are used and that the oil is traded through export agents who supply specialist producers (e.g. scented candle makers) but no information on trade routes or prices has been found.

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3.4.7 Irvingia (or Dika) nuts

- There are seven species of Irvingia (also known as African mango, bush mango, wild mango, or 'ogbono' (in Nigeria)). *I. gabonensis* var. *excelsa* is closely related to *I. wombolu*, but whereas *I. gabonensis* has an edible sweet, bright orange pulp, that of *I. wombolu* is slightly slimy and bitter, with the flavour of turpentine. The seeds of both species are edible. *I. gabonensis* has two fruiting seasons from April to July and September to October.

Box 3.4.7. Requirements to secure a supply of Irivingia nuts

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply seeds for high-value Irvingia products:

Locations where they grow:	Tropical Africa north from Angola, including Congo, Central African Republic and south-western Uganda. Also used for shade in cocoa/coffee plantations in West Africa
Soil type(s) required:	Deep soils with moderate fertility
Annual rainfall requirement:	500-2500 mm
Time from planting to first crop:	Up to 15 years for wild trees, but 4 years for planted trees to fruit and 7 - 8 years to give an economic yield

Typical annual yield per tree:	100 - 180 kg fruit, 20 - 35 kg kernels
Productive life of the tree:	n/a
Height of tree (form manual harvesting):	Not applicable - harvest from ground

n/a = information not available

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In local markets, *I. gabonensis* fruits are normally bought for their pulp and *I. wombolu* fruits are purchased for their kernels as these are more suitable for cooking, but there is often no distinction made between the two species. Although farmers sell only a small percentage of their harvest, retaining the remainder for home use, sales can account for a relatively large proportion of their annual income. The price that producers get for Irvingia fruits and kernels depends on the location of the market and seasonal availability, being up to three times more expensive at the start and end of the harvest season (Elah, 2010; Leakey, 1999). Ndoye et al., 1998 found that in Cameroon, the total value of sales over 29 weeks was 34,633,100 CFA francs (US$70,000). The traders' margins were 30% of the total value of sales. These high market values are repeated in Equatorial Guinea, where Sunderland (1998) found that Irvingia seeds were sold more widely than any other forest product. Awono et al. 2009, reported that 2,390,920 kg of *Irvingia gabonensis* was exported from the humid lowlands of Cameroon to Nigeria and 302,050 kg was exported to Equatorial Guinea and Gabon in 2007. Fruit is only traded locally, but thousands of tonnes of kernels are extensively traded each year locally, nationally and internationally from the forest zone to the savanna zone, particularly in West and Central African countries. They are also exported to Europe and the USA, mainly from Cameroon. The combined export trade of

Fig. 3.4.10. Dika nuts (Courtesy of Zz411)

107 MT per year of *I. gabonensis* and *I. wombolu* kernels from Cameroon has been valued at US$ 260,000. Ladipo, 1999 reported the value of the market for Irvingia products in 1975 as US$ 50 million, but more up-to-date data has been difficult to find. Processed Irvingia kernels are also exported to the UK, USA, France and Belgium.

Box 3.4.8. Local sales of Irvingia

The high demand for Assorokouin (Irvingea gabonensis) powder led her to start the business. She has developed many spices but the most promising is the assorokouin kernel powder. The quality criterion used to buy assorokouin kernels is their freshness. The enterprise sells from 1500 to 4500 kg per year of its products in Benin supermarkets, local markets and to wholesalers.

A more recent increase in demand for *I. gnabonensis* has occurred after it was discovered that eating it resulted in greater weight loss and improved blood test results in obese human volunteers when compared with a placebo (Ngondi et al, 2005). The study found significant reductions in weight, waist circumference, hip circumference and systolic blood pressure in subjects taking Irvingia. A further clinical trial (Ngondi et al, 2009) reported both weight loss and percent body fat loss. In another study (Oben et al, 2008), *I. gabonesis* was demonstrated to enhance the weight reducing effects of *Cissus quadrangularis* (Veldt Grape or Devil's Backbone). As a result, there are now many weight-loss preparations on the market in industrialised countries that contain Irvingia. Examples of the claims made for these product include "...you can expect it to suppress hunger, improve/control diabetes and lower bad cholesterol" (Spice Baby, 2013), and "… a natural, healthful dietary supplement. Due to the high fibre content of *Irvingia gabonensis,* African Mango supplements may help with weight loss by stimulating the body's natural metabolism and by acting as an appetite suppressant. The ogbono nut has the ability to increase the body's natural quantity of Leptin, a protein hormone that helps regulate the body's energy intake, including appetite and metabolism. African Mango may also help maintain healthy cholesterol and blood sugar levels." (Only Natural Inc, 2013). Similar claims are made in online newsletters concerned with 'healthy living', for example: "The Incredible Weight-Loss and Fat Burning Capabilities of Wild Mango" (The Healthier Life, 2013). Examples of retail values of products are shown in Table 3.4.13. (Note the considerable increase in value by encapsulating the powder).

Product	Retail price	Price ($/kg)
Ground Ogbono powder	£2.79/100g	41.85
African mango seed	$19.95 to $25.50/60 x 300 mg capsules	1108.33 to 1416.67
Pure African Mango capsules	£29.95/60 x 2400mg	311.98

Table 3.4.13. Retail prices of Irvingia products (From Only Natural Inc, 2013; Australia Healthy Choice, 2013; Evolution Slimming, 2013; The Asian Cookshop, 2013)

Notes: Retail prices at March 2013. Currency conversions: £1 = US$1.5.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Irvingia nut oil has also been evaluated as a biodegradable lubricant and as an alternative diesel fuel (Bello et al, 2011), but no commercial sales outlets have yet been identified.

Processing

The fruit pulp is removed manually and processed into jelly, jam, juice and wine. If the pulp is not required for processing, the fruits are heaped and the pulp is allowed to ferment for 7 - 10 days and is removed by hand. The seeds are sun-dried and can be stored for 6 - 8 months. Fresh seeds are split open using machetes or dried seeds are cracked open using a hammer. In both cases the seed shell splits along a longitudinal line of weakness, exposing the kernels, which are contained in a dark brown testa. The cracking process is both arduous and dangerous and a large proportion of the brittle kernels are broken, which reduces their market value. Research has been undertaken to mechanise this process (Dienagha, 2011). The two flat white cotyledons of the kernel are further dried in the sun on drying racks before sale.
The fat content of kernels varies from 54-67% and they are pounded to produce an edible cooking fat (or butter) that is solid at ambient temperatures. It is extracted by boiling the ground kernels and scooping off the oil from the surface (see Fellows and Axtell, 2012). The butter is used as a

substitute for cocoa butter and for making soap and cosmetics. The press-cake is also suitable for thickening soups and is used as a cattle feed.

Quality standards

The quality characteristics of Irvingia kernels that are important to both sellers and consumers are the appearance (kernel size/maturity, colour, shape, and the extent of blemishes); absence of defects (pest damage or mechanical damage); oil content; flavour/sliminess after processing or cooking; and level of adulteration of *I. gabonensis* with *I. wombolu* kernels. It is important that the two species are kept separate as the required quality characteristics are different in the various markets in which they are sold. Drying the kernels is very important: inadequately dried kernels become discoloured and prone to fungal attack, which is a major quality determinant. Post-harvest attack by insects can also seriously affect market acceptability. High storage humidity and temperatures cause the cream kernels to turn brown and reduce their quality. More formal quality specifications for the kernels have been proposed by Ladipo, 1999 (Table 3.4.14).

Grade	Quality parameters
A	No extraneous debris Moisture content = 8% Cream colour Kernel whole, large, thick and unbroken Kernel powder is very slimy No pest or fungal damage
B	Little debris Moisture content = 8-10% Cream/yellow colour Kernel whole, averagely large, thin and unbroken Kernel powder averagely slimy No pest or fungal damage
C	High debris content Moisture content = >10% Darkish brown colour Kernel size variable/small and thin Kernel powder not particularly slimy Slight pest or fungal infestation
D	Very high debris content Kernels inadequately dried Blackish (mottled) or green (immature) colour Kernel powder not slimy Kernels small, thin or broken Heavy pest or fungal infestation Heavy fungal infestation

Table 3.4.14. Irvingia kernel quality grades (From Ladipo, 1999)

Ladipo, 1999 also proposed a 50% price difference between grades A and B and a 10% price difference between grade B and grades C and D. The intention was to discourage production of grade D.

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3.4.8 Kukui nuts

The kukui tree (*Aleurites moluccans*), also known as the 'candlenut', 'Indian walnut' or 'varnish tree', grows predominantly in Hawaii, South Pacific Islands and in other areas of Polynesia, as well as parts of the Far East and Asia.

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Box 3.4.9. Requirements to secure a supply of kukui nuts

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply seeds for high-value kukui nut products (Only Foods, 2013):

Locations where they grow:	Pacific Islands
Soil type(s) required:	Well-drained light or medium-textured soils
Annual rainfall requirement:	640 to 4290 mm
Time from planting to first crop:	n/a
Typical annual yield of nuts per tree:	30 - 80 kg
Productive life of the tree:	n/a
Height of tree (for manual harvesting):	15 - 25 m
Other considerations:	Cultivation is mostly in plantations Fruits are produced throughout the year

n/a = information not available

Further details of cultivation and management of kukui are given by Little and Skolmen, 1989 and Elevitch and Manner, 2006. The fruit is 4-6 cm in diameter, and contains one or sometimes two, very hard nuts. Traditional uses for the nuts include an Hawaiian condiment known as 'Inamona' made from roasted kukui nuts ground to a paste with salt, which is a key ingredient in the traditional Hawaiian salad 'poke'. The high-value product is kukui nut oil, with nuts yielding 15 - 20% of their weight in oil.

Fig. 3.4.11. Candlenuts (Courtesy of ChildofMidnight)

The highest value is obtained when the oil is used in skin-care and hair products. Retail prices for Kukui nut oil range from $150.00 to $160.00 per litre (Fushi Wellbeing, 2013; Oils of Aloha, 2013). A company in Hawaii produces kukui nut oil (Oils of Aloha, 2013) and others in the USA import the oil (e.g. Island Lotions, 2013; and Mountain Rose, 2013). It is also traded internationally (e.g. Jedwards, 2013). The oil is extracted and used for a variety of industrial purposes including soap-making, varnishes and fuel (in Hawaii, kukui nuts were burned to provide light (hence the name 'candlenut') or oil was burned in a stone lamp with a cloth wick).

Processing

After cracking the shells, the kernels are cold pressed, or oil is extracted using an expeller, and then refined to produce a semi-clear, pale yellow, non-greasy emollient oil having little or no odour. It has a shelf life of two years, provided it is kept away from heat and direct light. It has high levels of linoleic, linolenic acids and palmitic fatty acids, which make it highly suitable for use in skin creams, lotions, hair and scalp conditioners and as a massage oil. The oil also contains Vitamins A and E, which make it useful in anti-aging and revitalising skin creams and for restoring sun-damaged skin. It has been used to treat wounds and burns and for treating the symptoms of eczema, psoriasis and acne. When added to soap formulations, kukui nut oil increases the creaminess of the lather and enhances its conditioning effects. When compounding skin care products, kukui nut oil should be added after all stages that require heating. Essential oils may be mixed with the oil to enhance its fragrance and therapeutic actions. Popular additions include lavender, calendula for healing wounds, helichrysum and chamomile to sooth and reduce inflammation.

No detailed information has been found on quality standards for kukui nut oil, but individual buyers may specify ranges of values for Saponification Value (e.g. 185-195), Iodine Value (e.g. 153-175) and Specific Gravity (e.g. 0.92-0.93) (100% Pure Essential Oils, 2013).

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3.4.9 Marula fruits

Marula (*Sclerocarya birrea*) fruits are harvested between January and May. Fruits fall from the tree while they are green and hard and ripen on the ground within five days. The ripe fruits have a yellow skin with white flesh that is rich in vitamin C (up to 194mg per 100g) with a strong, characteristic flavour. The fruits contain a single thick-walled nut, which has two or more kernels.

Box 3.4.10. Requirements to secure a supply of marula nuts

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply nuts for high-value marula products:

Locations where they grow:	Indigenous to Southern Africa, the Sudan-Sahel region of West Africa and Madagascar. Also found at low altitudes throughout 29 sub-Saharan countries from Cape Verde to Ethiopia to South Africa
Soil type(s) required:	n/a
Annual rainfall requirement:	Thrives in hot, dry climates, tolerates saline water and grows well during droughts
Time from planting to first crop:	5 - 8 years
Typical annual yield of fruit per tree:	500 kg to 3 MT
Productive life of the tree:	n/a
Height of tree (form manual harvesting):	Not applicable - harvest from ground
Other considerations:	Trees are used for reforestation in areas suffering from deforestation and desertification.

n/a = information not available

Fig. 3.4.12. Green marula fruit (Courtesy of Rotational)

The kernels have a delicate nutty flavour and they are eaten raw or roasted as a delicacy, or the ground seeds are added to porridge and meat dishes.
The kernels contain ≈60% oil (*Styslinger, 2010*), which when refined is clear, pale, yellow-brown, also with a pleasant nutty aroma. It is a high-value oil that is both edible and used in skin care products. It is high in unsaturated fatty acids and compares favourably with extra virgin olive oil as a specialty salad oil or for culinary uses. It is noted for its heat resistance and stability against oxidation, making it suitable for use as a frying oil. It is also a non-drying oil and is used as a carrier oil for aromatherapy oils. Because the oil is easily absorbed into the skin, it is used as a body massage oil, an anti-wrinkle cream, and as a base oil for a range of moisturising lotions, skin creams, soaps and candles.

Marula fruits are processed commercially by a number of companies in southern Africa: in Namibia, Botswana, Zimbabwe and South Africa, fruits are collected by villagers and sold to marula processing facilities. In South Africa, ≈ 500 tons per annum of fruit are commercially processed for juice and 2,000 tons p.a. for Amarula Cream (*Styslinger, 2010*). Marula Natural Products Pty. Ltd. is a community-based producer of fair-trade organic marula fruit pulp and marula oil. The company intends to develop extracts for the healthcare and beauty markets, marula oil-based additives for cosmetics, skincare, soaps, perfumes as well as fruit juices, jellies, sauces, beverages and peel chutney. Another company sources marula nuts from community development projects to develop ecological sustainability and economic viability (a benefit-sharing agreement donates 5% of profits to San Bushmen communities).

Box 3.4.11. Examples of the development of marula products

The establishment of small businesses based on a natural resource seems to offer competitive advantages to small-scale food processing businesses, especially if the resource is only available locally. Marula is probably the best-known natural resource in South Africa. Its development has been the focus of many local universities, local and national government departments, large-, small- and micro-scale businesses and NGOs. The greatest commercial success is Amarula Cream, the world’s second-largest selling cream-based liqueur. Its development took several years, with the first product being a white spirit that failed. Its current position on the world market was achieved only after a major marketing and advertising effort. The producer sources all of its marula from communities in the Phalaborwa area.

A medium-sized fruit juice processor used an under-utilised citrus processing line and a large capacity freezer to produce a marula concentrate that was suitable for inclusion in blended pure fruit juices. It had to invest ≈US$ 50,000 for three years to produce sufficient concentrate to interest a US$ 350 million a year fruit juice producer. This would be difficult for a small single-product company to finance. The company eventually developed and launched a blended marula juice called 'Marula Mania'.

PhytoTrade Africa is a non-profit trade association, formed in 2002 that has a partnership with Aldiva, a French company that specialises in producing natural and organic ingredients for the cosmetic industry. Aldiva processes most of the marula oil that is produced in Southern Africa. PhytoTrade report that it took six years from the product concept to reach the point where marula oil was used in a commercial cosmetic, which involved many stages: market research, development of technologies, establishing the supply chain and time for the downstream users to find uses for the oil. Aldiva uses 'green processing' methods to ensure that the raw marula nuts received from community groups meet the strict standards required by the cosmetic manufacturers.

Mr S. has established a company to process the by-products from marula processing (i.e. unfit fruit and pips). The pips are separated from the waste fruit and dried so that they can be stored for extended periods for later processing. An amount of pips is returned to the marula pickers, who manually remove the kernels and return them for oil extraction and processing. The remainder are cracked and pressed on-site. The company sells high-value pressed marula oil to other users as it develops new markets for a range of marula cosmetics and a medicinal product it has developed using the oil - a market that is still developing but holds promise.

Marula fruits are sorted, washed and pulped using pulping machines developed by the company, which give it an advantage over potential new entries. The nuts are cracked to extract the kernel by hand and although the company has developed semi-manual equipment, it has not fully introduced it in an attempt to retain manual labour and benefit the local economy.

The Mineworkers Development Agency (MDA) is a South African NGO that developed marula collection and manual processing to produce 10 MT of pulp per year in 2006 for niche markets. Part of the motivation for manual processing was to create jobs, although high pulp quality and protection against damage to the seeds were also stated. MDA used the hand-pressed marula pulp to produce a shelf-stable version of the traditional marula beer, which is consumed extensively during the harvest period.

Marula oil has great potential, but to take advantage of the opportunities, companies need to be well-prepared, well-organised, well-managed and well-resourced. They have to know the market entry conditions and the standards expected by buyers.

Policy issues for the management and commercialisation of marula are described by Wynberg et al, 2002.

Product	**Retail price**	**Price ($/kg or litre)**
Kernels (dried or roasted)	$10.55/120g	87.92
Marula Oil from Swaziland	£7.95/50 ml	238.50
Marula Oil	£14.40/30 ml	720.00
Botanical intensive oil with blackcurrant/pomegranate and marula oils	$NZ 49.00/20ml	1886.50
Marula organic carrier oil	£14.95/50ml	448.50
South African marula oil	£2.99/10ml	448.50
Marula organic carrier oil	£5.00/10ml	750.00
Fair trade marula oil from Swaziland	£42.00/250ml	252.00
Glamour precious oil	£14.60/100 ml	219.00

Table 3.4.15. Retail prices of marula products (From Cebra, 2013; Oxygen Skincare, 2013; Mystic Moments, 2013; MNP, 2013a; The Aromatherapy Shop, 2013)

Notes: Retail prices at March 2013. Currency conversions: £1 = US$1.5, €1 = US$1.3, $NZ1 = US$0.77.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Note on Table 3.4.15: The very high $/litre prices for marula oil are in part due to small amounts in the packs.

Processing

Marula fruits are sorted, washed and peeled. The fruit is then pulped to produce a pulp having a total soluble solids content of 7.5-15.5o Brix (SAMOPN, 2013). The pulp is the base material for subsequent processing and, because of its relatively high value, some processors freeze it in barrels to retain its quality during storage. Marula fruit pulp is used to prepare juice, jelly, jam and chutney and it is an excellent base for beverages such as soft drinks, nectars and teas. It is fermented to produce marula cider, beer, wines and punches. These are distilled to produce alcoholic beverages such as the commercially produced South African 'maroela mampoer' brandy and marula pulp is added to alcohol to produce 'Amarula Cream' liqueur (section 3.6), each of which are high-value products. In Swaziland, a potent marula drink is so popular that beer sales drop dramatically after the trees bear fruit and Namibia has an official marula wine season (Styslinger, 2010).

Fig 3.4.13. Raw Marula nuts (Courtesy of Paul Venter)

After removing the fruit, the nuts are dried as quickly as possible to ≈4% moisture at which they are stable for many months. The oil content of the kernels depends on the climate, with drier locations producing kernels that have higher oil contents. Manual cracking of nuts is slow and laborious, yielding about 800g kernels per person per day and manual or powered cracking machines have been developed to increase the output. After cracking, the kernels are cold pressed to extract the oil. Marula kernels are difficult to press because they are soft and spongy and contain little fibre. Initially, they must be pressed gently and as the oil is removed, the pressure is increased. A small marula nut oil press, with a nominal throughput of 33 kg per day and a cycle time of 15 min, has been developed (New Dawn, 2013). The presscake is not recycled through this machine, whereas in other presses it is necessary to pass the seed cake up to three times. The raw oil is allowed to settle for 48 hours in drums. This produces oil having a high purity, which is improved by light refining, making the oil more suitable for cosmetic applications. The presscake may be sold as a snackfood.

Marula oil is very resistant to oxidative rancidity due in part to the presence of the natural antioxidant tocopherol (Vitamin E) but it is prone to hydrolytic rancidity by lipases, and all moisture should therefore be removed from the oil. The fatty acid profile is similar to that of olive oil (see MNP, 2013b for details).

Fig. 3.4.14. Marula nut oil (Courtesy of Fushi)

Quality standards

Marula nuts are checked a different stages in the process to remove substandard nuts (those that are infected, discoloured, insect damaged or mouldy). Specific quality standards for marula oil are required by individual buyers and are likely to include a requirement for the Acid Value (a measure of rancidity) below 5.0 (Swazi Secrets, 2013). Periodic checks are also made to ensure the absence of Salmonella, E-coli, yeasts, moulds and pesticides.

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3.4.10 Mongongo nuts

The mongongo tree (*Schinziophyton rautanenii or Ricinodendron rautanenii*), also known as manketti, is found in large groves in distinct belts in northern Namibia, northern Botswana, south-western Zambia and western Zimbabwe. A second area is in eastern Malawi and a third in eastern Mozambique.
The green fruits fall from trees between March and May and mature on the ground. The skin turns red-brown and the flesh softens, turning whitish brown and developing a pleasantly aromatic sweet flavour, comparable to dates. Further information on the tree and its fruits is given by Siloka, 2002.

Box 3.4.12. Requirements to secure a supply of mongongo nuts

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply nuts for high-value mongongo nut products:

Locations where they grow:	Hot, dry climates, widely distributed throughout southern Africa between latitudes 15o and 21° South
Soil type(s) required:	Raised sandy plains, 200 m to above 1200 m
Annual rainfall requirement:	Low
Time from planting to first crop:	≈ 25 year
Typical annual yield of fruit per tree:	≈ 950 fruits
Productive life of the tree:	n/a
Height of tree (for manual harvesting):	Not applicable - harvest on ground
Other considerations:	Cannot tolerate areas subject to flooding Because there are separate male and female trees, solitary trees do not fruit

n/a = information not available

Fruits dry on the ground and remain edible for up to eight months if not damaged by insects. The fruit is oval, ≈ 3.5 cm long and ≈ 2.5 cm wide, with a tough outer skin. It contains a thin spongy layer of edible flesh surrounding a hard nut. The nut shell is thick and, although porous, it is very hard and difficult to crack. The kernel is about the size of a hazelnut (≈ 1.4 g), surrounded by a hard thin seed coat. The taste of the kernel is similar to roasted cashews or almonds.

Fig 3.4.15. Mongongo nut (Courtesy of NoodleToo)

3

Mongongo kernel oil is sold to international buyers. For example, in south western Zambia, more than 3,000 people sell kernels to Kalahari Natural Oils (KNO), which sources oil for international skin care companies. In 2009, KNO produced 12 tonnes of mongongo oil. KNO has been assisted, particularly in its marketing activities, by the Southern Africa natural products trade association, PhytoTrade Africa. Previously, collectors earned ≈ US$100 per year from harvested nuts, but supplying KNO has allowed some to earn four times this amount, with the average annual income doubled. Kernels are transported to central collection points, every 10-15km in the harvesting areas, with one storage warehouse in each district. Training courses have improved quality standards and highlighted the importance of proper handling and storage of nuts to prevent contamination. KNO is also applying for organic certification, and is developing new nut-cracking equipment to speed up the process for the collectors. Further information on KNO is given by Natural Futures, 2013. The company also supplies a range of mongongo products to a supermarket chain in Zambia and is forming links with other South African businesses (Bafana, 2009).

Processing

Whole fresh or dried fruit is boiled or steamed to soften the tough outer skin. The pulp is used to make a sweet, maroon-coloured porridge, which has a taste similar to apple sauce. The nuts are roasted for ≈ 5 minutes, traditionally using a mixture of coals and hot sand to evenly distribute the heat. They are then cracked by hand and the kernels are pounded to flour that is used as an ingredient in meals. The flour contains ≈ 25% protein, an amount similar to peanuts and other protein-rich legumes. Although these products are popular, they are not especially high value and it is mongongo oil that is of interest for this book.

The kernels are cold-pressed to extract the bright yellow oil, which has been traditionally used to moisten the skin. The kernel contains ≈ 57% oil and of this ≈ 43% is polyunsaturated (mostly linoleic acid), ≈ 17% is saturated (palmitic and eleostearic acids) and ≈ 18% is monounsaturated oleic acid. The kernel also has high levels of vitamin E, almost entirely as y-tocopherol, which makes the oil very stable against oxidation. The tocopherol, linoleic and eleostearic acids make the oil useful for skin protection, not only effective in hydrating the skin but also for restructuring and regenerating the epidermis. The eleostearic acid reacts rapidly with UV light, to polymerise and provide a protective layer. The oil is therefore used in a range of skin, sun creams and beauty products, including moisturisers, baby-creams, shampoos, lipsticks, soaps, hair conditioning oils and massage oils (e.g. Shea Terra, 2013). The oil is also used for cooking and for the manufacture of linoleum, varnish and margarine.

Fig. 3.4.16. a) Mongongo oil, b) mongongo balm (Courtesy of Healing Earth)

Product	Retail price	Price (US$/kg)
Mongongo Nuts	$180 - 200/MT	0.18-0.2
Mongongo Nut Oil - Hair Food from the Kalahari	$36.00/4oz	283.46
Mongongo Nut Scrub	$17.00/175ml	97.14
Original Sprout Luscious Island Conditioner with tropical Mongongo Oil	$19.99/8oz	88.06
Ouidad Mongongo Oil Multi-Use Hair Treatment	$36.00/2oz	642.86
Mongongo & Banana Natural Conditioner	$22.00/16oz	48.46

Table 3.4.16. Retail prices of mongongo products (From Mezam Agrocam, 2013; Shea Terra, 2013; Rain, 2013; Curl Mart, 2013; Naturally Curly, 2013)

Notes: Retail prices at March 2013.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Agreements between mongongo oil producers and importers, such as the US company DLG Naturals, which sources and supplies distinctive indigenous oils, are used to bring the oil to health and beauty product retailers in the USA (DLG, 2013). Information on specific quality standards for mongongo oil has not been found, but they are likely to be agreed between buyers and sellers and include chemical analyses for rancidity such as the Acid Value and/or Peroxide Value.

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3.4.11 Moringa

There are 13 species of Moringa tree that are found in three forms: 1) four species of bottle trees that have large water- storing trunks, found in Madagascar, Namibia, Angola, Kenya and Ethiopia; 2) three species of slender trees, found mostly in India and the Horn of Africa; 3) six species of smaller trees and shrubs found in Kenya, Uganda and Somalia (Olson, 2001). *Moringa oleifera* is the main variety that has been commercialised for leaf powder, extracted oil and products that incorporate these ingredients (Table 3.4.17). It is a fast-growing, drought-resistant tree that is widely cultivated in tropical and sub-tropical areas.

Box 3.4.13. Requirements to secure a supply of moringa

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply leaves and nuts for high-value moringa products:

Locations where they grow:	Hot, dry climates, widely distributed throughout Africa.
Soil type(s) required:	Dry sandy soil, tolerates poor soils
Annual rainfall requirement:	Low
Time from planting to first crop:	2 years
Productive life of the tree:	n/a
Height of tree (for manual harvesting):	10m

n/a = not available

Moringa trees have been promoted to combat malnutrition by some NGOs partly because of the high nutrient content of the leaves and partly because the tree is in leaf at the end of the dry season when other foods are typically scarce. It can be grown cheaply and easily and the leaves retain a high proportion of their nutritional value when dried. There are also environmental reasons: moringa trees allow replenishment of shrubs that have been depleted by charcoal burning, which enables growers to benefit from 'carbon credits'. However, as with other crops, their introduction needs to be properly managed (Box 3.4.14).

Box 3.4.14. Expanding moringa cultivation

In Uganda, the moringa tree was massively promoted to rural households during the 1980s and 1990s as a plant supposedly able to cure a number of diseases. Leaves and seeds were intended to be used by herbal medicinal manufacturers as raw materials and this was used to promote its cultivation. However, the amounts that medicinal processors bought were small due to low demand for herbal medicinal products. The result was a massive over-supply and lack of sales, which resulted in farmers uprooting the trees on a wide scale. Currently, there is a shortage in the supply of moringa leaves and seeds for commercial processing in the country.

Box 3.4.15. Developing moringa products

The proprietor, Mr. R., came up with the idea of adding value to moringa while on holiday in Uganda from the USA when he was told by farmers that there was no local market for leaves from their moringa trees. When he returned to the USA, he explored opportunities for moringa-based products and discovered a market for moringa oil. He returned to Uganda with an investment plan to process moringa and, with his brother and sister, registered a company. The trio embarked on buying all available fresh moringa leaves and seeds from farmers in the district and mobilised and sensitised farmers who had previously abandoned moringa, informing them about the company's intentions of exporting the product. Establishing the company's head office in the district and using a local oil mill were some of the strategies to win the trust of once-frustrated farmers. The company is a small-scale enterprise and employs eight full-time workers. It has mobilised local farmers to sustain a stable supply of raw moringa for processing, it has access to export markets and the ability to meet the requirements of these markets. The company's product mix includes moringa oil that is exported to the USA, European countries and Kenya, moringa leaf powder that is sold on the domestic market and seed cake by-product that is sold to the animal feeds industry.

Box 3.4.16. Securing organic raw material supplies

The company established one-stop buying centres, not only to ensure a steady supply of moringa but also to reduce operational costs. In these areas, farming involves minimal use of agrochemicals and can be said to be 'organic by default', which makes conversion to organic production easier. They have also invested in a 25-acre plot of land to grow moringa trees organically. The company manager said: "2012 was a busy planting season for us because we expanded our operations to strengthen the supply chain with the aim of securing a high quality organic moringa. A total of 14 acres of trees were planted and the first full harvest of trees is envisaged in 2013. Once fully mature, the plantation will provide an additional 42 MT of seeds per year for essential oil production. The new leaf plantation is expected to expand the supply of raw materials to 4.5 MT annually."

However, it has been difficult to persuade farmers to grow moringa trees after previous failures to secure markets for their produce; there is inadequate technical expertise to set up and monitor systems that qualify for international organic certification and the procedure to obtain certification requires a high investment; unusual long rainy seasons mean that seeds cannot be harvested until they have dried to a certain moisture level; and increased cost of fuel has raised the transport costs to deliver seeds and fresh leaves to the processing facility.

Moringa leaf is also made into a tisane or herbal extract (section 3.1.2), which is promoted as containing > 47 antioxidants, 36 anti-inflammatory compounds, > 25 vitamins and minerals, and 20 amino acids including all eight essential amino acids (Moringa Source, 2013). Powdered moringa leaves are exported to the USA and Europe, where the powder is encapsulated and sold as a dietary supplement (Table 3.4.17).

Box 3.4.17. Support for moringa development

The business is managed as Ugandan Diaspora-led project that can impact entire communities. It is designed to transform over 1500 subsistence farmers into commercial farmers by creating markets for not only moringa but also for crops such as chilli peppers, neem and aloe vera. These are anticipated to increase farmers' earnings by broadening their market reach. The Ugandan Diaspora in the USA established a membership club in which members contribute funds towards viable projects in Uganda, of which the moringa project is one. The Diaspora's role includes crop selection, agricultural training, product development, supply chain management and international marketing. Some technical support was also obtained from USA-based Africeuticals, which played a critical role in starting the processing activities and offering technical advice.

Although the domestic market for moringa products in African countries is small, moringa leaves are traditionally consumed by people in rural communities to treat common ailments such as high blood pressure and diabetes, as a lactation enhancer for breast-feeding mothers, and for de-worming children and domestic animals. The demand for moringa oil and leaf powder is mainly from the herbal, medicinal and cosmetic industries and the food service/catering sector.

Box 3.4.18. Medicinal uses for Moringa

Moringa leaves are widely used to manage and treat over 200 diseases in Uganda. The company is involved in processing moringa leaves and seeds into moringa powder and oil. The main local buyers of the powder are Kampala-based private health units that use it to prepare multivitamin food supplements, herbal processors and clinics that prepare moringa tea, medicinal herbal aphrodisiacs and cures for joint pains rheumatism, skin disease etc., and cosmetic enterprises that make moringa soaps, baby ointments, beauty lotions and creams.

Mature seeds yield ≈40% edible 'Ben' oil, which is made by cold pressing moringa seeds. When refined, it is clear, odourless and resistant to rancidity. It contains ≈72% oleic acid and is used as a food supplement, in cosmetics and skin- and hair-care products and as a body massage oil. The oil is also used as a machine lubricant and has the potential for use as a biofuel.

Box 3.4.19. Moringa oil

Moringa oil is priced at UG Shs 40,000 (US$16) per litre on the local market and moringa powder costs UG Shs 15,000 (US$6) per kg. Because of the high value and small volume of moringa oil, the company delivers it directly to local buyers or to the company's new outlet in Kampala using commercial private buses or a company motorcycle.

Fig. 3.4.17 Moringa products, a) tea, b) capsules, c) oil, (Courtesy of Moringa Source), d) powder (Courtesy of Michael Lubowa)

Product	Retail price	Price (US$/kg or litre)
Organic Moringa Seeds	£45.00/0.33lbs	454.54
Moringa Oil	£12.00/2oz	321.43
Pure Moringa (Ben) Oil	£26/200ml	195.00
Moringa Body Butter	£11.49/150ml	114.90
Moringa Body Butter	£13.00/200ml	97.50
Organic Moringa Leaf Powder	£48.00/4 x 200g	90.00
Organic Moringa powder for smoothies	£10.99/250g	65.94
Moringa Capsules, 120 capsules each 400 mg of Moringa leaf powder	£24.95	779.68
Moringa Leaf Powder Veggie Capsules	£37.80/3 x 90 @ 500mg	420.00
Moringa Milk Body Lotion	£8.00/250ml	48.00
Handcrafted Moringa Lip Balm 1	£1.99/100g	29.85
Moringa Oleifera Tea	£13.95/24 tea bags (50g)	418.50
Moringa Shower Gel/Cream	£2.00/60ml	50.00
Moringa Soap 2	£2.00/100g	30.00
Moringa Body Mist	£7.50/100ml	112.50
Moringa Eau de Toilette	£8.50/30ml	425.00

Table 3.4.17. Retail prices of moringa products (From Moringa Source, 2013; Greens Organic, 2013; Moringa Mutual, 2010; Body Shop, 2013)

Notes: Retail prices at October 2013.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

[1] Made from moringa oil, raw cocoa butter, shea butter, extra virgin coconut oil, beeswax and honey.

[2] Made from moringa oil, extra virgin coconut oil, cocoa butter, shea butter & olive oil.

Box 3.4.20. Markets for moringa products

The company exports about 95% of its moringa oil production, of which 85% goes to the USA and European countries and 10% to Kenya. Exporting can prove a complex experience, because the distribution channels and actors differ widely from country to country. Oil exports to the EU are sold to intermediary agents/wholesalers whereas in the USA they are managed by one of the company's USA-based personnel and in Kenya the oil is delivered directly to pharmaceutical and cosmetic firms. In the USA, the proprietor Mr R. is a US resident and he coordinates all the company's exports. The company manager, Ms N. says: "sales turnover from USA deliveries is higher compared to European deliveries, despite the lower volumes and higher freight costs involved". The company's export volumes of moringa oil are low compared to a huge demand. It has explored organic market opportunities and the focus is now on certified organic oil as a niche export market. The market opportunities for moringa products in the country are buoyant. Current growth rates of moringa powder for the cosmetic industry are high and present a noteworthy business potential. Ms N. contends that prices for moringa products are attractive for more people to invest in the extraction and processing of moringa.

Box 3.4.21. Product promotion

The company promotes its moringa products through a number of promotional channels that include the following:
Networking at health-related seminars, symposiums and conferences attended by health practitioners, donors, government agencies and pharmaceutical companies.
Exhibitions and shows that are 2-3 day thematic events (e.g. health week, herbal medicines week, save the forests etc.).
Classified adverts in newspapers, FM radio programmes and radio adverts.
On-line advertising in which the company has a website on which it displays its products and receives inquiries and orders from potential export buyers.
Nevertheless, there are still challenges faced by the company in marketing, promoting and advertising moringa, including the need to create awareness

of the benefits of moringa powder as a culinary and a nutritive product. More working capital would enable the company to undertake more extensive market promotion in the local market

Box 3.4.22. Extracting moringa oil

Extraction of moringa oil uses a rented Chinese-made expeller. Ms N. says that: "the power supply in Kampala is usually stable and the outsourcing services are offered at reasonable fees". Production output is 300 litres per month. Ms N. says that: "demand for oil is very high but the supply of seeds is currently inadequate to meet export orders. We need 100 MT per year".

Processing

To make moringa powder, leaves are dried at a temperature below 50-55°C, milled to a powder and packaged. To make oil, seeds are dried on-farm and collected from different areas to build up a sufficient volume to fill a truck, which lowers unit transport costs to the processing facility. After extraction the moringa oil is left to settle for a few days and the clear layer is filtered through muslin cloth and filled into containers ready for export.

Box 3.4.23. Problems with organic certification

Exporting agricultural produce from rural communities requires compliance with US and EU regulations, which requires a high level of internal organisation, communication and transparency. The project currently lacks the finances and organisation needed for certification. The company is training farmers in organic production practices based on EU organic production regulations, but needs formal contractual arrangements to prevent farmers selling their produce to competitors. The company cannot yet export organic oil because of lack of certification. However, as the Managing Director said: "There are difficulties in obtaining organic certification: the markets of the USA and EU each have different organic regulations and the company finds it difficult to meet both regimes. In Uganda it costs thousands of dollars to adhere to the regulations and this requires financial backing.

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3.4.12 Trichilia

Trichilia emetica (or Natal or Cape mahogany) is an evergreen tree that grows throughout sub-Saharan Africa from Senegal to the Red Sea, in East and Central Africa to Congo and South Africa (the name 'Trichilia' is Greek for 'in 3 parts', referring to the 3-lobed fruit, and 'emetica' means with emetic properties). There are 18 species in Africa and six in Madagascar. The round red-brown fruit contains 3-6 shiny black seeds, 14-18mm long, each with a fleshy scarlet aril that almost covers the seed.

Fig 3.4.18. Opened Trichilia ruba fruit showing the red seed (Courtesy of C. E. Timothy Paine)

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Box 3.4.24. Requirements to secure a supply of Trichilia

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply leaves and nuts for high-value trichilia products:

Locations where they grow:	Up to 1800 m, widely distributed throughout Africa.
Soil type(s) required:	Well-drained, rich alluvial or sandy soil and a high water table
Annual rainfall requirement:	500-2300 mm. Capable of withstanding long periods of drought.
Time from planting to first crop:	6-8 years
Productive life of the tree:	n/a
Height of tree (for manual harvesting):	21-30m

n/a = information not available

In southern Africa, fruiting is from December to March and in Tanzania fruit is collected in April to July. Seed yields of individual trees vary greatly and range from 20 - 180 kg/year, averaging 45 - 65 kg. The seed coat is extremely poisonous but skinned seeds are eaten raw or soaked in water and ground to produce a liquid that is mixed with spinach dishes. A sweet, milky liquid is extracted from the arils in some areas.

The seeds yield two types of oil: 'mafura oil' from the fleshy seed envelope and 'mafura butter', also named 'mafura tallow', from the kernel, which is solid below 30oC. The seed envelope contains 35–60% oil and the kernel contains 60–68% fat, which is easily extracted using a simple press. Traditionally, the seeds are immersed in hot water, the seed envelope is macerated and the oil floats to the surface and is scooped off. The seeds are then crushed and the solid fat is expressed or separated by boiling. In commercial production, the oil and fat are extracted together in a single operation (PROTA4U, 2013). Mafura oil is edible, but mafura butter is unsuitable for consumption because of its bitter taste. It is high in palmitic, stearic, oleic and linoleic acids and it exhibits antimicrobial and anti-inflammatory properties. It is used in soap and candle making, as a body ointment, wood-oil and for medicinal purposes. In eastern and southern Africa, oil is extracted on a small industrial scale and used in soap manufacture. Seed is also exported from Mozambique under the name 'mafura nut'. Mafura butter is exported from East Africa, particularly from Mozambique, which exported 100 - 300 MT/year during the period 2000–2004 (Agro-Forestry Tree Database, 2013).

Fig 3.4.19. Mafura butter (Courtesy of Cebra Ethical Skin Care)

Soap is made from unrefined trichilia oil and sold for $ 5.69/75g ($75/kg) via the internet by a not-for-profit company set up to generate income for rural Swazi women (Swazi Secrets, 2013 and Akua Wood, 2013). Trichilia oil is on sale as an essential oil for $11.00 per oz ($392/kg) (Aromatics International, 2013).

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3.4.13 Ximenia

Ximenia americana and *Ximenia caffra* (also known as wild plum, monkey plum or sour plum) are semi-deciduous shrubs or small trees that grow throughout tropical Africa. The fruits, which ripen from September to December, resemble plums and vary in colour from dark red-brown to scarlet and bright orange. The pale orange flesh is edible with a tart almond-like flavour. Fruits of both species are eaten raw and used to make jams, jellies, drinks, a sour preserve and an alcoholic drink. The preserves and drinks are sold for local consumption but are not considered to be high-value products for this book. The fruit contains one yellow seed, up to 1.5 cm long, 1.2 cm thick with a fatty kernel and a brittle shell. Seeds yield ximenia oil, which is the high-value product of interest in this section.

Fig. 3.4.20. Ximenia fruit (Courtesy of Paul Venter)

Box 3.4.25. Requirements to secure a supply of ximenia seeds

The trees have the following requirements and characteristics that need to be taken into account if small-scale processors consider planting trees to supply seeds for high-value ximenia products:

Locations where they grow:	Throughout tropical Africa in hot, low-altitude areas from Senegal and Sudan to Angola and Northern Transvaal.
Soil type(s) required:	Most types, often poor and dry, including clay, loam, sands,
Annual rainfall requirement:	300-1250 mm, drought resistant.
Time from planting to first crop:	n/a
Typical annual yield of seeds per tree:	n/a
Productive life of the tree:	n/a
Height of tree (for manual harvesting):	2-7 m

n/a = information not available

The seed contains up to 67% oil that is an edible, pale yellow, non-drying oil. It is extracted from the kernels by cold-pressing using manual methods. The oil contains polyunsaturated, long-chain ximenynic acid, which increases blood flow in the skin and stimulates the production of sebum moisturiser (Eromosele and Eromosele, 2002). Sebum production in the skin slows down with age and ximenia seed oil is therefore especially beneficial because it hydrates, softens, heals and protects skin from the effects of aging (Esoteric Oils, 2013). Ximenynic acid also has anti-inflammatory properties and the oil can be used on blisters and scars. The oil is used in the manufacture of soaps and hair conditioners, eye-care products, anti-acne products, lipsticks and lip balms. Because it also coats the skin, it is excellent for soothing irritation, for massages, body scrubs or as a moisturizer. A typical retail price for Ximenia seed oil in 2013 was $600/litre (Pure Oils, 2013).

Members of PhytoTrade Africa (PhytoTrade, 2013) export virgin oil from southern Africa to France where it is refined to ensure it meets EU cosmetic standards by a company that specialises in producing natural and organic ingredients for the cosmetics manufacturers. Other companies, including DLG (DLG, 2013) also import the oil. Around three tonnes is produced annually worldwide and cosmetics formulators use it in very low concentrations, with one company, Swazi Secrets, selling pure ximenia oil (Swazi Secrets, 2013). The refined oils retain the natural oxidative stability and antioxidant properties of the virgin oils while also complying with the stringent quality specifications required for cosmetic formulations by international skin care companies. The oil is produced in accordance with social and environmental guidelines, described by a charter that guarantees a supply chain with clear lead times; fair and sustainable pricing; prompt payments; and full traceability (see also section 4.3.6). There is a commitment to biodiversity conservation and management and social and regulatory equity Good Manufacturing Practices (GMPs) and organic certified processes. Further information is available from Aldiva, 2013. Published information on quality standards has not been found and it is assumed that these are agreed with individual buyers.

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3.5 Insect products

This section has two parts: the first describes high-value products from honeybees that have a high demand worldwide; and the second describes other edible insects that are eaten as part of the diet, or sold as snackfoods or novelty foods. Honey is the most important bee product and has long-established regulations and quality standards that must be achieved to obtain high sales prices. Quality standards of other insects are largely unregulated. Insects are popular in many ACP, Asian and Latin American countries, where they can have a high local value. They also have a high value when sold as novelty foods in Western industrialised countries, but they currently have a small market as foods in these countries due to resistance to eating insects.

3.5.1. Honeybee products

The most widely produced products of beekeeping are honey and beeswax, but pollen, propolis, royal jelly, bees and their larvae, are also high-value products that have a ready market in many countries. Honey has by far the largest volume of all insect products sold worldwide: estimates of world trade in honey show total exports of 482,149 MT and total imports of 494,445 MT in 2010. China and Argentina are the largest exporters and the USA, Japan and European countries are the largest importers. By contrast in 2010, Africa exported only 2524 MT of honey and imported 6625 MT; the Caribbean exported 4221 MT and imported 239 MT; and Oceania exported 12,794 MT and imported 3428 MT (FAOSTAT, 2013). There are thus considerable opportunities for processors in ACP countries to increase their participation in the honey value chain, both for local sales and export.

International honey traders buy honey from producers worldwide and offer a complete service, managing every aspect of the supply chain including raw material selection, quality and authenticity testing, logistics management and deliveries. They require suppliers to deliver honey at their specifications and approve the production processes needed for consistent quality. Their quality assurance includes testing for authenticity, impurities and pesticide residues and this enables full traceability back to individual bee keepers. They offer a range of honeys including polyfloral honeys, monofloral honeys and fair trade honeys. Most traders source honey from China, South and Latin America, Europe and Eastern Europe, New Zealand, Australia, USA, Canada and India (FDL, 2013). None has been found that is sourced from ACP countries.

Annual worldwide production of beeswax is 60,000 - 70,000 MT of which around 17,000 MT was traded internationally, mostly for use in cosmetics, candles and polishes. Data on world production of other bee products has not been found.

Production of honeybee products

Honeybee species (*Apis mellifera*) and some of the stingless bees (*Meliponinae* sp.) live in large colonies in either wild nests or in artificial hives constructed by beekeepers (details of different types of hive construction and methods used in beekeeping are outside the scope of this book and are described by a number of authors, including Sammataro and Avitabile, 2011; Jones and Sweeney-Lynch, 2011; and Bush, 2011. There are also a number of free on-line publications, including Kelley, 2013 and Bees for Development, 2013).

In each colony there is a single female queen bee, a seasonally variable number of male drone bees to fertilize new queens and between 20,000 and 40,000 female worker bees. Worker bees secrete beeswax from glands on their abdominal segments, chew it into pliable pieces with the addition of saliva and enzymes and use it to build strong hexagonal cells (the combs) in which the young (brood) are raised and honey and pollen are stored.

Worker bees collect flower nectar, plant saps and honeydew (a sugary liquid, secreted by aphids when they feed on plant sap). The enzymes, including glucose oxidase and invertase, produced by the worker bees, convert most of the sucrose in the nectar to a mixture of glucose and fructose, to produce honey. The temperature inside the hive is maintained by the bees at ≈ 35°C and, together with ventilation caused by bees fanning their wings, this causes evaporation of water from the honey. When the moisture content has fallen below ≈20% and it cannot ferment, the bees seal the honey into the cells with wax cappings. The 'ripe' honey is then stored for use by bees as a source of energy when nectar is scarce or inclement weather prevents them flying. Foraging honeybees also bring pollen into the hive and this is also packed into cells. During packing, the pollen is mixed with nectar, enzymes, fungi and bacteria that transform the pollen into 'bee pollen' (sometimes also named 'ambrosia'). This material has a higher nutritional value than the untreated pollen and is the main source of protein for bees in the hive.

Propolis is a resin collected by bees from trees and plants, which is then worked with wax and mixed with bees' saliva to produce a sticky filler material. This is used to line the inside of brood combs, repair combs and seal small cracks in the hive. It protects the hive from micro-organisms and parasites due to its antibacterial, antiviral and antifungal properties.

Worker bees raise larvae in brood cells. An 'apilarnil' is an almost fully formed drone larva. 'Royal jelly' is secreted by young worker bees and used to feed all larvae and adult queen bees. If a queen bee is weakening through age or illness, or has died, worker bees feed small larvae with large amounts of royal jelly. This triggers the development of the queen morphology needed to lay eggs. The cells of queen larvae are over-stocked with royal jelly and this may be harvested when the queen larvae are about four days old.

The composition of royal jelly, honey and propolis each depends on the location of the hive and the season. This in turn influences which plants the worker bees gather nectar and pollen from, and this can vary by the hour, day or week, so no two samples of these products are exactly identical.

Each of the above products (honey, honeycomb (or beeswax), royal jelly, propolis, apilarnil, bee pollen (or bee bread)) is high-value. Additionally, honey wine, honey vinegar and honey liqueurs have a high value. Some products are used for apitherapy (the medical use of honey bee products - see Stangaciu, 2013) and there are also a large number of foods, health products and cosmetic products that contain honey or honey products as ingredients.

Caution: all bee products may cause allergic reactions, including hives, asthma and fatal anaphylaxis, in people who are sensitive to bees.

Bee products have a wide range of properties and characteristics for which there are no synthetic substitutes; their highly distinctive qualities and, for some people, an almost mystical reputation for their beneficial effects, mean that their use as ingredients enhances a product's value or quality. Even where purchasing power is limited and additional value is not achieved by higher prices, customers may place a higher value on foods that contain bee products and preferentially purchase them. Examples of 2013 retail prices for bee products are shown in Table 3.5.1.

Product	**Retail price**	**Price ($ per kg or l)**
Honey (For comparison, the retail price of bulk supermarket honey ≈ $8/kg)		
Finest quality fir and thyme honey	£7.58/227g	50.08
Spanish eucalyptus organic honey	€5.25/250 g	27.30
Lavender honey	$12.76/250g	51.04
Raw honeycomb square	$24.00/11oz	76.97
New Zealand active Manuka honey, Factor 20+	£27.00/340g	119.12

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Pure English heather honeycomb	£6.60/180g	55.00
English honey with cacao, or infused with ginger root, or mixed with nuts, or vanilla	£4.25/380g	16.78
Beeswax		
Pure bulk beeswax unstrained	£7.14/kg	10.71
Pure beeswax polish	£4.20/200g	31.50
Beeswax candle (Length: 150mm, diameter: 22mm)	£1.33 each	-
Honey & beeswax hand cream	£5.16/200g estimated	38.70
Royal jelly		
Royal jelly capsules - 200mg extract, (600mg royal jelly)	£10.45/600mg	26,125.00
Royal Jelly Capsules (30 vegecaps, 1500 mg per vegecap)	£16.95/pack	565.00
Organic Royal Jelly	£27.50/20g	2,062.50
Propolis		
Propolis Skin Cream	£7.00/50g	210.00
Propolis extract in water	€6.95/30ml	301.16
Bee pollen (or bee bread)		
100% Spanish bee pollen	€3.25/250g	16.90
Pollen Sprinkles (Pollen grains)	£7.60/200g	57.00
Sweet Bee Pollen Granules	£7.99/175g	68.48
Organic Bee Pollen	£15.99/250g	95.94
Honey wine		
Honey mead	£9.99/0.18l	83.25
Honey mead with walnut or almond flavour	£31.98/l	47.97
Honey vinegar		
Honey wine vinegar	$19.95/250ml	79.80
Fire roasted chilli honey vinegar	$11.99/9.5oz	44.52
Sundried tomato & tarragon honey vinegar	$11.99/9.5oz	44.52

Balsamic honey vinegar	$44.99/64 oz.	24.80
Honey liqueurs		
Barenjager	$31.99/750ml	42.65
NV Lourensford Honey Liqueur, South Africa	£14.09/375ml	56.36
Other honey products		
Honey BBQ Sauce	$7.95/11 oz	25.49
Honey butter	$35.89/6 x 8oz cups	158.24

Table 3.5.1. High-value bee products (From Melissa, 2013; Multinectar, 2004; Avanti Savoia, 2013; Savannah Bee, 2013; Paynes, 2013; Healthspan, 2013; Seventh Wave, 2013; Really Healthy, 2013; Manuka, 2013; Greens, 2013; Medovina, 2013; Slide Ridge, 2013; Honey Ridge, 2013; Total Wine, 2013; Wine.co, 2013; Stonewall, 2013; Curdelicious, 2013)

Notes: Retail prices at March 2013. Currency conversions: £1 = $1.5, €1 = $1.3.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

The following section outlines the production and markets for high-value bee products.

Honey

Honey consists of a mixture of sugars, mostly glucose and fructose, plus water and small amounts of minerals, vitamins, proteins and amino acids. Pollen is also a minor, but important component of most types of honey. These components contribute to the different colours and flavours of honey and make it a nutritious food that has a high demand in most regions of the world. Depending on the source of the nectar, some types of honey are more likely to crystallise (or granulate) than others, but there is no difference in other quality characteristics between liquid and crystallised honeys.

Antibacterial properties

Honey has antibacterial activity due to its high sugar concentration (80-82%) and acidity (pH 3.5-5.0) but diluted honey also shows antibacterial activity. This is attributed to hydrogen peroxide, which is a by-product produced by glucose oxidase when honey is formed by bees and which protects immature honey until the higher sugar concentrations are achieved. Honey is used in pharmaceutical preparations that are applied directly to open wounds, sores and burns, where it helps prevent infections, promotes tissue regeneration and reduces scarring (Natural Therapy, 2013). Because of the antibacterial effects and the soothing effects of fructose syrup, honey is used as a remedy for colds and mouth, throat or bronchial infections. Specific benefits are claimed for unifloral honeys made from medicinal plants, based on the assumption that these honeys have similar beneficial activity as the plants themselves, but these claims are not based on scientific evidence. Manuka honey is produced in New Zealand by bees that collect nectar from the manuka bush. In addition to hydrogen peroxide, manuka honey has other components with antibacterial qualities, especially MG (methylglyoxal) which is converted from a compound (dihydroxyacetone) that is found in high concentrations in the nectar of manuka flowers (MG is also present in other types of honey, but in small quantities. Several studies suggest that manuka honey is effective when used on wounds and leg ulcers, in fighting infection and promoting healing (WebMD, 2012). Manuka honey is marketed using a number (e.g. 10+ or 15+) to indicate the strength of the factor, the higher the factor, the stronger the antibacterial strength.

Caution: Although not common, honeys made from some flowering species are toxic, including those from Ericaceae (e.g. Rhododendron, Azalea); Solanaceae (e.g. Datura, Hyoscyamus); Compositae (e.g. ragwort); Lagnonaceae (e.g. Gelseminum); Ranunculaceae (e.g. Aconitum); and some species of the genus Euphorbia in South Africa. Bitter or off-flavoured honeys are produced from many more plant species.

To be high-value, honey has to be differentiated from the bulk honey that is produced by large-scale processors, which has relatively low value. Value is added by selecting unifloral honeys from specific types of plant (e.g. lavender or acacia), or multifloral honeys from specific geographic regions (e.g. those from named forest areas or from regions that are guaranteed to be not contaminated by pesticides). These can have between two and nine times the value of bulk honey (Table 3.5.1). Value is also added to honey by using unusual or attractive packaging (Fig. 3.5.1), or by marketing the honey as a medicinal, gourmet or speciality food (Box 3.5.1). Mixing chopped dried fruits, puréed nuts and seeds, cacao, cream or milk powder also creates products that increase the value of honey. Other methods of adding value include placing a piece of honeycomb in jars of liquid honey, making finely crystallised (or 'creamed') honey, and adding pollen, propolis and/or royal jelly to the honey.

Fig. 3.5.1a-c. Attractive packaging of honey (Courtesy of a) Aaron Landry, b) Peter Fellows, c) Yeshiwas Ademe)

Box 3.5.1. Examples of marketing high-value honey in industrialised countries

"Our Acacia honey is a clear, liquid and very smooth honey. This French honey is produced in Robion, a little village in the South of France." (Saveur du Jour, 2013). (Retail price in 2013 = $55.6/kg)

"We collaborate only with beekeepers that produce 100% pure Greek honey, which is extracted cold and unfiltered so the beneficial properties of the nectar and pollen remain. Our high-quality and carefully controlled production system guarantees that the honey reaches you with its authentic rich taste. Our honey comes in limited quantities due to the traditional methods of production which do not interfere with life in the beehives. Our bees are taken care of in pollution-free areas, protected during the winter then moved during the spring and summer to areas all over Greece." (Melissa, 2013). (Retail price in 2013 = $50/kg).

"Honey is one of the best foods: it contains more than 180 substances, such as organic acids, proteins, amino acids, natural aromatic substances etc. which make it a highly important nutrient. It strengthens resistance to infections;

helps diseases of the digestive and enteric system; benefits the heart and the cardiovascular system, reducing hypertension; aids the composition and decomposition of the liver's elements; has antiseptic and antimicrobial action; has a hydrating action; and it can reduce the multiplication of malignant cells in prostate and breast cancer" (Melissa, 2013). (Retail price in 2013 = $25/kg).

Honey is used as a food in industrialised countries whereas in many parts of Africa it is more often used for brewing honey beer or wine, and in most Asian countries it is used as a medicine or an occasional sweet. The high consumption in industrialised countries (Table 3.5.1) is mostly because it is used as a food ingredient (e.g. in bakery products, confectionary, spreads, breakfast cereals, snack bars, beverages and dairy products) rather than widespread direct consumption. However, industrial buyers do not pay a premium price for honey and this market is not sufficiently high-value to be considered in this book.

Box 3.5.2. Adding value to honey wine

Honey wine is a traditional and cultural drink among well-to-do families. The owner manager worked as an accountant in a government institution for more than 20 years before she decided to run her own business. She was inspired by her mother, who was well-known for her special honey wine. She buys honey that is harvested from bees that gather nectar from specific fields where nigerseed and flaxseed flowers grow year-round using irrigation, which is noted for its special flavour. The honey is bought in 25 - 50 kg plastic containers and filtered through pure white cotton cloth before fermentation. The business is highly profitable due to the added value from using the special type of honey and the high quality and unique flavour of her honey wine. To ensure that the wine has the quality required by customers, the owner assesses the colour, odour, appearance and taste of the honey at the time of buying it. The quality of the wine depends on maintenance of strict hygiene standards and the special and unique flavour that is a secret formula that she is not willing to share with anyone.

In general, light-coloured honeys have the highest value whereas dark honeys are used for industrial products. Mild-flavoured honeys are often preferred, but honeys that have characteristic flavours (e.g. some unifloral honeys such as lavender honey) may have a high value in some countries. In most ACP countries, prices for honey are higher than international prices for bulk honey and if neighbouring countries have low honey production this can be a favourable export market. In general, processing honey for niche export markets in industrialised countries faces high competition and requires very high quality standards.

Box 3.5.3. The importance of honey colour to maintain high value

Mr T. buys, processes and sells honey and specialises in Kaffa honey types, which are very natural and pure. The honey of the first season is pure white due to the flowering trees at that time of year whereas that of the season beginning in September is yellow because of the yellow flowers covering entire fields. Supermarkets, hotels, cafes and restaurants like white honey, whereas honey wine producers prefer yellowish honey. The yield of wine from the honey is also important to wine processors and Kaffa honey has a higher yield ratio compared to others. Mr T. therefore consistently keeps the same colour and taste qualities for each market. To ensure the quality, he visually assesses the colour, odour, appearance and taste at the time of buying the raw honey. He also interviews suppliers to find out which region it has come from and in future he will have buying stations in the Kaffa region.

Comb honey is produced by placing small round, square or hexagonal wooden or plastic frames in bee colonies and allowing the bees fill up the sections with comb and honey. The frames are packaged in a clear container (e.g. a plastic wrap or a cardboard carton with clear window) to protect the product from contamination and breakage during distribution and retail display (Fig. 3.5.2).

Fig. 3.5.2. Packaging for comb honey (Courtesy of Rusty Burlew at Honey Bee Suite)

Alternatively, 'cut-comb' honey is made by carefully cutting pieces of honeycomb to the required shape and size and allowing the cut cells to drain on a wire rack. Once dry, the pieces of honeycomb are packaged as above. Careful handling is required to avoid breaking sealed cells or smearing honey over the comb. This type of honeycomb is regarded as pure and having a finer flavour than processed honey, which can result in a high local demand and a higher price than other types of honey (e.g. $55-77/kg compared to $27-51/kg for other high-value honeys (Table 3.5.1)). An alternative product is to have a small piece of comb packed in a jar and filled with liquid honey that has the same colour.

Box 3.5.4. Constraints on exporting

Once he has built his production capacity to that which needed for export markets, Mr T. is keen to start exporting his honey. However, he has realised that laboratory services for detecting residues in honey and other tests needed for the export business are not available locally, but he is optimistic that the country will have them soon.

Creamed honey is completely crystallised, stable and homogeneous honey having a creamy consistency. It can be produced at a small scale as an alternative to liquid honey and may be preferred by some consumers. It is produced by mixing a small quantity of crystallised (or 'seed') honey into liquid honey at a ratio of 1 kg of seed honey to 9 kg of liquid honey. The mixture may be warmed to 24-28°C to assist mixing and, after filling into retail containers, the honey is then left to crystallise and allow any air bubbles to escape. Crystallisation is completed after 10-14 days. The main disadvantage of creamed honeys in ACP countries is their instability if stored above 20°C for long periods: the crystals may precipitate to the bottom of containers leaving a thick liquid layer at the surface, which is unattractive to consumers.

A note on crystallisation

In some ACP countries, honey is sold as liquid, crystallised or semi-crystallised products, with or without wax particles, whereas in other countries, consumers prefer liquid honey without any particles. Crystallisation is an important characteristic for honey marketing: in temperate climates, most honeys crystallise at normal storage temperatures but above 25˚C virtually no crystallisation occurs. Honeys that have lower moisture and higher glucose contents crystallise more readily, but the presence of particles (e.g. pollen grains) or slow stirring also result in faster crystallisation. Water is released during crystallisation and partially crystallised honey may have an increased risk of fermentation, and is not attractive for retail sales. This is why some processors ensure controlled and complete crystallisation, especially when selling into temperate markets.

Box 3.5.5. Markets for honey

Honey has a good market domestically, regionally and internationally. Added-value processing is financially viable, even when operations are at household-level. The international market for honey is very competitive and Uganda has no competitive edge unless it focuses on organic honey, which can fetch a premium price.

Honey with pollen, propolis and/or royal jelly is made by mixing 100g propolis powder and 125g of finely ground bee pollen, with an optional 1-3g of royal jelly to each kg of honey.

Honey spreads are produced by adding puréed fruits or nuts either to crystallised honey or to liquid honey before it is crystallised. An example of the second method is apricot honey spread: a 10kg batch contains 8.5kg light coloured liquid honey, 1kg finely crystallised seed honey and 0.5kg high quality puréed dried apricots. The mixture is filled into jars, sealed and stored at ≈14ºC until it has crystallised. Another product is made by mixing two thirds honey with one third tahini (sesame seed paste).

Small-scale processors may also wish to consider high-value **honey-containing products** to expand local markets or to increase the diversity of their product range: examples include: confectionery products such as nougat and halva; caramels that have a liquid honey centre; honey yoghurt or ice cream; honey and lemon juice drinks; honey-cured cooked hams; and snack bars made from flaked or puffed cereals, dried fruits, nuts or seeds that contain honey as the binding and sweetening agent. The use of honey in these products enables them to be promoted as more 'natural' in many countries and increases their value.

Honey processing

Most honey produced by small-scale processors is collected from hives and not from the wild. When harvesting honeycombs, only those without pollen or brood cells are selected. In the simplest processing method, honeycombs are broken into pieces and the honey is strained through coarse and then fine cotton or muslin filters to remove wax particles and other debris. The remaining honeycombs are pressed inside a cloth bag to remove as much honey as possible. The clear honey is packed into clean, dry glass jars or other containers and is usually sold locally. At larger scales of operation, the thin wax cap that seals the honey cells is removed using a long, thin, sharp knife dipped in hot water or electrically heated (Fig. 3.5.3). Alternatively, uncapping machines are available that cut the caps using blades or wires.

Fig. 3.5.3. Uncapping honeycomb (Courtesy of Ben pcc)

The frames are then placed in a honey extractor (Fig. 3.5.4), which can range in size from a manual two-frame model to motorised units that extract 20 or more frames at a time. Extractors remove the honey by spinning the frames at high speed, and can have either a 'tangential' or 'radial' design. In a tangential machine, up to eight frames lie against a drum and the outer side of the frame empties as the drum spins. The frames are then turned so that the other side faces outwards and these are spun until empty. In a radial machine, the frames are arranged like spokes of a wheel and honey is extracted from both sides simultaneously. Although honey can be extracted more quickly and completely at higher temperatures, the combs become softer and may break; extraction temperatures should not therefore exceed 30°C.

Fig.3.5.4. a) Manual honey extractor (From Krell, 1996), b) Extractor in motion (From Ben pcc)

The extracted honey is clarified either by straining it through fine nylon or stainless steel filters, or allowing it to settle in large food-grade plastic or stainless steel containers for a few days. Settling tanks are less expensive and labour-intensive than strainers and also enable blending of different honeys to achieve greater uniformity in the final product. During settling, air bubbles, wax particles, insect pieces and other debris float to the surface and are removed. Honey is drawn off near the base without disturbing any sediment.

Honey is hygroscopic and in areas that have high humidity (>60%, see Table 3.5.2) it can be difficult to produce honey that has a sufficiently low moisture content. Osmophilic yeasts can grow in honey if the moisture content is above 19 - 20% with the risk of fermentation, but there is little risk below 18% moisture. If the level of moisture is found to be too high, it can be reduced using a dehumidifier or by blowing air over a pan of honey for several hours using an electric fan. Honey should not be heated to remove the moisture. Krell, 1996, describes a small-scale honey drier, adaptable for solar heating, in which heated air is passed over a thin film of honey running down an inclined surface.

RH of air (%)	Moisture content of honey (%)
50	15.9
55	16.8
60	18.3
65	20.9
70	24.2
75	28.3
80	33.1

Table 3.5.2. Equilibrium moisture content of clover honey at different relative humidities (RH) of air (From White, 1975)

Some processors pasteurise honey for a few minutes at 60-65°C to destroy contaminating yeasts using special heat exchangers that quickly heat and cool the honey and prevent significant damage to its quality. However, any heating reduces honey quality due to loss of components that give its specific aroma, flavour and biological properties, and the loss is proportional to the temperature and duration of heating. Heat-treated honey is also regarded by some consumers as having an inferior quality. If heating is necessary to facilitate handling in cooler climates, it should be to the lowest temperature and for the shortest period consistent with the required quality - which for high-value honeys means heating them as little as possible.

Honey is traded internationally in 300 kg metal drums rather than in retail containers. Storage and bulk transport containers should be made of glass or stainless steel, or coated with food grade plastic that does not impart any odour to the honey. The containers should have airtight lids with openings that are sufficiently large to enable crystallised honey to be removed. Care should be taken to ensure that honey is not damaged by overheating during transport (e.g. parking distribution vehicles in direct sunlight while waiting unloading) and it should be stored away from heat and light.

Retail honey packaging should be airtight and display the product in an attractive way to add value (Fig. 3.5.1). Examples include small portion packs for hotels and restaurants and gift packages that contain honeys having different colours and origins. The preferred material is glass or transparent plastic, with screw-on lids or heat sealed plastic or aluminium foil membranes on plastic cups.

Quality standards for honey

Quality standards for honey have two purposes: 1) to verify that honey is genuine and reveal fraud (such as artificial honey, adulteration with sugar etc.), and 2) to determine its quality in relation to the needs of the market. Because of the wide variations in the qualities of honey (colour, flavour, clarity etc.), the different types of honey and the risk of contamination, this product is more closely regulated and controlled than other insect products. Most national and international buyers use detailed standards to ensure the quality of honey. Although it is customary to call any sweet syrup 'honey'in many ACP countries, and in some this may be legal, in most countries there are laws that define honey precisely. As a minimum the name 'bee's honey' is reserved for products that conform to international standards. International standards and composition limits are defined by the Codex Alimentarius Commission (Codex, 1981) (Table 3.5.3). The standard is used by many commercial buyers: it defines the different types of honey, lists the quality factors that should be assessed, and describes methods of analysis.

Codex Standard for Honey (Codex Stan 12-19811)

Definition

Honey is the natural sweet substance produced by honey bees from the nectar of plants …. which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in the honey comb to ripen and mature.
Blossom Honey or Nectar Honey is the honey which comes from nectars of plants.
Honeydew Honey is the honey which comes mainly from excretions of plant sucking insects (Hemiptera) on the living parts of plants or secretions of living parts of plants.

Essential Composition and Quality Factors

Honey shall not have added to it any food ingredient, including food additives. Honey shall not have any objectionable matter, flavour, aroma, or taint absorbed from foreign matter during its processing and storage. The honey shall not have begun to ferment or effervesce. Honey shall not be heated or processed to such an extent that its essential composition is changed and/ or its quality is impaired. Chemical or biochemical treatments shall not be used to influence honey crystallisation.

Moisture Content

(a) Honeys not listed below - not more than 20%
(b) Heather honey (Calluna) - not more than 23%

Sugars Content

Fructose and glucose content (sum of both):
(a) Honey not listed below - not less than 60 g/100g
(b) Honeydew honey, blends of honeydew honey with blossom honey - not less than 45 g/100g

Sucrose content: (a) Honey not listed below - not more than 5 g/100g (b) Alfalfa (Medicago sativa), Citrus spp., False Acacia (Robinia pseudoacacia), French Honeysuckle (Hedysarum), Menzies Banksia (Banksia menziesii),Red Gum (Eucalyptus camaldulensis), Leatherwood (Eucryphia lucida), Eucryphia milligani - not more than 10 g/100g (c) Lavender (Lavandula spp), Borage (Borago officinalis) - not more than 15 g/100g **Hydroxymethylfurfural (HMF) Content** The hydroxymethylfurfural content of honey after processing and/or blending shall not be more than 40 mg/kg. However, in the case of honey of declared origin from countries or regions with tropical ambient temperatures, and blends of these honeys, the HMF content shall not be more than 80 mg/kg.
Name of the Food Honey may be designated by the name of the geographical or topographical region if the honey was produced exclusively within the area referred to in the designation. Honey may be designated according to the common name or the botanical name of the floral or plant source if it comes wholly or mainly from that particular source and has the organoleptic, physicochemical and microscopic properties corresponding with that origin.

Table 3.5.3. Extract from the Codex standard for honey (Codex, 1981)

Many small-scale producers can only make simple assessments of honey, such as colour, taste and moisture determinations, and most rely on outside laboratories for more detailed analysis. Simple methods for detection of adulteration without laboratory equipment are the taste, viscosity (most adulterated honey is thinner), absence of incorrect odours or fermentation. A simple check to determine whether honey has been adulterated or has a moisture content that is too high is place a droplet of honey in cold water; it should remain intact without dissolving rapidly. If the edges of the droplet start dissolving after a few minutes, the moisture content is too high.

Fig 3.5.5. Testing honey (From Krell, 1996)

Box 3.5.6. Honey quality checks

Mr L. says that to achieve the highest quality he ensures that quality assurance practices are followed right from honey extraction stage to processing into honey-based products. These include strict hygiene when collecting honey from combs, testing the sugar content using a refractometer, ensuring the moisture content is kept below 18%, sterilising glass jars before filling honey and observing high levels of hygiene in the processing facility, including insect-proof windows.

Characteristics that exceed the quality standards may indicate adulteration of honey, for example: a high sucrose content (> 8%) indicates added sugar and a high HMF value (>200) indicates added corn syrup. Honey should have a moisture content <18.0% for top grade (<21% for all honeys) and a maximum HMF <10mg/kg for top grade (<40mg/kg for all honeys). Chemical contamination of honey can occur if antibiotics and other chemicals are used to treat honeybee diseases, to kill wax moths, or hives are located in areas with high levels of air pollution.

The main causes of loss in quality are:

1. HMF, which is not present in very fresh honeys but it is formed slowly during storage and very quickly when honey is heated. The HMF content is therefore used as an indicator of the age of the honey and/or the damage caused during processing or storage. Some buyers require extra-low HMF values for the highest grades.
2. Excessive moisture content that leads to fermentation: the sugar content can be measured using a refractometer (Fig. 3.5.6).
3. Contamination by insects or insect parts, particles of wax, dust etc., which lower the value of the honey.

Depending on the buyer, the composition of sugars and microscopic examination for comparison with the declared botanical and geographical origin are also assessed.

When assessing the quality of honey, the aroma and taste are important quality characteristics, but the colour is the single most important factor that

Fig. 3.5.6. Refractometer (a) Courtesy of Peter Fellows, b) Courtesy of Kandschwar)

determines its value and price, once minimum quality requirements are met. Honey colour may be measured using a Pfund scale (an optical density reading used in the international honey trade) (Table 3.5.4).

Colour Name	Pfund Scale (mm)	Optical Density	Example
Water White	<9	0.0945	-
Extra White	9 – 17	0.189	Citrus (14)
White	18– 34	0.378	-
Extra Light Amber	35 – 50	0.595	-
Light Amber	51 – 85	1.389	Eucalyptus (58)
Amber	86 – 114	3.008	Heather (96)
Dark Amber	>114	-	-

Table 3.5.4. Honey colour measurement on a Pfund scale (Adapted from Anon, 2011)

The US Dept. Agriculture has a voluntary grading system that may be used by buyers, which has standards for two types of honey: filtered honey (in which all or most of the pollen, air bubbles etc. have been removed); and strained honey (most particles of comb and propolis have been removed but pollen and air bubbles remain). The grading system covers four aspects shown in Table 3.5.5.

Rating Factor	Grade/Points
Moisture Content	A – 18.6% max B – 18.6% max C – 20% max
Absence of Defects[1]	A – 37 to 40 pts B – 34 to 36 pts C – 31 to 33 pts
Flavour & Aroma[2]	A – 45 to 50 pts B – 40 to 44 pts C – 35 to 39 pts
Clarity[3] (not for strained honey)	A – 8 to 10 pts B – 6 to 7 pts C – 4 to 5 pts
Total	Grade A – Min 90 pts Grade B – Min 80 pts Grade C – Min 70 pts

Table 3.5.5. USDA Grading system for honey (Adapted from Manley, 1985)

1. Absence of defects = freedom from particles of comb, propolis, or other defects which may be in suspension or deposited as sediment. Grade A: Practically none that affect appearance or edibility; Grade B: Reasonably free, do not materially affect the appearance or edibility; Grade C: Fairly free – do not seriously affect the appearance or edibility.
2. Flavour and aroma = the taste and aroma for the predominant floral source and an assessment of caramelisation, smoke, fermentation and chemical flavours. Grade A – Good, free from caramelisation, smoke etc.; Grade B – Reasonably good, practically free from caramelisation, smoke etc.; Grade C – Fairly good, reasonably free from caramelisation, smoke etc.
3. Clarity (for filtered honey) = transparency and freedom from air bubbles, pollen grains, or other fine particles suspended in the product. Grade A: Clear; Grade B: Reasonably clear; Grade C: Fairly clear.

Other important honey characteristics that are not covered by the grading system but are defined by honey standards and labelling regulations include: purity or added syrups, heating, contaminants, authenticity of labelling (natural, organic, raw, unheated), biological source (floral, honeydew), botanical source, or regional source. The grading system is based on points awarded to a sample using the criteria in Table 3.5.5.

The EU has a number of regulations for honey that supplement general legislation on foods and include the composition and definition of honeys, sales names, labelling, presentation and information on the origin of honeys, which is regulated by rules on the Protected Geographical Indication (PGI) and the Protected Designations of Origin (PDO) of products (EU, 2001).

Honey beer

This product is traditionally produced in non-Islamic parts of Africa. Pressed or drained honey is fermented for 5-6 hours and the beer is consumed before the fermentation has finished. Although production of honey beer is a valuable additional source of family income, it is not considered to be a sufficiently high-value product for inclusion in this book.

Honey wine

Also known as mead in European countries, this is fermented and matured from a few days to several months depending on the type of product. Recipes often include fruits or aromatic herbs (Table 3.1.6). (Production of beers and wines is described in Axtell and Fellows, 2008)

Box 3.5.7. Marketing honey wine

The honey wine enterprise is strong in the growing market in Mwanza and the neighbouring lake regions of Mara, Shinyanga and Kagera, giving it a high sales income and a lucrative profit. The owner's marketing strategy is to focus on promotions in rural areas, direct deliveries to retail outlets and maintaining product quality and a consistent supply to the market. His market share continues to increase and in future he plans to open depots in Bukoba and Tabora, to open a sales outlet in Dar-es-Salaam for both pineapple and honey wines and to penetrate the regional East African market that will include Rwanda, Burundi, Kenya and Uganda.

There is a high local demand and a rising export demand for honey wine from countries where people of Ethiopian origin live. The local sales are mainly to individuals and organisers of special occasions, who each have their own specifications of the type and quality of wine that they require. The owner aims to consistently maintain the quality and sells directly to individuals and event organisers so that she is sure that the quality is not altered somewhere between the producer and consumers, which would defame the business name and make it hard to get approval of end users and hence future orders. The company provides samples and the organisers order their requirements, based on the strength of wine that they require. Similarly, individuals order their requirements for 'hard', 'medium' or 'Berz' types of wine. The owner blends the different strengths of wine to meet the customers' requirements and takes samples and tastes them to make sure that they have an acceptable taste for the market. The success of the business depends on meeting the taste requirements of the consumers and the needs of special occasion organisers, who are the buyers.

Box 3.5.8. Quality of honey wine

All products are made from fresh raw materials and the high quality ingredients provide the honey wine with a very fresh, unique flavour that distinguishes it from other cheaper imitations. Procurement of high quality raw materials is through contracted suppliers who have been trained in the quality requirements of the business. The quality and safety of the product is assured through strict observance of hygiene and sanitation in the production unit, and following good manufacturing practices. Periodic testing of product samples is done at the Tanzania Food and Drugs Laboratory or the National Bureau of Standards. The wines have been granted certification by the Tanzania Bureau of Standards and they comply with other market requirements (e.g. having a barcode).

Honey vinegar

Vinegar can be produced from honey wine in the same way as fruit wine vinegar (details of vinegar production are given in Axtell and Fellows, 2008). It is a gourmet vinegar that is used as an ingredient in dressings, marinades, glazes, sauces and desserts, and has a considerably higher value than malt or spirit vinegars (Table 3.5.1).

Box 3.5.9. Market feedback

Mr. L. says: "When a chef from one the leading hotels tasted my honey vinegar, his eyes lighted up. This shows how the honey vinegar is unusual".

Honey used for vinegar is unmarketable honey that is sterilised by boiling for 15 minutes to kill any micro-organisms. After sterilisation, the honey solution it is fermented for 10 days in 100-litre stainless steel containers fitted with a spout. The fermented solution is filtered using a coarse muslin cloth and inoculated with a starter culture of acetic acid bacteria. The spout allows air to enter freely during the second fermentation for 6-8 months. The vinegar is standardised using an alcoholmeter, filled into bottles and pasteurised in hot water to a product temperature of at least 60°C.

Box 3.5.10. Honey vinegar quality assurance

"For my honey vinegar, the quality control includes regular checking of fermentation rates using a hydrometer and testing for alcohol content using an alcoholmeter. There are also regular checks for mould growth and insect contamination. Standardisation involves testing the acetic acid content using an alcoholmeter". Mr L. says: "After a few weeks of fermentation, it is time to test the vinegar. I check the sugar and acetic acid levels, and of course the flavour. I use a titration kit to determine whether or not the acetic fermentation is complete. Alternatively you may judge by looking for the complete absence of alcohol in the nose and on the palate when tasting the vinegar."

Honey liqueurs

These products have a high value (Table 3.5.1), comparable to other types of spirit liqueurs (see section 3.6). The alcohol in honey liqueur is not produced by honey fermentation, but by the addition of pure alcohol or another distilled beverage such as gin, vodka etc.. Distilled alcoholic drinks that have honey added for flavouring after distillation include Benedictine, Drambuie, Irish Mist and Grappa. Different formulations may be used that involve adding aromatic chopped fruits or fruit pulp, herbs, flowers and/or spices to 70 - 90% alcohol and storing it in a covered container for around one month. The liquid is then filtered through a very fine cloth and honey is added, either directly or after dissolving it in boiled water.

Propolis

The average production of propolis is 10 - 300g per colony per year. The antibacterial and antifungal properties, together with organic and amino acids, vitamins, minerals and bioflavonoids, have resulted in propolis being marketed as a health food. Unprocessed propolis can be used in small pieces or it may be frozen and ground to a fine powder that is taken in capsules or mixed with food or drinks. Owing to its antibiotic and anti-fungal properties, propolis is used in herbal medicines in sub-Saharan Africa. In industrialised countries it is used to protect against dental caries and other oral diseases and by some chewing gum manufacturers to make propolis gum. Its bactericidal and fungicidal characteristics have also led to propolis and its extracts being widely used in dermatological and cosmetic applications. Examples include an emollient for treating skin burns wounds or scalds, ulcers, eczema, and improved wound healing and reduced scar tissue from plastic surgery. It is also used to treat a number of other medicinal conditions including anaemia, respiratory infections, cancer, digestive tract ulcers and infections and liver conditions.

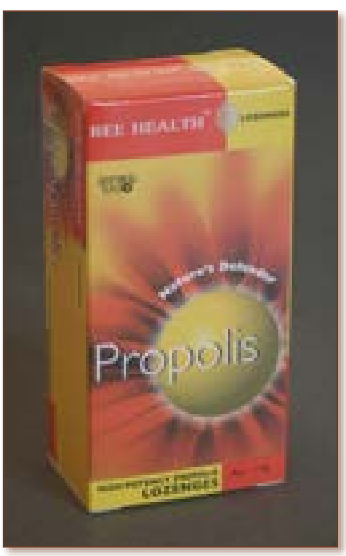

Fig 3.5.7. Propolis capsules (Courtesy of Peter Fellows)

Most commercial uses of propolis as foods, medicines or cosmetics are made from liquid extracts using ethanol as a solvent. It is possible to use vodka or other distilled spirits to extract propolis, but to produce high quality products, particularly for cosmetics or medicines, laboratory-grade 70% ethanol should be used.

Note: In most countries, special laws apply to the manufacture of products using or containing alcohol and processors should obtain a licence where necessary.

The alcohol and propolis are mixed in a container, which is sealed and shaken briefly once or twice a day for up to two or three weeks. The liquid is then refrigerated (but not frozen) and filtered through a very fine cloth or paper filter. The solids remaining from the filtration may be re-soaked in alcohol to extract residual propolis. The filtrate should be clear, free of particles and have a dark brown/reddish colour. The concentrated first extract may contain ≈30% propolis and this may be diluted using the second extract to the required concentration. Higher concentrations of the extract can be achieved by leaving it in an open container for a few hours to evaporate the alcohol. Propolis paste is made by allowing the alcohol to evaporate, or by warming the extract. Simple distillation apparatus enables most of the alcohol to be collected for reuse, which is important to make the process economically viable. All extracts should be stored in clean, airtight and lightproof bottles made from dark glass. If dark glass is not available, bottles should be wrapped with aluminium foil and stored in a dark place, preferably below 12°C. With good control over quality, propolis paste may sell for a considerably higher price than other bee products except royal jelly (Table 3.5.1).

It is difficult to test the quality of propolis or the strength of its extracts and processors should therefore only buy them from producers who have a good reputation. A simple test for propolis activity is to put a half teaspoonful of ground propolis into a small cup of fresh milk and let it stand at room temperature for four days. If the milk is fresh after that time, the propolis is active.

Propolis extracts are included at 1 - 3 % in ointments, lotions, shampoos, lipsticks, anti-cellulite and anti-wrinkle creams, mouth and nasal sprays, and also in tablets, lozenges and tinctures. Propolis syrups are made by mixing the ethanol extract with honey or a sugar syrup. Propolis tablets are made by mixing water with gum arabic and slowly adding the propolis extract and powdered sugar. This forms a dough that is then rolled out to a uniform thickness and cut with metal or plastic rings of the required diameter or shape for the tablets. The tablets are dried at <40°C and stored in clean, dark containers.

Bee pollen

Bee pollen is bitter and yellowish-brown and is used in apitherapy and naturopathic medicine and as a nutritional supplement. It contains vitamins, minerals, proteins, amino acids, Omega-3 oils, folic acid and antioxidants. Suppliers claim that it 'stimulates the metabolism' and that it 'contains an appetite suppressant for people who are overweight and also stimulates the appetite of people who are underweight'. It can also 'smooth fine lines and wrinkles, rejuvenate the skin to prevent premature ageing and stimulate growth of new skin tissue' (Greens, 2013). It is sold in health food stores as encapsulated pollen or pollen tablets (Table 3.5.1) or mixed with honey to give it a more attractive taste. The high prices (e.g. 1kg of pollen pills or capsules is 30 times the price of dried pollen) and relatively simple procedures for extraction, encapsulation or tablet-making make this product suitable for small-scale manufacture by honey processors. To prepare bee pollen into tablets or pills, a paste is made by mixing the pollen with a little honey, gum arabic or beeswax as a binder and pressing it using a simple pill-pressing machine (Fig. 3.5.8). The pills may be coated with beeswax to make them non-allergenic. Alternatively dried pollen, honey/pollen paste or pollen with propolis and/or royal jelly may be filled into gelatine capsules using a manually-operated capsule filler. Capsules should be stored in sealed bottles, preferably refrigerated, and consumed within six months.

Fig. 3.5.8. Pill pressing machine (Courtesy of Huadacn)

Royal jelly

Royal jelly is a fluid paste, whitish in colour with yellow tinges, with a phenolic odour and a characteristic sour flavour. It is rich in vitamins and contains free fatty acids that have unusual and uncommon structures, which give rise to its reportedly unique biological properties. Its consumption has increased despite the lack of scientific data on its clinical effects and users have declared that it can solve most of their health problems, for which other treatments do not work. These include a feeling of general wellbeing, resistance to fatigue, improved intellectual performance, greater self-confidence and feeling of euphoria. It appears to act as a stimulant, improving immune response and general body functions. However, the mechanisms by which royal jelly is active are not known and none of the hypotheses for its activity has been confirmed scientifically. It is sold as a dietary supplement and has a number of claimed health benefits due to its B-complex vitamins, amino acids, fatty acids, trace minerals and antibacterial and antibiotic components. Royal jelly is also used as a component in skin care and beauty products because it is believed to have anti-aging properties.

Royal jelly is not a traditional beekeeping product in ACP countries because harvesting becomes feasible only during queen rearing, when royal jelly accumulates in the queen cells. However, a well-managed hive can produce ≈ 500g of royal jelly over a 5 - 6 month season. China is the world's largest producer and exporter of royal jelly with an estimated annual production of several hundred tonnes, nearly all of which is imported by Japan, Europe and the USA. Other producing areas are the Far East and Eastern Europe. However, because of its very high value (Table 3.5.1), it should be considered by ACP beekeepers and honey processors as a potentially attractive product.

Fig. 3.5.9. Royal jelly (Courtesy of Well Bee-ing)

Royal jelly deteriorates quickly if it is not cooled immediately to below 5°C and it has a shelf life of two weeks in a refrigerator or a few months when frozen. Apart from cold storage and distribution, production and sales require no special technology and they are suitable for small-scale processors. Producers may also sell royal jelly in its original queen cells after removing the larvae and sealing the cells. This is attractive to consumers because it indicates that the product is untreated and fresh. It can also be added into many food and dietary supplements as well as its use in cosmetics and medicine-like products. It is packaged in small, dark glass bottles in sizes of 10, 15 or 20g that correspond to the number of 250 mg 'treatments'. It can also be encapsulated, mixed with honey, sugar syrup or water. Yoghurt enriched with royal jelly is popular in some countries. It is also sold as a 'medicine' in the form of tablets and hard or soft gelatine capsules. Hard capsules may be filled by hand or by small machines at a small scale, but soft capsules need expensive equipment and are manufactured only by larger enterprises.

Apilarnil

This is processed drone bee larvae used as a food, nutritional supplement or cosmetic ingredient, often in powder or tablet form. Larvae are killed, ground, strained through special filters and added to bee pollen. It is claimed to have anti-viral properties, to improve male sexuality and treat gastro-intestinal illnesses.

Beeswax

Honeycomb beeswax is a valuable byproduct and has the potential to increase incomes of both beekeepers and honey processors. Darker wax that surrounds brood chambers is used in crayons and modelling waxes and as a component of shoe, floor, furniture and car polishes and is not considered as high-value product in this book. Further information can be found at for example Interpolymer, 2013 and Zinski, 2013. World production of beeswax is shown in Table 3.5.6.

Country	Production (MT)
India	23000
Argentina	4700
Ethiopia	**4500**
Turkey	4235
Korea	3396
Kenya	**2510**
Angola	**2300**

Country	Production (MT)
Tanzania	**1830**
Brazil	1700
Spain	1600
USA	1600
Uganda	**1220**
Mexico	1966

Table 3.5.6. Main beeswax producing countries in 2011 (FAOSTAT, 2013)
ACP countries are highlighted.

Smaller amounts are produced in Central African Republic, Madagascar, Cameroon, Senegal, Jamaica, Burundi, Sierra Leone and Guinea-Bissau.

There are possibilities to make high quality wax products for local markets in ACP countries and for import substitution. However, there is little evidence of widespread use of beeswax and it is believed that most is either used by beekeepers or exported unprocessed for use in industrialised countries to make cosmetics (approximately one third of imported wax), pharmaceutical preparations (one third), candles (one fifth) and the remainder for other uses. This section gives an outline of the main uses, and examples of prices for beeswax products are given in Table 3.5.1. Further information on the methods used to produce each of the products is given by Krell, 1996.

Box 3.5.11. Use of beeswax

Beeswax is an important byproduct of beekeeping that is produced in great quantities in Uganda and has many uses in the cosmetics industry, for the production of candles and polishes and in the pharmaceutical industry. Mr L. buys beeswax from beekeepers and re-sells it as an intermediate product. However, the majority of farmers throw away the wax or leave it in the hive, despite the high value of beeswax.

Beeswax is safe for human consumption and is used in food processing to coat cheese and as a glazing agent (EU additive e901). It is not digested and passes through the body unaltered. However, substances dissolved or encapsulated in the wax are slowly released. This property is used in medicinal preparations and pharmaceuticals when beeswax is mixed with, or used as a coating for, drugs or pills to slowly release the compounds when they reach the digestive tract. However, any fat-soluble toxins can also be absorbed in the wax and released later when the wax is consumed or used in cosmetics, and only highly purified beeswax is suitable for these applications. There are no other materials that can completely substitute for beeswax: it assists the formation of stable emulsions and increases the water holding capacity to improve the appearance and consistency of skin and hair creams, lotions and ointments. Beeswax is also a preferred ingredient for lipsticks, because it contributes to the sheen, consistency and colour stabilisation. Most industrial users prefer to buy rendered and filtered wax in relatively larger quantities (5-15 MT per batch) and use their own processing methods to guarantee the quality of food products.

Candle-making

3

Well-designed and well-made beeswax candles (Fig. 3.5.10) are expensive and potentially highly profitable for small-scale producers. Beeswax for candles should be free of impurities (e.g. propolis or pollen) that would make the candle sputter while burning. The wax may be dyed with pigments to give different coloured candles. Pure cotton thread is the best material for the wick. The most suitable methods for small-scale candle-making are dipping, using candle moulds, or using wax sheets to produce rolled candles. All candles should be stored in a cool, dark place, wrapped in clean paper or plastic to keep them clean.

Fig 3.5.10. Examples of high quality beeswax candles (Courtesy of Paul Davies of Heathmont Honey)

Dipped candles are made by repeatedly dipping a weighted wick into a bath of liquid wax at 65°C to add another layer of wax, cooling the candles for a few minutes between each dip. Moulded candles use moulds to give the wax its final shape and are more commonly used because the process is easier and faster than dipping. Moulds may be any geometric shape (e.g. cylindrical, egg shaped, conical, triangular) or have an irregular, carved design. Metal moulds are available from internet-based candle-making suppliers (e.g. Peak Candle, 2013), Sculptured silicone rubber casting moulds produce candles in shapes such as animals or ceremonial or religious symbols for birthdays or other special occasions. Rolled candles are made using plain or patterned wax sheets that are rolled around a wax-impregnated wick. Two sheets are made at a time using a smooth, wet, wooden board that is dipped a few times into molten wax (one sheet on each side of the board). Alternatively, the wax is poured into a flat mould. The mould surface may be sculpted to give the candle surface a decorative effect.

Cosmetics

Skin creams provide moisture and replace some of the oils in the skin. A basic cream therefore contains water, oil and beeswax to make the mixture creamy and allow even distribution of the water. Different formulations are used by each cosmetic manufacturer and details of typical formulations are available at a number of websites (e.g. Chemists' Corner, 2013; Specialchem, 2013). Cosmetic applications of beeswax are in cold creams (8-12%), deodorants (up to 35 %), depilatories (hair removers, up to 50%), hair conditioners (1-3%), mascara (6-12%), rouge (10-15%) and eye shadow (6-20%). These products require careful preparation and the use of the highest quality ingredients, but are potentially suitable for manufacture at a small scale. Details of their production are given by (Krell, 1996).

Processing beeswax

Honeycomb beeswax is collected after honey extraction; the yield of wax being 10-20% of the weight of honey. Before processing, all wax pieces should be thoroughly washed to remove honey and other debris. If small amounts of water are used the first washwater can be used for brewing honey beer. The comb is formed (or 'rendered') into a block by melting it gently in warm water or a solar wax melter (Fig. 3.5.11). Wax should not be heated above 85°C to prevent discolouration. Purified beeswax has a relatively low melting point of 62 - 65°C and it may also be softened by adding vegetable oil to make it more workable at room temperatures.

Fig 3.5.11. Solar wax extractor (Courtesy of Simon Rees)

Fresh beeswax is susceptible to attack by wax moths and it should only be stored after being rendered. It should be stored in a cool dry place and never in the same room with pesticides or other chemicals when it is to be used in food, cosmetic or pharmaceutical products. Wax also becomes discoloured by reactions with steel, iron, brass, nickel, zinc or copper containers and therefore stainless steel, aluminium or heat resistant food-grade plastic containers should be used.

Bleached beeswax is preferred for many cosmetic preparations and candles because it is pure white, which permits better colour control of the final product and it has no aroma. At a small scale, beeswax is cut into small pieces and exposed to sunlight on large trays to bleach it. Most commercial processors use chemicals such as hydrogen peroxide to bleach wax or pass liquid wax through absorbent filters made of bone charcoal, Fuller's earth or diatomaceous earth to absorb impurities, but these methods are rarely used at a small scale.

There are industry quality standards for beeswax for each type of product in which it is used, which can be obtained from industry trade associations. Testing methods are described in FAO, 2005. Processors should also beware of adulteration with cheaper paraffin waxes by beekeepers, but their detection is only possible with melting point and chemical tests at a recognised laboratory.

3.5.2 Edible insects

Eating insects is known as 'entomophagy' and there are reported to be up to ≈2000 edible insects and arachnids (FAO 2013a). Globally, the most commonly consumed insect groups are:

- Beetle larvae and adults (Coleoptera) (31% of the total)
- Caterpillars from various species of butterfly and moth (Lepidoptera) (18%) such as bamboo worms, mopane worms, silkworms and waxworms
- Larvae, pupae or adult bees, wasps and ants (Hymenoptera) (14%)
- Mature grasshoppers, locusts and crickets (Orthoptera) (13%)
- Mature cicadas, leafhoppers, planthoppers and scale insects (Hemiptera) (10%)
- Mature termites (Isoptera) (3%)

- Mature dragonflies (Odonata) (3%)
- Fly larvae (Diptera) (2%) and
- Others (5%) including mature scorpions, spiders and tarantulas, myriapods (mainly centipedes), mantises and cockroaches.

Examples of edible insects are shown in Table 3.5.7 and comprehensive lists of edible insects have been produced by FAO, 2013a; Martin, 2013; and Deane, 2013. Insects that are usually avoided are those that either sting or bite, insects that are covered with hair, brightly coloured insects, disease-carrying insects, or any insects that produce strong off-odours.

Edible insect	Notes
Agave (or 'maguey') worms	Larvae of Hypopta agavis or Aegiale hesperiaris, added to tequila and also eaten with a meal in Mexico.
Bamboo Worms	Larvae of the Grass Moth dried or fried as a gourmet treat by street vendors in Thailand and packed for international sales.
Bee larvae	Popular in many countries, sautéed, baked or deep fried. Also often covered in chocolate and sold as a gourmet item in Mexico. Adult bees may be roasted and ground to a flour.
Centipedes	Eaten as a street food in China.
Cicadas	After they moult into adults, skewered and deep fried in the USA, Japan, Thailand and Malaysia.
Cockroaches	Fed on fresh fruits and vegetables for 48 hours to clean the digestive system, eaten toasted, fried, sautéed or boiled.
Crickets	The most widely consumed roasted insect, also eaten fried, sautéed, and boiled in Mexico, Thailand and Cambodia.
Dragonflies and damselflies	Adult or larval forms boiled in coconut milk with ginger and garlic, grilled or fried in Indonesia and China.
Dung beetles	Abdomens are removed, dried and seasoned, fried in South America, often cooked with pork and vegetables.
Escamoles ants	Larvae of the venomous black Liometopum ant. Expensive and known as 'Insect Caviar', served in guacamole or sautéed in Mexico.
Flying ant queens	Roasted with salt and lime juice in Guatemala.
Golden orb spiders and giant wood spiders	Among the few spiders that are eaten, found in areas of the Pacific. Golden orb spider is eaten raw, or roasted in a green bamboo tube over a fire until the tube is blackened.

Grasshoppers and locusts	Eaten dried without wings and legs, roasted with chilli and lime in Mexico, Nsenene is a Ugandan delicacy, prepared fried.
June bugs	Larval and adult stages roasted over coals as snackfoods.
Kanni (Cirina forda)	Caterpillar collected from shea butter trees, squeezed carefully to retain esteemed yellow liquid, then boiled and dried before eaten. Used as an ingredient in vegetable soup in some African countries.
Leafcutter ants	Two genera, Atta and Acromyrmex, eaten toasted as 'popcorn' in South America.
Mealworms	Larvae of the Darkling Beetle, boiled, sautéed, roasted, or fried.
Midge flies (or blind mosquitoes)	Pressed into solid blocks and cooked into 'Kunga cake' in East Africa.
Mopane worms	Processed commercially in Southern Africa.
Mosquito eggs	Dried then roasted, wrapped in a tortilla or served with lime or lemon in Mexico. Dried then roasted, wrapped in a tortilla or served with lime or lemon in Mexico.
Praying mantis	Eaten when young and tender, usually fried.
Rhino beetle	Adult and larvae eaten fried, grilled, roasted and stewed. Clarified larvae fat used as butter.
Sago grubs	Larvae of the palm weevil, fried as a delicacy in Malaysia and Indonesia. Cooked in sago flour and wrapped in a sago palm leaf in Borneo and Papua New Guinea.
Sapelli caterpillars	A delicacy valued for their flavour, dried and eaten in Africa.
Scorpions	Skewered and fried in Thailand and China.
Silk worms	Sold by street vendors in most of Asia and also canned and exported.
Tarantulas	Cooked with salt, oil, sugar and garlic in Cambodia.
Termites	Eaten raw in Kenya, roasted in West Africa.
Wasps	Both adult and larval stages boiled, sautéed, roasted or fried.
Water bugs	Eaten whole, steamed or fried, and an ingredient in Thai sauces.
Waxworms	Larvae of the Wax Moth, fed on bran and honey then roasted or sautéed.
Weaver ant eggs	Eaten directly. Adults are sour and mixed with rice for flavouring. Also used to make a drink like lemonade in Thailand and the Philippines.

Table 3.5.7. Examples of edible insects (Adapted from FAO, 2013a; Martin, 2013; and Deane, 2013)

Box 3.5.12. The importance of insects as cultural foods

The enterprise was established in 2009 by its sole proprietor, Mr. M. at a town on the shores of Lake Victoria in Tanzania to process and market products derived from long-horned grasshoppers (or 'senene' - Ruspolia differens). These are a delicacy and high-value food for people in the Kagera region, who serve them as a symbol of great respect and love between a woman and her boyfriend or spouse. In return the man is expected to buy a symbolic gift for the woman. Senene are also widely consumed as a snack food.

Fig. 3.5.12. Examples of edible insects on sale, (Courtesy of a) Ruth Axtell, b) Takoradee)

Entomophagy can be divided into three different categories: 1) insects used as a source of nutrients as a regular (if sometimes seasonal) part of the diet; 2) insects eaten as snackfoods; or 3) novelty foods or gifts.

1) Insects as part of the diet

The protein content and protein quality of insects are generally high, similar to other animal meats. In the dried form most frequently found in village markets, insects have high levels of protein; above 60% in many species. Insects vary widely in their fat content: larvae of termites, moths and caterpillars are among the highest, and in general insects are a good source of essential polyunsaturated fatty acids (DeFoliart, 1992). Insects are also a significant source of iron, zinc and vitamin A. The nutritional composition of several insects has recently been added to the FAO Food Composition

Database for Biodiversity (FAO, 2013b). Consuming insects has a number of advantages over other types of animal-raising (FAO, 2013a):

- They have high feed to meat conversion efficiency (kg of feed per kg of weight gain). For example, crickets require 1.7kg of feed per kg weight gain compared to 2.5kg for chicken, 5kg for pigs and 10kg for beef cattle.
- They can be reared on waste products, reducing environmental contamination and adding value to the waste.
- They emit relatively few greenhouse gases and little ammonia.
- They require significantly less water than rearing large animals such as cattle.
- They have few animal welfare issues, although it is largely unknown whether insects experience pain.
- They pose a low risk of transmitting infections to humans or other animal species.

Large-scale entomophagy as an alternative to eating animal protein has raised the potential benefits of greater efficiency in land use, feed and water resources, increased food security and greater environmental and economic sustainability. They also have a high output of protein compared to the energy used to raise them. Each kilogram of insect biomass requires ten times less plant nutrients and a small fraction of the space and water requirements compared to meat production (Premalatha et al, 2011).

Insects can be processed in three ways:

1) **Whole insects:** In many ACP countries, whole insects are processed by roasting, frying, drying or boiling to make ready-to-eat foods. Insects are also traditional and nutritionally important foods in many non-Western cultures, particularly in parts of Asia and Latin America where they are considered a delicacy. Caterpillar larvae and locusts are popular in parts of Africa, the most important being mopane worms in Southern Africa, which are commercially processed in large amounts. In Uganda, termites are steamed in banana leaves, boiled or roasted and then sun-dried and/or smoked and dried, and in Botswana and many West African countries, winged termites are roasted in hot ash and sand. Most religions have no restrictions or taboos on consumption of insects, but in Muslim regions the use of insects is very restricted. Only grasshoppers are considered halal

(allowed to be eaten), when they die a natural death or are killed lawfully; nearly all other insects are considered haram. Jewish traditions also consider only a few types of insects to be kosher (Food Info-net, 2013). FAO has a programme to develop insect products in the Asia and Pacific regions where entomophagy has been historically accepted but has declined in popularity (Durst et al, 2008; Verniau, 2010).

Box 3.5.13. Marketing grasshoppers

The current sales outlets for Mr M.'s products include direct sales to local consumers and wholesalers, trade fairs and exhibitions. He also exhibits, promotes and sells products at agricultural shows and other local fairs. The enterprise carries out occasional promotional activities, including publication of newspaper interviews and having its own display/sales point at the central market, where he displays his products and educates customers on the differences between his products.
To make unique products, Mr M. uses his knowledge that grasshoppers have an abundance of natural fats, which can be used to enhance the quality of products - most grasshopper processors roast or fry them in cooking oil, whereas Mr M. processes them in three different ways to satisfy different consumers' requirements and achieve greater market penetration. These are toasting, deep-fat frying and smoking, with or without chilli. The most preferred products are toasted and smoked senene - even though on first glance customers go for the deep fried ones because they are shiny and attractive, but they are not as delicious as the toasted and smoked products. Annual sales can reach Tshs 50 million shillings.

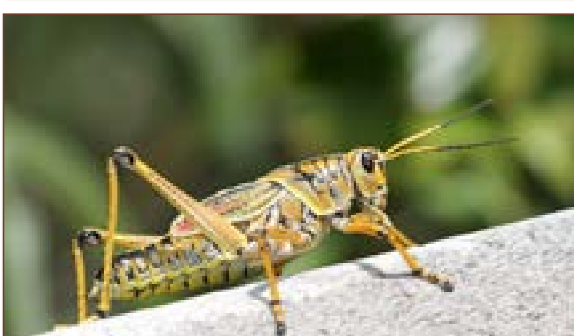

Fig. 3.5.13. Edible grasshopper (Courtesy of Ryan Wood)

2) **Insects ground to pastes or powders:** These are used as part of traditional cuisine in many ACP, Asian and Latin American countries. For example, in the Lake Victoria region in East Africa, seasonal termites and lake flies (*Diptera, Chaoboridae, Chironomidae* and *Ephemeroptera* sp.) are roasted, sun dried, ground and mixed with other ingredients to provide an important source of nutrition for both people and livestock. Crackers, muffins, meatloaf and sausages made from termites and lake flies have been found to have high potential for commercialisation (Ayieko et al, 2010). Throughout the Great Lakes region, sun-dried termites may be crushed using a pestle and mortar and eaten with honey. In societies where consumers are not accustomed to eating whole insects, powders or pastes may be better accepted. Dried insects can also be ground and added to low-protein foods to increase their nutritional value (e.g. the SOR-Mite project, in which a fermented sorghum mixture is enriched with termites and can be consumed as porridge) (Institute of Food Technologists, 2011).

3) **Insect extracts:** protein, fat or chitin may be extracted to fortify food and feed products. Traditionally the fat remaining from fried termites is used to cook meat in DR Congo. At present (2013), the cost of extracting proteins is prohibitive. Wageningen University in The Netherlands has a research programme on the sustainable production of insect proteins for human consumption (Wageningen, 2013).

Western markets

A potentially high-value market is sales of insects to consumer markets in Western industrialised countries, but consumer acceptance of entomophagy is more limited than in many Asian, Latin American and ACP countries and there is a widespread resistance to eating insects (although this is an acquired abhorrence as children often eat them willingly). Insect consumption has periodically been promoted in Western countries over the last 50 years and there is a current (2013) resurgence of interest. In 2011, the European Commission issued a request for reports from each member state on the current use of insects as food, with the intent to inform legislative proposals for novel insect protein foods. The EU is investing more than $4 million to research entomophagy as a human protein source (Schultz, 2012). FAO is also proposing to create an 'International Society of Producers of Insects as

Food and Feed' to complement the existing Association of Insect Rearers for Biocontrol and to develop a code of practice and standards. Special FAO meetings were held in 2012 and 2013 to plan the further development and commercialisation of insect foods and the report of these meetings was published in 2013 (FAO, 2013c).

Insects are sometimes used by restaurants as novelty dishes that do not resemble their insect source (e.g. sushi-style cubes, minced crickets, caterpillar croquettes, dried grasshopper paste) (Eddy, 2012). Other restaurants have insects on the menu (e.g. The Archipelago, 2013), including mealworm faux caviar, pan-fried locusts, and frozen crickets and locusts that are baked until they are crisp and then mixed with chilli and garlic or ginger. Restaurant chefs report crisp insects as being more acceptable than 'anything that is soft and squidgy', which customers tend to be squeamish about (Smithers, 2011). There has been some success in commercialising processed insects in the Netherlands: three insect species (yellow mealworm larvae, lesser mealworm larvae and locusts) are processed for human consumption. One day's fasting is applied to ensure that the insect has an empty gut it is then freeze-dried whole. This produces a safe product with a shelf life of one year if stored in a cool, dry place. Freeze-drying also retains the nutritional value and the capacity of the product to re-absorb water, but it is a very expensive process. Another Netherlands company has introduced insect foods for retail sale, including chocolate pieces containing ground mealworms, whole worm and cricket snackfoods, an Asian vegetable dish with mixed crickets, and nuggets that contain 80% ground chicken and 20% ground mealworms (Tagliabue, 2011). 'Buqadilla' is an innovative spicy Mexican snackfood made of chickpeas and lesser mealworms that is under development for the Dutch market. It was well received in several restaurants where it was tested (van Huis, van Gurp and Dicke, 2012). 'Crikizz' are spicy, popped snacks based on 10-20% mealworms and cassava, developed by Ynsect and French students (FAO, 2013c). According to focus groups, the taste is pleasant and the texture is as crunchy as other snacks. Dutch insect breeders who previously supplied insects for pet foods have seen a new market opportunity and, with government backing, have founded a trade organisation to promote the idea. It intends to prepare legislation governing insect farms, health and safety standards and marketing through retail outlets. Researchers from Wageningen University and FAO have also published an evaluation of the potential of edible insects as a protein source (Klunder et al, 2012) and new report (FAO, 2013c).

Box 3.5.14. Case study: introducing insect foods to Western diets

'Ento' is the outcome of a postgraduate project at the Royal College of Art and Imperial College London, UK that addressed the issues surrounding the introduction of insects into Western diets in relation to environmental and nutritional benefits of eating insects compared to meat (Dasan et al, 2012). It found that most people could accept dishes in which the insect parts were not identifiable, such as biscuits made from insect flour. Even a layer of breadcrumbs was sufficient for many people to find whole insects appetising. Adding insects to existing recipes, such as cricket falafel or insect sushi, produced mixed responses. The team modified a food pairing database (Foodpairing, 2013) and substituted insects for close flavour matches (e.g. baked waxworms taste like roasted pistachio nuts). Using this method they produced >70 ingredients that, in collaboration with a chef, could be used to create new recipes. The team then calculated the insects required from insect farming to support a single restaurant as being one million insects (300kg) per month and proposed a series of modular cabinets to grow the insects, which each contains ≈32,000 insects during six weeks of maturing. On harvest the insects are frozen to kill them and store them ready for use.

Insect collection and 'farming'

In ACP countries, most edible insects are harvested from the wild and are not bred. However, catching them in their natural habitat requires a large workforce which increases production costs. Although insect collection, processing and consumption via sales in local markets or as streetfoods can bring substantial additional seasonal family incomes for farmers, these products are not considered to be sufficiently high value for inclusion in this book.

Box 3.5.15. Processing grasshoppers

Mr M. operates a small enterprise employing two people on the regular payroll and engaging 20 to 50 people as seasonal labour, depending on the numbers of grasshoppers at the onset of the main rainy season in late April. Grasshoppers are collected at night using high-energy bulbs that provide a bright light to attract the insects. They are trapped in iron funnel-shaped receivers or netting. The senene are packed in sacks or baskets and taken to the processing sheds, where they are plucked to remove the wings, roasted or fried, or roasted and smoked depending on the market requirements. The quality of the products depends on the post-harvest handling and processing conditions, especially the cleanliness of equipment, the quality of oil used in frying, and the materials used to produce the smoke.

Opportunities exist to 'farm' insects at a small scale, which can improve their quality and ensure a more regular supply. These developments would allow ACP producers to supply new markets (e.g. local hotels, restaurants and retailers) in a similar way to which mopane worms have been commercialised (below), and this has the potential to add considerably more value.

If insects are to become a more widely used raw material for food and feed, large quantities of high-quality insects need to be produced on a regular basis. To reduce costs, this requires either coordination of production by small-scale producers or investment in automated large-scale 'farming' and processing. Raising insects by farming has the potential to expand and develop the market by ensuring a reliable consistent supply, and developing standards on sanitation and production to ensure safety. Insect rearing (or 'mini-livestock') enterprises have the following advantages:

- In many ACP countries, there is a demand that often outstrips the supply.
- Insects have a high reproductive rate that allows cash income in a short period.
- They are easy to manage and are easily transportable, so can be sold to consumers in both rural and urban markets.
- They have minimal space requirements.
- They do not compete directly with food for human consumption.

- At a small scale, the required investment is relatively low.

(FAO, 2013c)

Fig. 3.5.14. Insect snackfoods (Courtesy of Hotlix)

Insect species that are suitable for farming need to have a high rate of weight gain/ conversion rate per day (kg biomass gain/kg feedstock), a short development cycle, high survival rates of immatures, the ability to live in high densities and resistance to disease. The feed also needs to be cheap or free of charge, of consistent quality and locally available with a reliable supply. Insects that are intended for human consumption may have to be fed on feed-grade or even food-grade food if they are not degutted and low-cost wastes might not be a viable option. All feeds need to be inexpensive, locally available with a constant supply and consistent quality; and free of pesticides and antibiotics. Examples of insect that are suitable for farming are the black soldier fly (*Hermetia illuscens*) and the yellow mealworm (*Tenebrio molitor*) (Vantomme, et al, 2012). Crickets (*Acheta domesticus*), mealworms (*Tenebrio molitor* L.) and the greater waxmoth larva (*Galleria mellonella* L.). In some Asian countries, including Thailand and Vietnam, two species of cricket (*Gryllus bimaculatus* and *Acheta domesticus*) are reared for human consumption with production largely concentrated in household and small-scale farming operations (e.g. in Thailand there is estimated to be 20,000 insect farmers who mainly rear crickets and palm weevils).

Insects can be reared in backyard sheds or in concrete rings ≈0.5m high and 0.8m in diameter. They are fed on rice hulls, vegetable scraps and grass. Crickets are prevented from escaping by covering the area with mosquito netting; which also prevents predators such as geckos from entering (Yhoung-aree and Viwatpanich, 2005). Other insect-rearing methods, using boxes and trays (Fig. 3.5.15) are described by Hanboonsong *et al*, 2013.

Fig. 3.5.15. Types of breeding containers: a) concrete cylinder, b) concrete block, c) plywood box and d) plastic drawers (Courtesy of Hanboonsong et al, 2013)

Large-scale production of insects

At higher levels of investment, large-scale industrial insect production (a minimum of 1 MT per day of fresh-weight insects) is also being considered as food or to replace increasingly expensive fish meal and soybeans. To be profitable, this requires more cost-effective production systems and mechanisation than small-scale processing. At present (2013) large-scale production is practised by only a few operators and there are no generally recognised safety, health or environmental standards. FAO has recommended that standards and strategies need to be developed, including preventive insect disease management strategies; prevention of human hazards related to production, such as passing on pathogens or the development of allergies among staff in production units; and the development of risk guidelines and sanitary standards for each species. Examples of industrial insect farming are Hao Cheng Mealworm Inc. in China, which sells mealworms, superworms and maggots using 15 rearing facilities that produce 50 MT of live insects per month. The insects are available dried, canned and powdered. The company exports 200 MT of dried mealworms to Australia, Europe, North America and Southeast Asia each year as animal feed and additives for food. Mealworm powder can be used as an ingredient in bread, instant noodles, pastries, biscuits, candy and condiments. The insects can also be consumed whole as meals and side dishes, or processed into medicinal supplements. AgriProtein in South Africa rears housefly larvae on wastes, including faeces, abattoir blood and spoiled food, in sterile cages, each holding over 750,000 flies. Each female fly can lay up to 1000 eggs per week, which hatch into larvae and are harvested just before they become pupae. They are dried, milled into flakes and packed. The product is similar to marine fishmeal and production is expected to exceed 1 MT per day, with a target of 100 MT of larvae per day (Agriprotein, 2010).

2) Snackfoods

There are traditional seasonal markets for insect snackfoods in many ACP countries and other countries in Asia and Latin America, in which insects are mainly fried or roasted and sold by streetfood sellers or in local marketplaces. A well-known example is the Mopane (or Mopani) worm (Fig. 3.5.16).

The 'worms' are large edible caterpillars of the Emperor Moth (*Gonimbrasia* (or *Imbrasia*) *belina*) that feed on a range of plants, including mopane trees (*Colophospermum mopane)* that are widespread in the grasslands of Southern Africa. They are collected from the wild and the picker pinches the tail end to rupture the innards and then squeezes the worm to expel the gut contents. Details of their processing are shown by Mukwazhi, 2013. The traditional method of preserving worms is to dry them in the sun or smoke them to produce additional flavours and then sell them in village markets. Demand

Fig. 3.5.16 a) Harvested mopane worms (Courtesy of Hsuepfle), b) retail packs of dried mopane (Courtesy of Edible, 2013), c) Mopane meal (Courtesy of ComQuat)

is very high and dried mopane worms are eaten as a crisp snack, or soaked to rehydrate them before frying them until they are crunchy. Mopane worms are also processed at a larger-scale, which involves canning the caterpillars in brine, or in tomato sauce or chilli sauce to enhance the flavour. The harvesting and sale of mopane worms is a multi-million dollar industry in Southern Africa (The Hindu, 2013); the main producing countries being Botswana, Namibia, South Africa and Zimbabwe. It is estimated that South Africa alone trades 1.6 million kg of mopane worms annually (Banda, 2012). The canned product is distributed to supermarkets, shops, hotels and restaurants throughout Southern Africa for a retail price equivalent to ≈$640/kg. The canned and dried products are also both exported and sold via the internet for a retail price of £15.95 per pack of 40g (equivalent to ≈$600/kg) (Harvey Nichols, 2013; Firebox, 2013).

Since the 1950s traditional harvesting from the wild has been replaced by commercial farming, particularly in South Africa. During the harvest season, from November to January, hundreds of people are employed to hand-pick caterpillars from the trees. In some areas that were once rich in mopane worms the lack of a sustainable approach to commercial worm farming has led to over-harvesting. Captive breeding projects (e.g. at the University of Pretoria) aim to ensure the preservation of wild stocks of mopane worms. Farming mopane worms is low-cost and low-maintenance and produces a profitable harvest, with three kilograms of mopane leaves yielding one kilogram of worms (Toms et al, 2002). The large demand for dried worms and measures to address the issues of a sustainable supply mean that although this product has potential for small-scale ACP processors to enter the market, there is significant competition from existing processors, which would make market penetration more difficult. There is, however, potential to commercialise the rearing of other types of insect snackfoods in ACP countries.

3) Novelty foods and gifts

In the USA and to a lesser extent in Europe, eating insects has increased, but as a curiosity niche food sector and not as a normal part of the diet. These insects are marketed as high-value novelty foods and gifts (Table 3.5.8). For example, specialist suppliers (e.g. Edible, 2013) sell a range of delicacies including Thai Curry crickets, oven-baked tarantula, scorpion lollies, dried crickets and BBQ worm crisps that are stocked by large UK retailers (e.g. Selfridges, 2013; Harvey Nichols, 2013). An increasing number of customers are willing to try new products and sales are strong having grown by 20% in 2012 (Smithers 2013).

Fig. 3.5.17. Insects as gifts - cricket in candy (Courtesy of Hotlix)

Product	Retail price	Price ($ per unit)
Mopane Worms	£15.95/40g	598.12/kg
Amber Scorpion Candy	£4.25 each	6.37 (each)
Banana-flavoured lollipop with a real scorpion	£3.39 each	5.08 (each)
Freeze dried grasshoppers	£54.82/100g	822.30/kg
Tarantula in resin	£33.90 each	50.85 (each)
Frozen waxmoths	€ 30.86/500g	80.24/kg
Frozen crickets	€ 9.24/200g	60.06/kg
Freeze dried mealworms	€ 5.65/50g	149.90/kg
Freeze dried crickets	€ 9.45/50g	245.70/kg
5 assorted bugs (sago worm, silk worm, big cricket, grasshopper and weaver ant)	$5.60/10g	560.00/kg
Chocolate covered silkworm pupae	$4.80 each	4.80 (each)
Giant water scorpions	$5.90/ 20g (1 or 2 scorpions)	295.00/kg
Rino beetles	$5.60/20g (2 or 3 beetles)	280.00/kg
Water scorpion chilli dipping paste	$2.57/ ≈175g	14.68/kg
Bamboo worm vodka	$8.99 /75ml	119.86/l
Winged flying termites	$5.60/20g	280.00/kg
Scorpion infused vodka	$9.99/70ml	142.70/l
Chinese armour tail scorpions	$7.99 for 3 scorpions (≈20g)	399.50/kg

Table 3.5.8. Retail prices in 2013 for different types of edible insect snackfoods, novelty foods and gifts (From Edible at Harvey Nichols, 2013; Trau-dich, 2013; Kreca, 2011; Thailand Unique, 2013)

Notes: Retail prices at March 2013. Currency conversions: £1 = $1.5, €1 = $1.3.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Quality and safety standards

Because of their long history of consumption, it is generally believed that edible insects do not pose a significant health risk and are safe to eat. At present (2013), there are few quality standards or legal issues surrounding the sale of insects. In countries where insects are consumed whole, this usually includes their gut microflora. Little is known about the gut micro-organisms in insects and the possible presence of pathogens, viruses and toxins that could pose a danger when eaten. In general, insect pathogens have been found to be different to vertebrate pathogens and can be regarded as harmless to humans. Likewise, insect gut micro-organisms are not seen as potential human pathogens. Processing and eating insects might cause allergic reactions in people who are sensitive to specific proteins and the allergenicity of insects should therefore be tested.

The application of pesticides to kill wild insects is an issue when these are collected for food. Many ACP countries do not have policies controlling the use of agri-chemicals in areas where people collect edible insects and collection takes place with little knowledge of the consequences of eating chemically treated insects (Ayieko et al., 2012). Insect farming allows greater control over hygienic practices and use of safe feeds for insects, which reduces potential microbiological hazards.

Box 3.5.16. Quality control of grasshoppers

The quality and safety of grasshoppers can be assured by proper handling and processing of the catch when it is fresh. Mr M. ensures the quality of the catch by having his own hired labour during the season, who he trains to handle the grasshoppers hygienically in clean bags/containers and to bring them quickly for processing the next day. He ensures that all processing equipment and utensils are clean and made from food-grade materials, and specifies packaging materials from manufacturers who supply food-grade plastics. In addition, he ensures control over the processing stages of peeling to remove unwanted parts, washing the uncooked grasshoppers, cooking/frying/toasting/smoking, cooling and packing into containers, and storage for sale.

Because of its importance, the mopane caterpillar, which is degutted before consumption, has been studied in more detail than other insects. Caterpillars were found to be contaminated with moulds and mycotoxins (Mpuchane, Taligoola and Gashe, 1996), and it was concluded that frequent consumption of infected foods over long periods is likely to pose health risks, but it is likely that contamination was caused by poor quality water, flies and soil. Drying insects limits the growth of most micro-organisms but in humid areas dried insects are susceptible to moisture pick-up, which can enable bacterial or mould growth. Insects can also become contaminated during drying and handling, and strict hygienic practices are required during processing, together with an additional heating stage before consumption (Amadi et al., 2005; Giaccone, 2005).

Fresh insects, like other foods, are rich in nutrients and moisture that allow microbial growth and require processing methods of boiling, roasting and frying to preserve them. Safe products are produced by applying quality assurance and HACCP methods in the same way as other types of food processing (see Section 4.2). To maintain their microbiological quality dried insects should be dried quickly and uniformly after harvesting, and stored in a cool, dry place. Rapid processing by frying, boiling or roasting fresh insects also reduces the risk of microbial contamination and hygienic handling is important to prevent re-contamination and cross-contamination (Klunder et al, 2012). Management strategies are needed to prevent insect diseases from occurring and risk guidelines and sanitary standards need to be established for each species. When using waste materials as feed, their safety (pathogens, contaminants, heavy metals) needs to be assured. Regulations and quality control guidelines for insect-based feeds and foods need to be developed.

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3.6 Alcoholic liqueurs

Liqueurs are alcoholic drinks made from distilled spirits that are infused with flavours from one or more fruits, flowers, herbs or spices (known as 'botanicals'), cream, coffee, chocolate or nuts, and sweetened with added sugar or honey. Most have lower alcohol contents (15-30%) than spirits, but some may contain as much as 55% alcohol. They originated as European herbal medicines in the 13thcentury, often made by monks, and are now used as aperitif drinks or after a dessert, in cocktails and in cooking. 'Bitters' are flavoured with herbs, roots, and other botanicals, and are added in small amounts to flavour other alcoholic drinks, especially cocktails. They contain lower quantities of botanicals and sugar than liqueurs, and usually have an astringent taste. The best known product is 'Angostura' bitters, produced in Trinidad and containing 44.7% alcohol and a mixture of herbs and spices that are a closely guarded secret. However, it is unlikely that small-scale processors could compete with this well-established product and bitters are not considered further in this book.

Liqueurs can be broadly divided into two categories: 1) 'generics' that can be made by any producer (e.g. Crème de Cacao, Curaçao). 'Schnapps' is a generic term used for any flavoured white spirits made from grain, potatoes, or molasses that originated in northern European countries, especially Germany or Scandinavia; 2) 'proprietaries' that have trademarked names and are made to a specific formula (e.g. Kahlúa, Grand Marnier and Southern Comfort). These can only be made under licence from the company that owns the trademark.

There are hundreds of different types of liqueurs, each distinctive in a local area, but with a few notable exceptions (e.g. Amarula in South Africa, Ogidiga in Nigeria, Omulondo in Uganda and Pimento in Jamaica), most originate from Europe. These products are likely to have a limited demand in many ACP countries, but because of their high value (Table 3.6.2), small-scale production may be profitable. The likely ACP sales outlets are airport shops, hotels and restaurants in up-market areas of cities that have affluent nationals, international visitors and tourists as their clientele. Some ACP liqueurs, especially Amarula, also have a strong export demand.

Type of liqueur	Examples
Fruit liqueurs	Amabilli (banana), Amarula (marula fruit - see section 3.4.9), Aurum (rum, tea and tangerines), Cointreau (orange), Curaçao (bitter orange), DeKuyper (pomegranate), Ginjinha (cherry), Grand Marnier (orange), Kirsch (Morello cheries), Kruškovac (pear), Limoncello (lemon), Ly Shan (lychee), Maraschino (cherry), Slivovitz (plum), Van der Hum (tangerines, herbs, spices, seeds and barks) and Vok (melon).
Berry liqueurs	Chambord (raspberry), Crème de cassis (blackcurrant), Lakka (cloudberry), Zurawinówka (cranberry), Wiśniówka (cherry) and Sloe gin (sloe).
Coffee liqueurs	Aruba arehucas, Bahia and Bols coffee liqueurs, Kahlúa, Mokatika, and Tia Maria. Cream liqueurs include: Advocaat, Baileys Irish Cream, Dooley's, Dulce de Leche liqueur (Caribbean rum, caramel and cream), Ponche crema and Vermeer Dutch chocolate cream liqueur.
Chocolate liqueurs	1) chocolate cream liqueurs (e.g. Dwersteg's, Florcello chocolate orange cream liqueur, Vermeer Dutch chocolate cream liqueur); 2) chocolate liqueurs (e.g. Afrikoko (coconut and chocolate), Ashanti gold, Sabra liqueur (dark chocolate and Jaffa oranges)); and 3) crème de cacao, which may be either clear or a dark caramel colour (note: the French word 'crème' refers to the creamy texture of this liqueur, but it does not contain dairy cream).
Crème liqueurs	In French with 'de' followed by the fruit flavour (e.g. Crème de banane, Crème de cacao etc.) and include cassis, menthe, rose and violette (although the last two are also grouped as flower liqueurs).
Flower liqueurs	Lavender, hibiscus, lotus, passionfruit and lychee flowers.
Herbal liqueurs	These may contain 50 or more different herbs and recipes are often closely guarded secrets. Anise-flavoured liqueurs include: Dimmi (an infusion of absinthe, anise, vanilla, ginseng, rhubarb, bitter orange, apricot and peach blossom) and Sambuca from Italy, Ogidig from Nigeria, Ouzo from Greece, Pernod from France and Raki from Turkey. Other herbal liqueurs are: Angelika Bitter (11 herbs, especially Angelica archangelica), Bénédictine (27 plants and spices), Chartreuse (130 herbal extracts), Demänovka (14 herbs and honey), Fernet (myrrh, rhubarb, chamomile, cardamom, aloe, and saffron), Galliano (30 herbs), Jägermeister (56 herbs), Paan (betel leaf, betel nuts, saffron, cardamom, sandalwood and other herbs and spices) and Strega (70 herbs, including mint, fennel, and saffron).
Honey liqueurs	Bärenjäger, Krupnik, Mesi and Yukon Jack.
Nut-flavoured liqueurs	Amaretto (almonds, or the almond-like kernels from apricots, peaches, cherries, or similar stone fruits), Dumante (pistachio), Frangelic (hazelnuts and herbs), Kahana Royale (macadamia nut), Nocello (walnut and hazelnut) and Castries Peanut Rum Crème (peanut).

Whisky liqueurs	Made by adding honey, herbs and spices to Scotch whisky or Irish whiskey (e.g. Bruadar, Drambuie). Eblana contains Irish whiskey, coffee, honey, almond, and peanut, and Glayva has Scotch, Seville oranges, herbs, and honey. Irish Mist is aged Irish whiskey with heather and clover honeys, aromatic herbs and other spirits.
Other liqueurs	Advocaat (egg yolks and vanilla), Aurum (rum, tea, and tangerines), Campari (bitter and aromatic herbs, plants and fruits), Gabriel (cinnamon, apple, black pepper and peppermint), Pimento (allspice) made in Jamaica, Southern Comfort (whiskey and other spirits with peach, orange and spice flavourings), Vana Tallin (rum, citrus oil, vanilla, cinnamon, and other spices) and Y Chilli (cinnamon, chilli peppers, and other ingredients).

Table 3.6.1. Types of liqueurs (Adapted from Graham, 2103; Beverage Testing Institute, 2013; Wikipedia, 2013)

Herbal liqueurs may contain dozens of different flavour elements that a master blender manipulates to achieve the desired flavour profile. Liqueurs are not usually aged (although their base spirit may be), but they may undergo resting stages during their production to allow the various flavours to form a harmonious blend.

Box 3.6.1. Development of the market for Amarula liqueur

Initially the business explored the possibility of producing a unique product from marula fruit, an under-used natural resource, rather than by meeting the needs of a known market. Initial attempts at selling the pulp were focused on production of jam, juice and chutney. After it was decided to produce Amarula Cream and during the development of the market, there were times when the business size was not clear and success was not guaranteed. However, it has now reached ≈4000 MT of marula a year. There are many imitators of Amarula Cream on the market but none appears to have made any real impact. An example was Ilala Cream, which was based on fermentation of the sap of the Ilala palm, found in North Eastern KwaZulu Natal. This was an exact parallel to Amarula involving the production of a cream liqueur from a natural resource used by the local communities to make a wine. However, the multinational that launched Ilala Cream was unable to compete with Amarula, which was already well-established

Box 3.6.2. Amarula cream and by-products

The company was started by Mr S. in 1992 when he recognised that vast quantities of marula were not being used in the North East of South Africa. In 1998, Distell, the producers of Amarula Cream, bought a 45% share in his company and he is the exclusive supplier of marula pulp to Distell. This joint venture is the base from which Amarula Cream became a success: it was the second largest-selling cream liquor in the world in 2011 and was found by Euromonitor to be among the 15 most popular and well-known liqueurs in the world. It also won several awards in 2012. The demand for Amarula Cream has produced the first industrial market for marula fruit, which in 2013 generated R 1.5 million (US$ 170,000) to gatherers in the community. It is estimated that ≈60,000 people benefit from the collection of marula fruit through the 6 000 collectors.

The company is one of the smaller liquor manufacturers in South Africa that operates in the lower-cost part of the market, mainly with generic products. Its products are blended alcohol-based drinks, including spirits, liqueurs, cream liqueurs, cocktails, sambuca, love potions and spirit coolers.

The company's strengths lie in its experience in blending and packaging small runs of spirit-based products. This gives the opportunity for growth and expansion because of the large size of the market: a small market share is sufficient to allow the company to run a profitable business, provided it can achieve sufficient market penetration.

The company spends little on advertising, relying mainly on their shelf presence of bottles in stores and bars. They have a website but do not sell online; the products are listed online by exporters, wholesales and retailers. Although the majority of its production is sold into the South African market it has recently entered the export market.

Product	Retail price	Price ($ per l)
Kirschwasser (Cherry Brandy)	$27.95/375ml $5.00/50 ml (miniature)	74.53 100.00
Fruit Liqueurs (e.g. Cranberry, cassis, raspberry, pear)	$22.45/375ml	59.86
Limoncello (lemon liqueur)	£18.50/70cl	39.64
Tuaca (Italian brandy infused with citrus fruit and sweet aromatics)	£22.49/70cl	48.19
Ouzo (spirit flavoured with aniseed, star anise, fennel, nutmeg, coriander, cinnamon and cardamom)	£17.50/70cl	37.50
Krupnik honey vodka liqueur	£22.19/70cl	47.55
Coffee tequila	£32.75/70cl	70.17

Table 3.6.2. Examples of high-value liqueurs (From Clear Creek 2013; Addison, 2013)

Notes: Retail prices at October 2013. Currency conversions: £1 = $1.5, €1 = $1.3.

Prices are used to illustrate the relative values of different products and it is not intended to suggest that these prices would be paid to suppliers.

Box 3.6.3. Local liqueurs

Two liqueurs are produced in Uganda: a coffee liqueur and a liqueur flavoured with the roots of the herbal plant Mondia whitei or 'Omulondo', which is patented as 'Mulondo Liqueur'. The company began in 2012 and is a privately owned business, established by a university lecturer who had previously undertaken research on the plant. The company operates under the Makerere University Food Technology and Business Incubation Centre. The company employs three full-time people and four part-time workers. The company buys wild roots and coffee beans and extracts the flavours which are mixed with ethanol to produce the flavoured liqueurs. The products were launched in 2012 and have a small but growing market, with about 30% of total sales made locally in Kampala and 60% in other parts of Uganda. There are also few exports to Kenya estimated at 10% but exports outside the region are insignificant. Omulondo competes with imports of South African Amarula Cream liqueurs and its market share is estimated to be between 10-15%. However, there are many competitors for its coffee liqueur and the company has less than 5% of the market. Liqueurs are distributed directly (door-to-door) and to a shop located at the university.

The company's other main customers are from the entertainment industry: clubs, bars, restaurants and hotels.

Her bottled liqueurs are made from traditional palm wine, flavoured with orange, lemon or coconut and sweetened with sugar. She learned how to make them from researching recipe catalogues and chose to produce these high-value drinks instead of her syrup products which were in competition with other syrups sold everywhere. She does not know of any competitor who produces these types of products. The enterprise exports the liqueurs through an export agent and sells them in Benin supermarkets.

Processing

Nearly all liqueurs are produced by buying the base spirit and infusing the required mixture of flavouring ingredients.

Warning note: a licence is required to buy and handle alcoholic spirits in most ACP countries. Care is needed to ensure that only reputable spirit suppliers are used: unscrupulous spirit suppliers may substitute ethanol with methanol, which causes blindness and death in low concentrations.

Box 3.6.4. Using alcohol

Operating an alcohol-based business requires strict controls to meet both the Excise requirements as well as protection against theft.

Ethanol is manufactured by sugar companies, which have a minimum order level and only sell it to bulk buyers. However, since my company is small, I can only source ethanol from dealers.

The main cost for a new processor who wishes to develop a liqueur is the product development phase. This is used to find the optimum blend of ingredients that will produce the required flavour, colour and aroma. This requires a sufficient budget and time for an experienced flavourist to experiment and conduct tasting trials with target buyers and consumers to perfect the recipe and the balance of ingredients. The production process is relatively straightforward, involving soaking the ingredients to infuse the base spirit, filtering, standardisation of the alcohol content and bottling. Liqueurs are expensive, luxury products and the packaging is especially important. Technically, it is only required to prevent the aromas and alcohol evaporating during storage, but from a marketing perspective, only high quality glass bottles should be used. Ideally, an unusual design, colour or shape for the bottles is desirable to assist the marketing effort. The label should be attractive because the bottle is likely to be displayed in hotels and restaurants (as well as other sales outlets) and it must be able to attract consumers (Fig. 3.6.1).

Fig. 3.6.1a, b. Different types of liqueurs (Courtesy of a) Smooth_O and b) Joseph Hounhouigan)

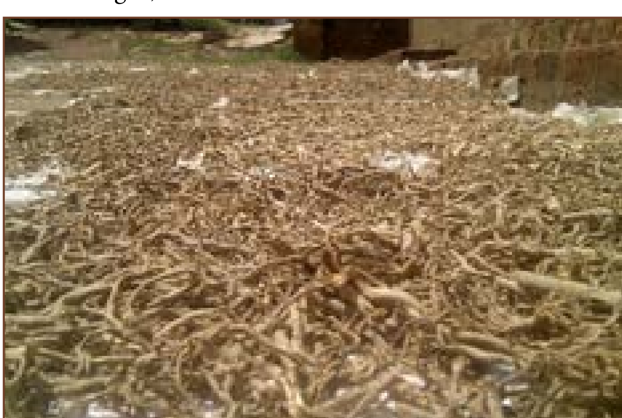

Fig. 3.6.2. Sun drying omulondo roots (Courtesy of Michael Lubowa)

Fig. 3.6.3. Omulondo liqueur (Courtesy of Peter Fellows)

Box 3.6.5. Quality assurance of raw material supply

In the omulondo root supply chain, collectors apply Good Post-harvest Practices, to ensure that roots not microbially contaminated. Deliveries from middlemen and traders are subject to the application of Good Distribution Practices. The university facilities require the application of Good Manufacturing Practices and there is a designated Quality Officer who monitors the product and process up to packaging and storage. The centre also has a testing laboratory, certified by the Bureau of Standards, that can test the liqueurs for colour, sugar and alcohol levels.

The root has become threatened due to over-collection for medicinal purposes and de-forestation in general. There are also reports of collectors uprooting the whole plant instead of removing some roots. The high demand for the fresh roots, which are sold by hawkers all over the country, deprives the company of a steady supply and at competitive prices.

Box 3.6.6. Quality of liqueurs

The marula creams are blended from purchased spirits, cream and other flavour and colour ingredients. About 15% of Amarula's alcohol derives from the marula fruits, but the delicate marula fruit character that gives the product its unique quality is due to the pulping, storage, distilling, aging and blending of the marula fruit.

Omulondo roots grow wild in forests and are collected and sold for medicinal purposes. The company buys directly from collectors and works closely with them to guarantee quality, price stability and a constant supply. One of the company's directors said: "we have organised farmers into groups to start cultivation of Mondia whitei to achieve our philosophy of promoting sustainable and ethical raw material sourcing".

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Entrepreneurs' checklist

Have you:

❏ Selected a product that matches the investment you have available?

....

❏ Identified the specific varieties of raw materials that add value to a product and confirmed that they are available in your area?

....

❏ Fully researched the available technologies to make the product?

....

❏ Identified packaging requirements and potential suppliers?

....

❏ Involved a chef if you need to formulate a new recipe?

....

❏ Obtained details of international or buyers' quality standards and made sure that the production process allows these to be met?

....

Reader's notes

Please use this space to write your own notes on Chapter 3.

3

Quality assurance and legislation 4

Summary of the chapter

✔ Understand your consumers' specific requirements for quality.
✔ Find out if any international quality standards apply to your product.
✔ Discuss in detail quality requirements with buyers.
✔ Devise a QA scheme that assures the safety and quality of your product and is affordable to implement.
✔ Ensure that the QA scheme covers the following aspects of your production:
  - Inspection of raw materials and ingredients
  - Ingredient weighing and process control
  - Packaging, fill weights and sealing
  - Storage procedures and stock control
  - Cleaning of equipment and facilities
  - Maintenance of buildings, water supplies, sanitation and pest control
  - Employee responsibilities for personal hygiene and cleanliness.

✔ Ensure that the scheme permits traceability of products to deal with any customer complaints or product recalls.
✔ Regularly audit the scheme and verify that it is working satisfactorily.
✔ Make sure you are aware of regulations that relate to your product in terms of
  - Hygiene and sanitation
  - Composition and labelling
  - Water supplies and waste disposal
  - Weights and measures
  - Licensing
  - International regulations on imports/exports.

Keywords: Methods of quality management, HACCP, quality assurance, methods to control raw material supplies, ingredient weighing, processing and packaging, product quality, hygiene and sanitation, traceability, customer complaints and product recall, audits and verification, food legislation, composition and labelling, water supplies and waste disposal, weights and measures, licensing and control, international regulations.

Tips for success

- ✔ Understand the detailed quality requirements that consumers demand for your product and make sure these can be met.
- ✔ Research international quality standards that apply to your product.
- ✔ Discuss individual quality requirements with a range of potential buyers.
- ✔ Understand the scope of a quality assurance (QA) scheme.
- ✔ Ensure that you use appropriate elements of international safety management guidelines when setting up a QA scheme, getting professional advice if necessary.
- ✔ Ensure that your raw material suppliers are also aware of the importance of quality and include them in your QA scheme.
- ✔ Include all processing and warehouse operations in the QA scheme and ensure that all staff are properly trained in its implementation.
- ✔ Ensure that the QA scheme is properly managed and regularly reviewed.
- ✔ Make sure that your product complies with laws on composition, labelling and weights and measures.

4.1 Introduction - the need for high quality products

Minimum standards for food safety apply to all processed foods and form part of the food legislation in most countries. In addition, consistent high quality is essential for sustained sales of high-value foods over long periods: buyers and consumers will not be willing to pay higher prices if they have any doubts over the quality of products. A genuine commitment to quality management by processors is therefore essential for every high-value food in order to gain and retain market share. This was found by researchers to be a constant message emphasised by all the successful small-scale processors that were interviewed (Box 4.1).

Box 4.1. The need for high quality products

It is extremely costly for small-scale mushroom growers to institute quality assurance systems at all processing stages from cultivation and harvesting to processing and distribution. Nevertheless, Ms R. praises the supermarket chain's insistence of high safety and quality standards and practices, as they have enabled her to sell mushrooms at a higher price than before. "New supermarket and grocery businesses immediately seek supply negotiations once they see my products on the shelves of the international chain."

Their high quality herbs have a good demand and are sold in both the South African and EU markets. To compete successfully with established processors requires strict adherence to standards, and development of a brand that is recognised for its quality.

Compared to other chocolates, high quality hand-crafted chocolates can have a very high value.

The high quality ingredients provide the wine with a very fresh, unique flavour that distinguishes it from other cheaper imitations.

The company owner knows he must be able to demonstrate that they can produce kernels having the consistently high quality required by commercial buyers to be able to gain market share and sell them at an acceptable price.

Processing honey for niche export markets in Europe faces high competition and requires very high quality standards. Control systems help the manufacturer to produce safe, high quality products and virtually all importers require them to be followed. The business is highly profitable due to the added value from using the special type of honey and the high quality and unique flavour of her honey wine.

Many micro-scale processors maintain product quality using their long experience of the product, especially when supplying local markets and where informal quality standards exist for a particular product. Other processors who supply export markets have invested in support from a food technologist to develop or improve their quality assurance (QA) procedures to meet export quality standards (Box 4.2).

Box 4.2. Maintaining quality to meet international standards

The company has a quality assurance system that conforms to international certification, with certifiable activities including: an internal control system to address quality issues at farms using trained field-staff who work with contracted farmers to translate export market requirements into practice.

Buyers of essential oils and oleoresins are often very conservative and may be resistant to dealing with new suppliers. In order to enter the market, new producers must be able to show that they can supply uniform quality materials at competitive prices and importantly, that they can assure continuity of supply.

Honey traders require suppliers to deliver honey at their specifications, and approve the production processes needed for consistent quality. Their quality assurance includes testing for authenticity, impurities and pesticide residues and full traceability back to individual bee keepers.

The refined oils comply with the stringent quality specifications required for cosmetic formulations by international skin care companies.

To achieve safe, high quality products, it is not sufficient for processors to rely on the older concept of quality control: this was a reactive approach in which a processor checked the finished product to ensure that its quality was correct. This risked producing unsafe or low quality products if failures in processing passed un-noticed. It also wasted company resources because money had already been spent on producing the food by the time it was tested, and any rejected food was a financial loss.

It is much better to adopt a proactive approach to quality management in which problems that could affect food safety and quality are identified and prevented before they arise, rather than trying to correct them after they have occurred. This preventative approach is termed quality assurance. There are many benefits of having a QA scheme: more cost effective production by 'getting it right first time'; a reduction in wastes; improved machine efficiency and increased production capacity; consistently meeting customer requirements, which results in increased customer confidence and sales and fewer customer complaints; better trained staff and heightened awareness and commitment to quality, which shows regulatory authorities and buyers that the processor has a commitment to produce high quality products.
In summary a QA scheme covers the following areas:

- Inspection of raw materials and ingredients before processing.
- Ingredient weighing and process control.
- Packaging, fill weights and sealing.
- Storage procedures and stock control.
- Cleaning of equipment and facilities.
- Maintenance of buildings, water supplies, sanitation and pest control.
- Employee responsibilities for personal hygiene and cleanliness.

Processors who wish to export their products to markets in industrialised countries must have QA systems in place that meet international standards and, increasingly, retailers and other buyers in many ACP countries also require a formal QA system to be in place.

Box 4.3. Meeting international standards for quality assurance

The blending and packing subcontractor is GAP certified and complies with internationally accredited food safety standards, is introducing HACCP and is organically certified. All exported teas are inspected and certified by the Perishable Products Export Board to comply with Notice NoR 707 of the Agricultural Products Standards Act.

The whole process for producing lemongrass tea has a traceability system to control quality. The company buys unblended tea from tea companies whose entire production facilities are ISO 22000 accredited. Mr W. comments: "Our entire production facility is ISO 9001 accredited and blending is carried out in accordance with the company procedures, legislative standards, export licensing requirements, and phyto-sanitary documentation required by North American and EU buyers".

Employers received HACCP and technical training from the quality assurance officer and the manager.

To maintain their microbiological quality dried insects should be dried quickly and uniformly after harvesting, and stored in a cool, dry place. Rapid processing by frying, boiling or roasting fresh insects also reduces the risk of microbial contamination and hygienic handling is important to prevent re-contamination and cross-contamination.

She does not employ a quality assurance officer but the owner has been trained in good manufacturing practices, good hygienic practices, HACCP, etc., which helped to install and organise the processing unit, to train the workers and develop an adapted quality management system. This was certified by the National Food and Applied Nutrition Office.

The two main standards used by international buyers to ensure food safety are ISO 22 000, the International Standard for Food Safety Risk Management (ISO, 2013a), which was developed from an earlier Quality Management Standard (ISO 9001), and secondly the Codex Code of Practice on General Principles of Food Hygiene (Codex, 1969). In Europe, similar legislation is the General Food Law (Regulation (EC) No. 178/2002), which sets out general principles, requirements and procedures relating to food safety (EU, 2002). Similar regulations exist in the USA, which may be accessed via FDA, 2013.
The World Trade Organisation (WTO) has produced an agreement on food safety and animal and plant health standards (the Sanitary and Phytosanitary Measures Agreement (or SPS)). The agreement includes provisions on control, inspection and approval procedures. It allows countries to set their own standards and regulations to protect human, animal or plant life or health. WTO member countries are encouraged to use international standards,

guidelines and recommendations and they may also use measures that result in higher standards based on appropriate assessment of risks. The agreement allows countries to use different standards and different methods of inspecting products, but if an exporting country can demonstrate that the measures it applies to its exports achieve the same level of health protection as in the importing country, then the importing country is expected to accept the exporting country's standards and methods (WTO, 2013a).
Elements of the ISO 26 000 Standard on Social Responsibilities of Businesses are also concerned with protecting consumers' health and safety. Other QA systems that are used by larger processors in some countries include Total Quality Management (TQM) and the 'Technical Standard for Companies Supplying Retailer Branded Food Products', by the British Retail Consortium (BRC, 2003). These standards are used by retailers to monitor and control foods produced by their suppliers, which may be implemented through retailer's inspections or third-party inspection bodies.

ISO Technical Specification 22 004 (ISO, 2013b) gives guidance for small- and medium-sized enterprises on how to implement the ISO 22 000 standard. However, full implementation can be expensive and beyond the expertise of many small-scale food processors without assistance from food technologists who have experience of the particular product and the process (e.g. from a local university, Bureau of Standards, private sector consultants or manufacturers' associations). This section describes how components of the standard can be implemented at a reasonable cost to produce a QA scheme that meets the needs of both international buyers and small-scale processors who make high-value foods. It begins with a description of the Hazard Analysis Critical Control Point (HACCP) system, which is the basis for management of food safety, and then describes how QA methods may be implemented in a small-scale food enterprise. Further details are given by FAO, 1998.

Note: Other international laws and standards exist for the supply of ingredients for food supplements, medicinal products and cosmetics, which are summarised in section 4.4.6.

4.2 HACCP

The HACCP system has two components: first (hazard analysis) to identify potential hazards in a process that have identifiable and significant food safety risks that should be controlled (Box 4.4), and secondly to identify 'critical control points' (CCPs) in a process where loss of control would result in an unacceptable risk to food safety.

Box 4.4. Examples of hazards in foods that could harm consumers if eaten

- Contaminants (e.g. dead or living insects, excreta, metal or glass fragments).
- Microbiological hazards (e.g. food poisoning bacteria or toxins that they produce, mycotoxins produced by moulds).
- Chemical hazards such as pesticide residues, cleaning chemicals, or compounds capable of causing a severe allergic reaction (e.g. traces of nuts).
- Potentially dangerous parts of raw materials that should not be processed.
- Inadequate processing, storage or transport conditions that would allow any of the above hazards to affect food safety.
- Inadequate seals on packaging that could result in contamination or deterioration of products.
- Poor staff hygiene or any actions by staff that may affect product safety.

The seven stages in the development of a HACCP system are as follows:

1. Identify what are the potential hazards associated with a food (Fig. 4.1).
2. Identify the critical control points in a process at which each potential hazard can be controlled or eliminated.
3. Establish preventive measures with critical limits for each CCP (e.g. heating a food at a specified minimum temperature for a minimum time).
4. Establish procedures to monitor each CCP (who will supervise the preventive measures and what that supervision should consist of).
5. Describe the corrective actions that should be taken when a critical limit has been exceeded (e.g. whether the food is re-processed or disposed of).

6. Establish procedures to verify that the system is working properly: i.e. to monitor the monitoring systems (e.g. by periodic inspection of weighing scales to ensure that they are accurate).
7. Set up effective record-keeping of the hazards, their control methods, the monitoring systems in place and the corrective actions taken.

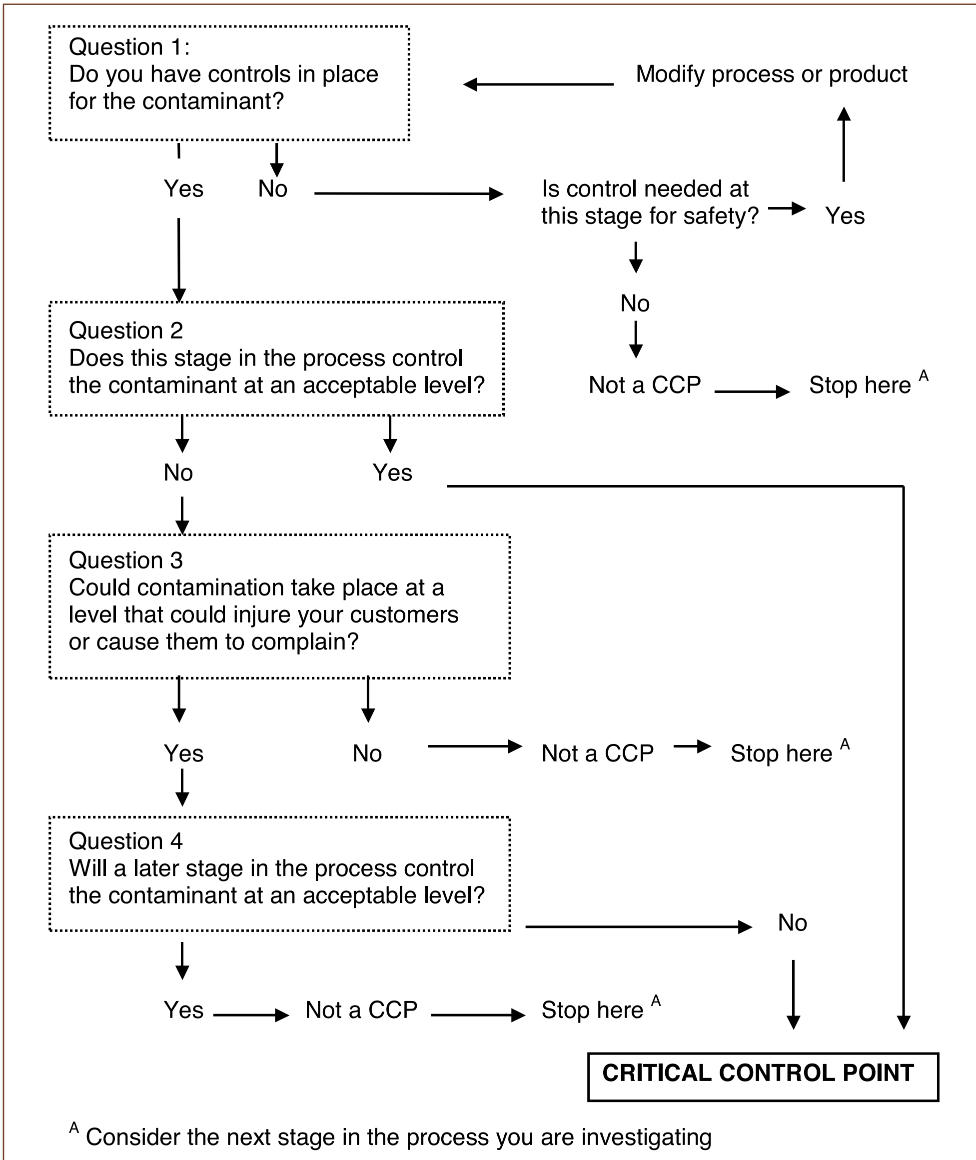

Fig. 4.1. Decision tree for CCPs (From Dillon and Griffith, 1996)

Different foods have different levels of safety risk and can be grouped into three categories (Table 4.1). HACCP is essential for processors who produce medium- or high-risk foods. If a full HACCP system is not a customer requirement, it is possible for processors who produce low-risk foods to adopt elements of the scheme to improve their quality management.

Category of risk	Examples of foods	Reasons
High-risk	Mainly foods that are eaten without further cooking, including sandwiches; pies; samosas; cooked, smoked or cured meats and fish; prepared salads and coleslaw; dairy products, especially cream, ice-cream and soft cheeses. Also products that contain dairy and egg ingredients, such as mayonnaise, or baked goods with cream fillings. Most types of seafood and products that contain them. Cooked rice and pasta.	These products support the growth of food poisoning bacteria.
Medium-risk	**Fresh and dried herbs and spices**, pasteurised dairy products, pizzas, unpasteurised juices and beers. Dried meat and fish, **fresh and dried mushrooms, insects**.	Foods that are normally safe but risk food poisoning if incorrectly processed.
Low-risk	Dried foods (cereals and legume flours, **nuts**, fruits and vegetables), peanut butter, **honey and other bee products**, jams/ marmalades. Bakery products such as breads, biscuits, cakes. **Flavourings and colourants**, butter/ghee and **nut/seed oils**, pasteurised drinks, **alcoholic spirits and liqueurs**, pickles and chutneys, sugar confectionery, **teas, cocoa, coffee and chocolate**.	Foods that do not normally pose significant health risks because of their high acidity, low water activity or heat treatment.

Table 4.1. Level of risk from different foods (foods described in Chapter 3 highlighted)

To identify the potential hazards in a process, the owner should assess the risks arising from suppliers of raw materials; the processing conditions; reworking of part-processed foods; storage conditions; distributors and their vehicles; and for some foods, wholesale and retail storage conditions (e.g. chilled or frozen foods). If it is possible for consumers to create a hazard in a food, there should be information written on labels aimed at preventing this (e.g. recommended storage temperatures and use-by dates). Small-scale processors may need assistance from a food technologist to identify all the potential hazards in a process and to assess the level of risk for each hazard. Information on HACCP schemes for individual products is also published by manufacturers' associations, FAO and some universities (e.g. FAO, 2001; FAO 2005; GMA, 2010). The example in Table 4.2 shows an analysis of the sources of potential hazards from aflatoxins in tree nuts (see also section 3.4).

Name of Product	**Tree nuts**
Description	Nuts, roasted
Customer specification	No mouldy or rancid nuts Aflatoxin limit: 2 μg/kg for aflatoxin B1, 4 μg/kg total aflatoxins for EU; 20 μg/kg total for USA
Conditions of storage	Ambient temperature
Shelf Life	1 year
Intended use	Confectionery and snack foods
Packaging	Plastic-foil laminate, vacuum sealed or with nitrogen
Target Consumers	Europe and US

Table 4.2. Developing a HACCP plan for tree nuts - analysis of potential aflatoxin hazards (Adapted from FAO, 2001, FAO 2005 with additional information from GMA, 2010)

Notes on Table 4.2.
Aflatoxin contamination of nuts is most likely to occur: 1) On farm, pre-harvest due to splitting of the shell, which can allow entry of mould spores; 2) On-farm harvesting if nuts are allowed to fall and remain on the ground for an extended period; 3) Inadequate on-farm drying of nuts in shells before storage; 4) On-farm storage of nuts in shells if stored at unsafe moisture contents, particularly if they have damaged shells; 5) Primary and secondary traders may cause aflatoxin contamination if nuts purchased from farmers are stored without drying; 6) Factory packing using inadequate packaging material may make nuts susceptible to contamination if re-moistening occurs.

Once potential hazards have been identified, the next step is to identify the level of risk from each hazard (see Fig. 4.1) and decide whether they should be addressed at CCPs or whether they can be controlled using good practice guidelines (below). Controls at each CCP should have target levels and critical limits that will produce a safe product, and it is necessary to devise ways of monitoring them, either using analytical tests or visual observations. Examples include inspecting raw materials for mouldy pieces; monitoring the temperature and time of processing using a thermometer and timer; or monitoring moisture content or rancidity by laboratory analyses. A QA plan should define the corrective actions that need to be taken when CCPs are outside the limits, and who should make the corrections (e.g. a QA Officer has responsibility to re-test, rework or discard a batch falls outside a CCP).

Hazards that are 'reasonably likely to occur' are those that are shown by experience or scientific data that, without controls, will occur in the particular product being processed. A hazard that is reasonably likely to occur should be reduced to an acceptable level, prevented or eliminated, by carrying out control measures at the CCPs identified in the analysis. If a potential hazard has a severe public health risk, even if it is not likely to occur very often (e.g. cuts caused by glass fragments in a product), it is a significant risk and should be identified as a hazard and be controlled by a CCP.

Good practice guidelines are components of ISO standards known as 'Prerequisite Programmes' (PRPs) and they are also covered by Sanitation Standard Operating Procedures (SSOPs). There are also a series of good practice guidelines, including Good Agricultural Practice (GAP), Good Manufacturing Practice (GMP), Good Hygiene Practice (GHP), Good Storage Practice (GSP), and Good Distribution Practice (GDP) (Swanson, 2003; Hantoro, 2011). These are not designed to control specific hazards and are used where it is not possible to establish critical limits for a hazard. For example, lubricants and cleaning chemicals used on processing equipment are potential hazards that could be controlled using a PRP. Provided that the PRP ensures that the material is used in accordance with manufacturer's recommendations, it is not included in the hazard analysis because the hazard is 'not reasonably likely to occur'. If control requires actions to be carried out by farmers or transporters, the control measure could be based upon a supplier guarantee to this effect, based on GAP or GDP respectively. The different uses of CCPs and good practice guidelines are shown in the example in Table 4.3 and Box 4.5.

Box 4.5. Aflatoxin control measures for tree nuts
(Adapted from FAO, 2005)

The most effective preventative control of aflatoxin contamination is to prevent mould growth by drying nuts to a water activity of 0.82 for short-term storage or 0.70 for long-term storage. At 25°C, these water activities correspond to ≈10% moisture content and 5 - 7% moisture content respectively. Physical removal of nuts that are contaminated by mould (by hand-pick sorting or flotation, and rejection of excessively contaminated batches) is the most effective control measure for reducing levels of aflatoxin to an acceptable level. These procedures are covered by CCPs and prerequisite programmes (GAP, GSP, GMP, and the Codex Recommended International Code of Hygienic Practice for Tree Nuts (CAC/RCP 6-1972)) (FAO/WHO, 1994) which describe hygienic requirements for orchard, on-farm processing and factory processing (Table 4.3).

Process Step	Type of hazard	Possible Control Measures	Control	Critical Limits	Monitoring Procedures	Corrective Actions	Records
1 On-farm, pre-harvest	Mould	Select resistant variety (long-term); reduce spore count in air and soil	IPSM	Remove >95% tree litter	Visual observation	Remove or bury tree litter	Farmers' records
2 On-farm harvesting	Mould	Farmers remove split and/or insect damaged nuts by HPS	CCP1	<1% damaged nuts remaining	Visual observation	Re-sort batch	Farmers' records
	Mould	Use tarpaulin on ground to catch nuts. Transport directly to factory within 8 hours of harvest	GAP				
3 On-farm drying	Mould	Dry thoroughly before storage to safe moisture content	CCP2	3 days for sun-drying to Aw = 0.7 (5-7% moisture) at 25°C	Time of drying	Extend drying period. Remove mouldy nuts	Farmers' records
4 On-farm storage of nuts in shells	Mould	Raise off ground & cover with roof	GSP				
	Insects	Insecticide treatment	GSP				
5 Secondary storage of nuts in shells (e.g. by traders)	Mould	Raise off ground & cover with roof	GSP				
	Insects	Insecticide treatment	GSP				
6 Factory storage	Mould	Procure nuts with no split shells (offer premium for <1% splits)	GMP				
	Mould	Raise off ground & cover with roof	GSP				
	Insects	Insecticide use	GSP				
7 Factory dehulling	Aflatoxin	Do not re-use water used for sorting/preparation	GMP				
8 Factory floatation	Aflatoxin	Remove floating material which reduces aflatoxin levels by ≈70%	CCP3	Remove >99% of floating material by HPS	Visual observation	Repeat removal process	Factory records

9 Factory drying	Aflatoxin	Dry nuts uniformly to 10% moisture (short term storage) or 6% (long term storage)	CCP4	Temperature and time of drying = 82°C +/- 2°C for 3 hours +/- 3 minutes	Timer. Record chart	Re-dry nuts or discard nuts	Factory records
10 Factory sorting	Aflatoxin	Remove very small nuts (those having more than 106 nuts per 100g) by HPS	CCP5	Remove >99% of small nuts	Results of grading checks	Repeat sorting	Factory records
		Remove discoloured, shrivelled or damaged nuts		Remove >95% of undesirable nuts	Results of grading checks	Repeat sorting	Factory records
11 Factory roasting			GMP				
12 Factory aflatoxin testing & grading	Aflatoxin	Analyse for aflatoxin in representative 30 kg sample	CCP6	< or = 2 µg/kg B1 for EU < or = 20 µg/kg total aflatoxin for USA	Results from aflatoxin testing kit	Reject batches with higher aflatoxin level	Factory records
13 Factory packing	Aflatoxin	Air-tight packaging, preferably vacuum packed, or with nitrogen	GMP				
14 Factory storage	Aflatoxin	Ambient temperature	GSP				
15 Export	Aflatoxin	Select packs that meet the customer's aflatoxin specification using data from Step 12	GMP				

Table 4.3. HACCP Plan for aflatoxins in roasted nuts (Adapted from FAO, 2005)

GAP = Good agricultural practice
GMP = Good manufacturing practice
GSP = Good storage practice
HPS = hand-pick/sort
IPSM = Integrated Phytosanitary Management

Notes on Table 4.3:
1: On-farm, pre-harvest: aflatoxin contamination can be reduced by applying IPSM to remove or bury tree litter to minimise mould spores and insect attack.
2: On-farm harvesting: CCP1 with removal of nuts with damaged shells as the control measure. This will reduce the mould hazard to acceptable levels and remove a high proportion of aflatoxin produced pre-harvest. Nuts that fall to the ground may become mouldy if left for an extended period. GAP is to place a plastic sheet under a tree before harvesting. Either harvest by hand or collect fallen nuts daily.
3: On-farm drying of nuts in shells: CCP2 with drying to a safe moisture content as the control measure. The critical limits are number of day's sun-drying to achieve safe moisture content.
4 and 5: On-farm storage of nuts in shells and by primary and secondary traders - GSP to prevent re-wetting of nuts and to control insect damage. Sound nuts with a safe moisture content store well provided that GSP is in place.
6: Factory storage of nuts in shells - GMP/GSP. GMP to buy high-quality nuts with a low percentage of damaged shells. GSP to prevent re-wetting of nuts for long-term storage with fumigation to control insects.
7: Factory de-hulling - GMP. Use wet de-hulling only if factory has a mechanical drier. If not, use dry de-hulling process.
8: Factory floatation - CCP3 with removal of nuts that float as the control measure to remove ≈40% aflatoxins. This CCP, and subsequent CCPs, reduces levels of aflatoxin to an acceptable level in a high proportion of batches. Monitoring by visual inspection using trained staff to check that <1% of floating material remains.
9: Factory drying - CCP4 with control measures of drying nuts to 10% moisture content within 24 hours for short-term storage, and to 6% moisture content within 48 hours for long-term storage. Critical limits are set for the operating temperature of the drier and the time in the drier. The critical limits for temperature are monitored by regular temperature readings using a calibrated thermometer and critical limits for time using a timer.
10: Factory sorting - CCP5. Hand-pick sort to remove small nuts and damaged nuts. Small nuts contain 20 - 40% of the aflatoxin originally present in a batch. After removal of small nuts, subsequent HPS to remove insect-damaged nuts and nuts having pieces of adhering shell further substantially reduces levels

of aflatoxin. Monitoring this CCP is achieved by visual observations of staff trained to detect an unacceptable level (e.g. 5%) of damaged or discoloured nuts remaining after HPS.
11: Factory roasting - GMP reduces levels of aflatoxin by ≈20%.
12: Factory aflatoxin testing and grading - CCP6. But with good aflatoxin control use aflatoxin testing for verification only. Grade batches according to aflatoxin test results. Critical limits are monitored by semi-quantitative aflatoxin testing on representative samples or sending samples to an accredited laboratory for analyses and certification.
13: Factory packing - GMP. Use packaging to prevent moisture pick-up.
14: Factory storage of finished product - GSP.
15: Factory export - GMP. Batches selected for export that meet customers' aflatoxin specification, using information from step 12.

Other hazards that are effectively managed as CCPs are pathogenic bacteria, including Salmonella, sharp materials and some allergens that cause acute illness/injury. Salmonella contamination may be due to environmental re-contamination of nuts or handling by infected operators. The presence of low numbers of Salmonella in nuts can cause acute illness - infection has occurred from consuming products contaminated with less than 1 organism per gram; 2) undeclared allergens may contaminate products due to incorrect label application or accidental addition (e.g., peanut fines mixed with another tree nut product); and 3) sharp foreign bodies such as metal fragments from wear of equipment.

Hazards that are managed by using GAPs, GMPs and PRPs include pesticide residues or other chemicals (including allergens) that cause illness after long-term, chronic exposure or the low likelihood of their occurrence. For example, foreign bodies do not usually present a significant risk; they may be aesthetically unpleasant but usually do not cause injuries and are best managed by PRPs such as supplier inspection procedures and preventive maintenance. Allergen control can be achieved by ensuring that validated procedures (e.g. cleaning, testing of products) are used to remove an allergen-containing product from processing equipment before producing a non-allergen containing product. There should also be controls to prevent inadvertent cross-contact during the flow of materials in a process (e.g.

covering conveyor belts to prevent allergen-containing ingredients from falling from one belt to another).

The QA plan should also have procedures to both verify that the HACCP system is operating correctly and review the system regularly to make improvements. Each of the above activities should be recorded to show that the system has been designed correctly and operates properly. These records are important to demonstrate to customers and regulatory authorities that a processor has the systems in place to produce safe foods. This evidence may help to avoid prosecution and also helps to deal with any customer complaints. Examples of monitoring and recording procedures are given in section 4.3.

4.3 Methods of quality management

In order to implement QA procedures, it is necessary for each product to have a specification listing the quality standards that should be achieved. These specifications are either developed by the processor, supplied by the buyer, defined by legislation or by Codex standards for some products. They describe the required quality and safety of a food, often listing limits for the contaminants that are likely to be present in a particular product. They may include some or all of the following:

- Amounts of raw materials and other ingredients in a product.
- Chemical composition.
- Characteristics such as size, shape, appearance, texture/viscosity, sweetness, acidity.
- Maximum levels of named micro-organisms.
- Maximum levels of insects, foreign bodies or unwanted parts of the crop.
- Tolerances in processing conditions.
- Type of packaging and label design/information.
- Recommended storage conditions.
- For some products, nutritional value or advice on potential allergens in the product.

Product specifications should be written down and show the expected level for each characteristic and the maximum tolerances that are allowed for divergence from these levels. Examples of standards for individual products are described in Table 4.4 and in Chapter 3 for honey (section 3.5.1) cashew nuts (section 3.4.1) and macadamia nuts (section 3.4.3).

Quality criteria	Specification
Purity	99% minimum faba beans by weight
Moisture	14% maximum
Defective seeds	6% maximum by weight
Poor Colour	3% maximum by weight
Screen Size (slotted)	3.75 mm
Foreign material	1% maximum by weight
Unmillable material	0.1% maximum by weight
Snails	Nil tolerance
Field Insects	Maximum one dead insect per 200g sample
Objectionable Material	Nil tolerance
Ergot	Nil tolerance
Mould	Nil tolerance

Table 4.4. Example of a buyer's quality specification for faba beans (From WFP, 2009)

Specifications should meet legal standards, but they may also include other standards required by the buyer that may exceed legal standards (for example ethical standards on sustainable sources or a requirement to use local ingredients or organic/fair traded raw materials etc.).

4.3.1 Control over raw material supplies

The strategies used by small-scale processors to buy raw materials and other ingredients should aim to ensure that only high quality materials are used. They should also minimise costs and ensure that there are sufficient supplies to meet the demand for their products. For many processors, this can present significant problems: buying crops from farmers or wholesale markets (or meat from abattoirs or fish from fish markets) often means that processors have little control over the quality, the price and the amounts that are available to buy, especially if there are a large number of competing buyers. Fellows, 2013, describes five strategies that small-scale processors may use to obtain their raw materials, with company-owned farms on rented or purchased land offering the greatest degree of control over raw material quality and volumes harvested (but with a higher investment in land, agricultural supplies and staff).

Box 4.6. Company-owned farms

They have also invested in a 25-acre piece of land to grow moringa trees in order to enter the organic market of moringa products. The company manager said: "2012 was a busy planting season for us because we were involved in expanding our operations to strengthen the supply chain with the aim of securing a high quality organic moringa. A total of 14 acres of trees were planted and an additional four acres were earmarked for moringa leaf production."

Mr M. ensures the quality of the catch by having his own hired labour during the season, who he trains to handle the grasshoppers hygienically in clean bags/containers and to bring them quickly for processing the next day.

To reduce investment costs, processors may alternatively contract local farmers to grow crops. Contracts can provide processors with a regular supply of raw materials at an agreed price and also offer farmers a guaranteed market with a known income. Research for this book identified a number of small-scale processors who have selected this option (Box 4.7). By employing field staff, they are able to assist farmers to supply crops of the required quality and have systems in place to trace raw materials to individual farmers in the event of a problem.

Box 4.7. Contracting farmers

The company has a quality assurance system that conforms to international certification, with certifiable activities including: an internal control system to address quality issues at farms using trained field-staff who work with contracted farmers to translate export market requirements into practice; and trained company staff who instruct farmers in handling vanilla during harvest.

Harvesting spices and herbs at the correct maturity, proper handling and storage, and proper drying are all of prime importance. He also has strict conditions on quality in contracts with the raw material suppliers and he has trained them to produce the quality required by his company. The company employs four permanent field staff who inspect farms and provide advisory services in agronomics and post-harvest handling and processing. This ensures that good cultivation and post-harvest practices are followed.

The company demands high quality coffee beans from its suppliers. To achieve this it supports smallholder coffee farmers by engaging directly with them to develop long-term relationships and encourage them to improve their product quality. It also negotiates guaranteed sustainable prices, using a transparent price model, to recognise the value of the crop that they produce.

There are many different types of arrangement by which processors may contract raw material suppliers: from informal verbal agreements to written contracts (Box 4.8). Agreements can be short-term (e.g. one harvest season) and renewed annually, or a new supplier is found each year. Alternatively, they can be more permanent if both parties are satisfied with the benefits.

Box. 4.8. Example of an agreement between a processor and a raw material supplier
(From Fellows, 2013)

This agreement is made on [DATE] between [PROCESSOR'S NAME], herein called 'the buyer' and [SUPPLIER'S NAME] here in called 'the supplier', for the supply of [PRODUCT NAME].

1. The supplier shall supply the buyer the quantity ordered and deliver according to delivery schedules stipulated on the order form.
2. The supplier shall sell the product to the buyer at [PRICE] per [UNIT] for the period of [TIMEFRAME OF AGREEMENT].
3. The product will be supplied according to specifications supplied by the buyer.

4. Supplied product may be returned or rejected at the suppliers cost if the specifications contained within this agreement are not met.
5. The product will be labelled with the product name, production date, use by date, suppliers name and batch/lot number.
6. The product will be supplied in containers of a size specified by the buyer.
7. The supplier shall deliver the product to the buyers' premises at [ADDRESS].
8. Deliveries will be made in closed vehicles and the supplier will ensure that the delivery vehicles are clean and free from objects, odours and pests that could contaminate or damage the product or its packaging, as damaged goods will not be accepted by the buyer.
9. The supplier will forewarn the buyer if he/she will be unable to supply the product on the agreed date as specified on the order form. The supplier must give the buyer as much notice as possible if delays will occur.
10. The buyer will make payments within 30 days of delivery of the product.

This agreement will remain in effect for the agreed timeframe, commencing from signature of this agreement. Termination of this agreement will be with the mutual understanding by both parties, with one month's notice given by either party.
This agreement is the entire contract between the parties and supersedes all prior agreements and negotiations made between both parties with respect to the subject matter.
In the event that any dispute or difference arises at any time hereafter, whether in effect of this agreement or determination of rights, duties or liabilities of either or both parties, the matter shall be referred to a single arbitrator to be agreed upon by both parties. The decision of the arbitrator shall be binding upon both parties.

Agreed on behalf of the supplier by:	**Agreed on behalf of the buyer by:**
Name…………………………………....	Name……………………………………
Date………………………………….....	Date…………………………………....
Signature………………………………..	Signature……………………………....

Without a contract farmers are likely to supply buyers who offer the highest price, who are willing to take all materials regardless of quality, and who collect and transport the raw materials. These competing buyers include traders, wholesale merchants, retail companies and other processing companies. To secure a raw material supply, processors may offer a premium price for the highest quality materials and/or other benefits to farmers (e.g. supplying seeds or planting materials of the required varieties, loan of tools and equipment, subsidised fertilizers, supplying workers at harvest time, advance payments, credit or short-term loans with reasonable interest rates). However, even with these types of assistance farmers may renege on contracts in ACP countries where legal systems are unable to enforce contractual agreements, and sell crops to the highest bidder, especially with crops that are easy to sell (Box 4.9). Other raw material buying strategies that are used by some small-scale processors include buying seasonal crops from local markets. However, these are not suitable for making high quality foods because of the lack of control over both volumes and quality.

Box 4.9. Problems with contracting farmers

Most farmers complain that the company's internal control system binds them to sell unprocessed vanilla, hence denying them the value-addition activities that would have earned them more money. Some retain green vanilla for curing at their farms and sales on the local market.

During periods of high prices, many traders buy vanilla from farmers, but they do not comply with traceability and quality requirements for organic products and the company refrains from buying vanilla from intermediaries.

During the harvest season some farmers process aloe into juice and bottle it for sale in local markets, leaving the company short of supplies to process for the off-season. This is due to a loophole in the contract that provides farmers with the right to either sell to the company or process their crop into other products for sale.

The average yields on the company farm are 5kg of vanilla which produces 1kg of cured vanilla, whereas the smallholder farmers have a lower ratio of about 7:1, which is attributed to many farmers not taking the standards seriously.

The absence of a formal out-growers scheme means that even though the company is training farmers in organic production practices based on EU organic production regulations, without formal contractual arrangements in place some farmers have already started to sell the produce to competitors.

Supplies of basic ingredients, such as salt, sugar, vinegar etc. present few problems to most processors, but other ingredients, such as preservatives, yeast, food flavourings/essences and colourings may be more difficult to obtain in some ACP countries and have to be imported. Minimum orders for imported materials may be too large for many small-scale processors and this is a significant constraint on their businesses (similar problems may exist with obtaining retail packaging materials in some ACP countries (Box 4.10)).

To ensure the quality of raw materials, the owner or manager of a small-scale food processing company, or in larger companies the QA officer, should visit suppliers and assess their ability to provide raw materials and ingredients of the required quality. Supplier inspection reports can be used to ensure that each supplier is assessed using the same criteria. The assessment includes facilities (e.g. condition of buildings, production processes, equipment condition and cleanliness) and records that are kept (e.g. QA records, traceability procedures, internal audit procedures, customer complaints and recall procedures). When a supplier is selected the contract should contain the quality specifications of the item to be supplied, conditions under which it is grown, packed, stored and transported; and specific packing requirements.

Transport operators are important potential sources of contamination and damage to foods: they may stack foods incorrectly, causing crushing, or contaminate them with oil, grease or absorption of odours from diesel fumes. The QA system should therefore include control over raw material transport to the processing unit with inspection of vehicles for cleanliness and a specification that raw materials are covered during transport. When a raw material delivery is received, the QA Officer should inspect the items to confirm that they have the quality described in the specification and complete a form to confirm acceptance or rejection of the delivery (giving the reasons). Each accepted delivery should be allocated a different Goods Received Number (GRN) (this is an identification number that enables the material to be traced through the process). If the materials need testing before they are accepted, or if they have slight defects and a lower price is to be negotiated with the supplier, the goods are temporarily placed in a quarantine storeroom until acceptable results are obtained. Incoming crops should be sorted before being placed into storage. Staff should remove pieces that are damaged, discoloured, over-ripe or infected with moulds or rots. They may also clean crops by picking out leaves, stalks, insects, stones etc. Careful inspection by properly trained staff to remove substandard materials before money is spent on processing them is one of the most cost effective methods of ensuring uniformly high quality in the final product. Defect Action Levels are defined for individual foods (e.g. FDA, 2011) for unavoidable defects that are not hazardous to health at low levels and processors should use these sorting and cleaning procedures to reduce the level of each defect to the lowest possible levels.

Box 4.10. Raw material supplies

Although the company does not have much control over ensuring standard oil extraction procedures are followed by suppliers, the lemongrass oil is checked to ensure a high standard. Inspection begins at delivery of the oil and the company employs a quality/technical officer who conducts simple tests to ensure that it has the required quality features, absence of contaminants and minimal variation in quality.

Nuts need to be dried quickly to a low moisture content to avoid spoilage and the potential production of mycotoxins. To ensure that the necessary quantities of quality pulp and nuts are achieved in the short season entails the implementation of HACCP and ISO quality management systems.

The contracted out-grower farmers have received training at the company's own vanilla farm. Buying is strictly by the company's trained staff after inspecting farmers' pods.

Analysis trend records (Fig. 4.2) show whether the quality of each supplier's materials is consistent or if there is variability between batches. The QA officer should warn a supplier if the trend in material quality has a risk of causing potential safety hazards or substandard quality. All such decisions and actions are recorded.

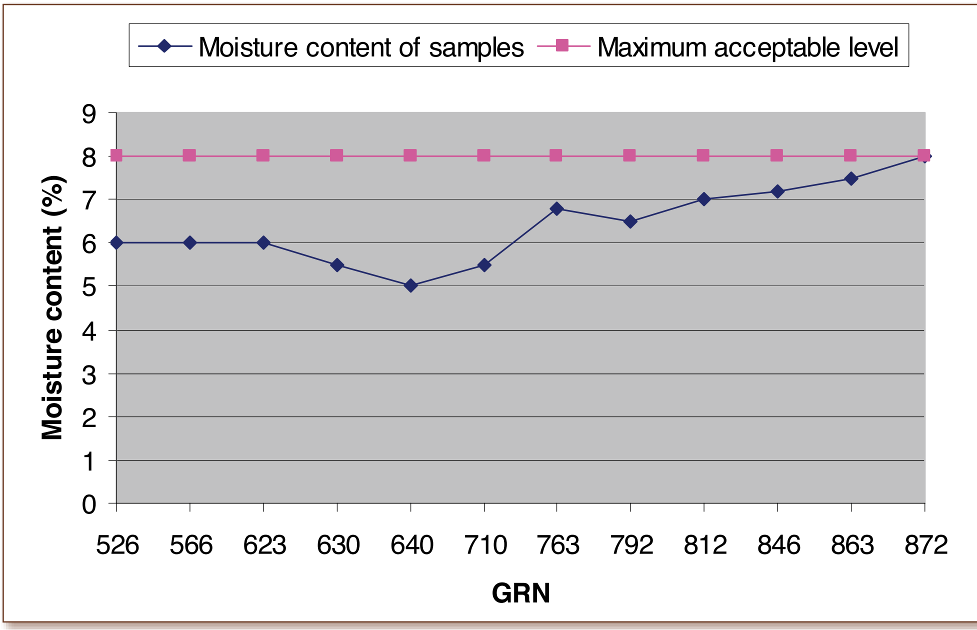

Fig. 4.2. Analysis trend for tree nuts

In Fig. 4.2, the trend indicates that the moisture content of tree nuts from the first supplier (GRN 526 to 710) had some variability but was satisfactory. The change to another supplier (GRN 763 to 872) showed higher moisture contents in the nuts, which approached the maximum acceptable level and prompted a warning to the supplier.

The storekeeper should operate GSP to maintain the quality of raw materials before they are processed. Examples of GSP include control over the temperature and ventilation in storerooms, stacking raw materials on pallets or shelves, insect- and rodent-proofing measures, and the frequency and methods used in cleaning routines.

4.3.2 Ingredient weighing and process control

The storekeeper should use a 'First-In-First-Out' (FIFO) system of stock control and record the amounts of raw materials and ingredients issued each day for processing and the amounts returned unused. When materials are weighed and processed, production staff should record the amount of each ingredient used in a batch of product, together with both ingredient GRNs and product batch numbers. This allows products to be traced to raw material suppliers in the event of a quality problem or customer complaint. The production supervisor should monitor the operation of processing equipment to ensure that processing conditions are within the prescribed limits. If products are produced when there has been a fault in the process, they should be retained in the quarantine store pending an investigation by the QA officer. This should examine the causes of non-conformity and the consequences for the safety or quality of the product. The QA officer should then decide whether to accept, reject or rework those products and record the decision. It is important that the QA officer has the authority to stop or change production routines and to prevent unsatisfactory products from leaving the production unit.

Box 4.11. Process control

In-house processing and blending is strictly monitored to prevent contamination by foreign materials such as stones, string etc. that may not have been identified during inspections on delivery. In general, since the bulk of products are for the export market, there are QA control points throughout the whole process including packing and transport to the point of FOB.

He ensures that all processing equipment and utensils are clean and made from food-grade materials, and specifies packaging materials from manufacturers who supply food-grade plastics. In addition, he ensures control over the processing stages of peeling to remove unwanted parts, washing the uncooked grasshoppers, cooking/frying/toasting/smoking, cooling and packing into containers, and storage for sale.

Mr W. listed examples of their procedures including:

- Checking unblended tea and lemongrass oil on reception.
- Blending tea and oil to the product specification and following the company's procedures.
- Testing to ensure that the blend meets product specifications for flavour.
- Monitoring process control points to confirm that the product meets specifications.
- Monitoring equipment to confirm correct operating conditions.
- Ensuring that out-of-specification product, process parameters and equipment performance are identified, reported and rectified.
- Ensuring that the blend contains a certain percentage of lemongrass oil and has a distinctive taste profile that conforms with the label depiction on the packaging.
- Ensuring that the blended tea is packed in conformity with national, US and EU standard specifications.

The company procurement staff only buy mature ripe vanilla pods, free of any foreign matter; they ensure high levels of hygiene during processing, with drying blankets not used for any other purpose. Drying surfaces and boxes are cleaned regularly and there is regular monitoring of both storage pests and the moisture content of the vanilla to prevent mould growth. There is full documentation of all incoming and outgoing lots.

To achieve the highest quality he ensures that quality assurance practices are followed right from honey extraction stage to processing into honey-based products. These include strict hygiene when collecting honey from combs, testing the sugar content using a refractometer, ensuring the moisture content is kept below 18%, sterilising glass jars before filling honey and observing high levels of hygiene in the processing facility, including insect-proof windows.

4.3.3 Packaging

Control over packaging ensures that correct fill weights are used and that packages are properly sealed, labelled and date-marked. Glass containers can have faults in the glass that are more likely to contaminate foods than other types of packaging materials and glass containers should be inspected individually to ensure that there are no defects that would cause serious harm to consumers. A glass breakages procedure should be part of a QA plan to manage breakages effectively and ensure that no glass fragments can enter the product. The following actions in a Glass Breakage Procedure should take place if any glass is broken in the processing rooms or storerooms:

- Notify the Production Supervisor immediately.
- Stop production if contamination of products or ingredients is possible.
- Discard any products or ingredients that could have been contaminated.
- Carefully remove glass fragments and dispose of them in external waste bins.
- Thoroughly clean and inspect areas in the vicinity of the breakage before production resumes.
- Keep a record of breakage incidents in a logbook and include the batch numbers of products being produced at the time of the incidents and the actions taken.

Glass containers can also have more variable dimensions than either plastic or metal containers and it is important to check their capacity and that the container neck is properly formed and will allow the lid or cap to fit properly. Another measurement is the 'headspace' (the space between the surface of a product and the lid), which should not normally exceed 10% of the capacity of the container.

Seals made on plastic films should be routinely checked by production staff to confirm that they are correctly formed. Any incorrectly filled/sealed packs or damaged packs should be emptied and the contents repacked.

The checkweight is the weight of the container plus filled product. Production staff should take a random sample of containers each hour of production for checkweighing and record the weights. The QA officer monitors the checkweighing results and corrects any under- or over-filling, either by adjusting the filling machine or by advising production staff to fill more accurately; recording the action on a checkweighing record.

Containers should be marked with a ‘best-before’ or ‘use-by’ date and a batch number or code that identifies that particular day’s production. The QA officer ensures that the correct expiry date and batch numbers are used each day.

Metal detection is a final check before containers are packed into cartons or palletised, but metal detectors are expensive and unless they are a legal requirement, few small-scale processors use them.

Box 4.12. Problems with packaging

The availability of packaging for mushrooms in the country is not well-organised and leaves a lot to be desired, which in turn reduces mushroom farmers’ market penetration and selling price.

The main weakness is Mr M’s limited ability get good quality packaging material to be able to export finished consumer products. As a result he has to export some products in bulk and they are repackaged and branded abroad, which deprives him some of the premium prices he would have obtained.

4.3.4 Product quality

To monitor product quality and the effectiveness of the QA plan, the QA officer should take random packs of product for sensory, chemical or microbiological analyses and compares the results with the product specifications. These analyses may require skills, laboratory equipment or facilities that are not available or affordable to small-scale processors and samples of foods are therefore sent to a local laboratory (e.g. government owned Bureau of Standards or university laboratories, or private sector companies). The ISO Standard ISO/IEC 17025 lists reference numbers for each analytical test so that these can be specified when ordering analyses from a laboratory (ISO, 2005). The frequency of sampling and the number of samples depend on the variability in the product and the seriousness of any potential faults; and this may need advice from a food technologist. Batches of final products are kept in quarantine until acceptable analytical results are received. Two reference samples are stored until the use-by or best-before date has expired. If the analytical results are not acceptable, the QA officer decides to retest, re-work or dispose of the batches, depending on the seriousness of the non-conformity, and records the decision. The storekeeper records the amount of acceptable product received into the storeroom and the batch numbers of products ready for dispatch to customers using the FIFO system of stock control.

Box 4.13. Monitoring product quality

The layout of the production unit separates the dirty, wet and dry operations. Periodically she takes samples to a laboratory for quality checks and uses consultants to trouble-shoot production problems and for product development and calibration of instruments.

Continuous quality control is undertaken by the company with sample testing being outsourced to certified test laboratories such as Uganda National Bureau of Standards. The company has a certificate of analysis obtained after it submitted samples of its products to an independent lab to get the breakdown of nutrients, toxicology levels etc.

Periodic testing of product samples is done at the Tanzania Food and Drugs Laboratory or the National Bureau of Standards. The wines have been granted certification by the Tanzania Bureau of Standards and they comply with other market requirements (e.g. having a barcode).

The company is certified ISO 9001 and employs a quality assurance officer who controls all products upstream and downstream. The company also controls its products through different analyses at the laboratory of Institute of Biomedical Applied Sciences, Benin toxicology laboratory and the laboratory of National Institute of Research in Public Health in Mali.

There is a designated Quality Officer who monitors the product and process up to packaging and storage. The centre also has a testing laboratory, certified by the Bureau of Standards, that can test the liqueurs for colour, sugar and alcohol levels.

A product has gained most of its final value by the time it is packaged and any quality deterioration of packaged food cause the greatest financial loss. GSP is therefore part of a QA programme and the QA officer should monitor the conditions and operations in the product storeroom. Products should be stored in boxes on pallets or racks to keep them off the storeroom floor and away from walls. Daily storeroom cleaning is part of a QA plan to prevent dust or spilled food accumulating, which would attract insects or rodents.

4.3.5 Hygiene and sanitation

A hygienic processing unit is essential to produce safe, high quality foods. QA procedures include proper cleaning of equipment and processing rooms and removal of wastes as they are produced. The QA officer has the responsibility to train production staff in cleaning and sanitation procedures; storage of cleaning chemicals; pest control; and maintenance of equipment and facilities. Cleaning should a planned and costed activity: there should be a cleaning plan and resources made available to buy sufficient cleaning materials and equipment, with sufficient time made available for staff to complete cleaning correctly. Cleaning chemicals should be approved for use in food production areas and should be used in correct amounts according to manufacturer's instructions, and stored in a separate storeroom. A cleaning record details cleaning procedures: what is cleaned; how and when it is cleaned; who cleans it; and what with. Staff should record that they have cleaned equipment and facilities to the correct standard and the QA officer should check this.

Box 4.14. Hygiene

To ensure that quality standards are met, Ms F., the Managing Director, is very close to the workers to make sure that everyone works according to the laid-down procedures. Cleanliness in the factory and staff hygiene, clean uniforms and equipment are all emphasized.

Quality control may be undermined because some moringa oil buyers repackage the product but the processor has no idea of the buyers' storage conditions or the cleanliness during re-packaging.

The quality and safety of the product is assured through strict observance of hygiene and sanitation in the production unit, and following good manufacturing practices.

Food wastes should be placed in single-purpose, covered, foot-operated waste bins in the production room and storerooms. Processors should have a system in place to regularly remove wastes from the building to external covered waste bins, which should be emptied at least weekly. Staff who handle wastes should not wear clothing used in the production areas and they should wash their hands before resuming work.

Electric insect killers and pest traps should be checked and emptied daily as part of a QA plan. Any evidence of rodents or birds in the production unit should prompt the QA officer to find the source of entry and apply corrective actions, including fumigation, to ensure that the infestation is removed and points of entry are sealed to prevent a recurrence. The incidence of pests and corrective actions taken should be recorded.

Some ACP countries have a legal requirement for all food handlers to undergo training in hygienic food handling and personal hygiene before they are allowed to work in food processing premises. Records of training are included in staff personnel files. The QA officer should routinely monitor staff activities and have the authority to stop production if any practices could make products unsafe. Hygiene and food safety rules should be part of the employees' terms of employment, resulting in disciplinary procedures followed by termination of employment if they are ignored. Hand washing is especially important and staff should wash their hands before putting on protective work clothing, before entering/re-entering the production area, after meal breaks or visiting the toilet and after handling wastes. Any visitors should also be requested to wash their hands before entering the production area. The processing unit should be designed to ensure that staff pass through changing rooms to put on clean protective clothing and hats/hairnets before they can enter the production area. Some processes that produce high-risk foods may also require staff to wear face masks, disposable gloves and overshoes or rubber boots. In most ACP countries, it is a legal requirement for staff who handle foods to undergo a medical examination before starting employment and thereafter every six months, with medical reports held in the individual's personnel files. Anyone who is suspected of having a disease or infection that could be transmitted through food (e.g. skin disorders, intestinal illnesses, or infections of the chest, ears, eyes or nose) should not be allowed to handle foods and should undertake other duties until they are cleared as fit to handle foods. All illnesses and treatments should be recorded in personnel files. Employees' food and drink should not be allowed in the production area, storerooms, changing rooms or toilets, and may only be consumed in a staff rest room. Smoking should not be permitted anywhere in food processing premises.

A maintenance schedule details the frequency with which routine inspections and maintenance of equipment and buildings are carried out and describes the maintenance procedures to be followed. Staff who carry out maintenance procedures should record that they have been completed and the QA officer should verify that greases and oils used to lubricate equipment are food grade and are used according to manufacturer's instructions. Production staff should be trained to monitor all equipment for flaking paint, loose nuts and bolts etc, and report any problems to the QA officer. Routine inspections should also be made to ensure that floors, walls, windows and ceiling panels have not developed cracks or other faults. All areas of a building in which repair work takes place and all equipment that has been repaired or maintained should be fully cleaned before production re-starts. A record of the maintenance or repairs should be completed.

4.3.6 Traceability, customer complaints and product recall

In the event of a customer complaint, GRN numbers and batch numbers are used to trace the product back through the production process to the ingredient suppliers (Fig. 4.3). QA records of raw material testing, ingredient weighing, process control, fill weights and product testing can all be used to demonstrate that the product was produced to specification before dispatch to the customer. The business owner has responsibility for dealing with customer complaints, which may be delegated to the QA officer as a single point of contact for customers, keeping them informed of progress. If a serious safety hazard occurs, such as growth of pathogens in reference samples or a safety-related customer complaint such as a reported illness from eating a product, it may be necessary to recall the products having the same batch number(s). When handled correctly, a product recall can improve the reputation of a company, showing buyers, consumers and regulatory authorities that it is a responsible producer, concerned for the welfare of consumers and guarantees to supply only high quality products.

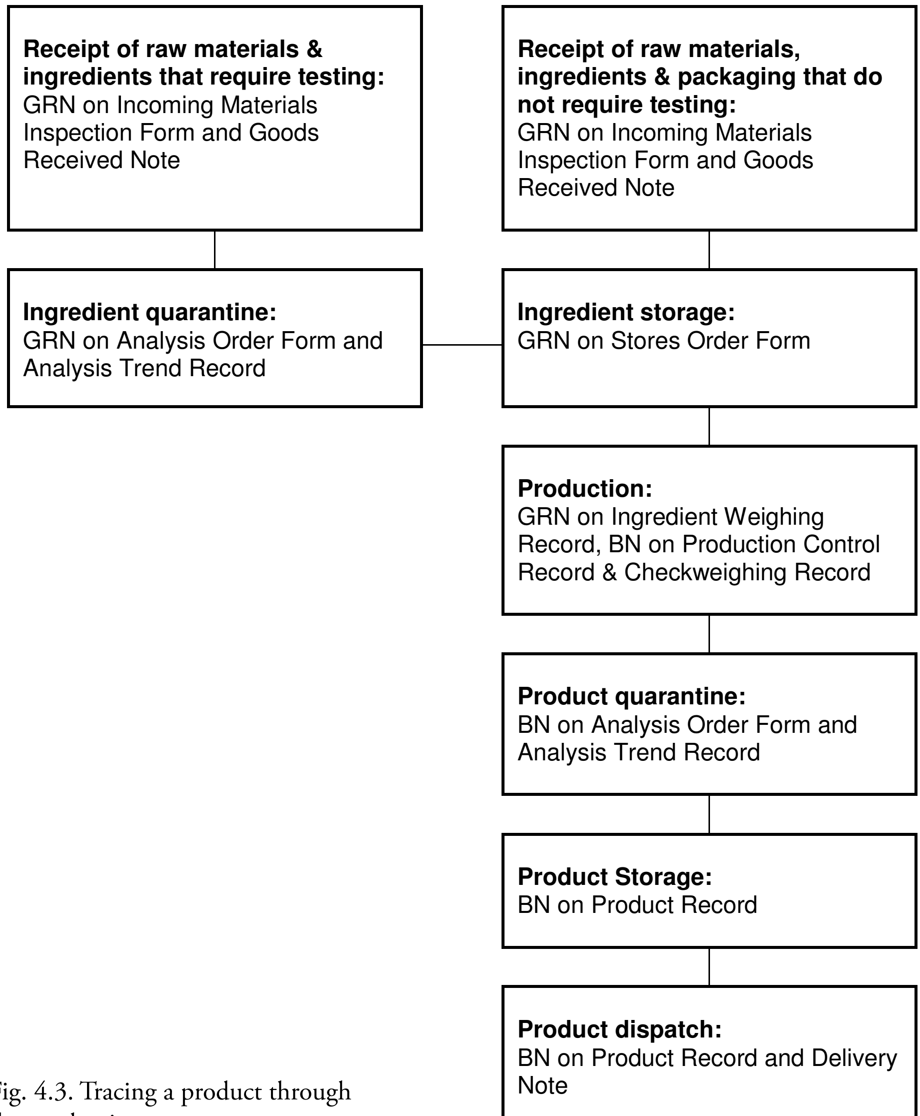

Fig. 4.3. Tracing a product through the production process

4.3.7 Internal audits and verification of the QA plan

A QA plan should be regularly evaluated both to make sure that it is working correctly and to identify where improvements can be made. This can be done using an internal audit procedure, or some buyers may wish to employ either their own audit staff or an independent external consultant. The audit should include a physical inspection of the production unit and an on-site verification of the QA procedures being used. An audit report is filed as evidence for customers and authorities that the QA system is in place and operating effectively. QA records are important for auditing and verification, and also for tracing products in response to a customer complaint or an investigation by regulatory authorities. The records should show who made decisions and the actions that resulted from the decisions. The QA system should also be clear about who is responsible for checking that correct actions are taken and that records are properly kept.

4.4 Summary of food legislation

In most ACP countries there are laws governing the setting up, registration and operation of food processing businesses that are intended to make sure that consumers are not harmed by foods or mislead by the claimed nature or quality of products. National legislation usually includes all types of food production, processing and trade, and may cover:

- Consumer protection through food safety, hygiene and sanitation at food premises.
- Composition, labelling, weights and measures.
- Laws relating to the import and export of foods.

National food laws vary widely in ACP countries, both in their complexity and the extent of their coverage: for example, some adopt international Codex standards for specific foods, whereas others have comprehensive legislation and/or religious codes. Because of the variations between countries, it is not possible to describe each type of food law in this book and advice and information should be sought from the local Bureau of Standards, Ministries of Health, Trade and Industry, or Agriculture; a local Food Commission, manufacturers' association, university food science department; or a consultant who has expertise in food law. Details of laws and standards covering imports, exports and international trade can be obtained from the United Nations Committee on Trade and Development (UNCTAD) and the Codex Alimentarius Commission sets standards and specifications for many foods. Each member country has a 'focal point' where information on UNCTAD or Codex standards can be obtained.

4.4.1 Hygiene and sanitation legislation

Hygiene and sanitation legislation sets out the basic principles and rules to ensure that safe and wholesome foods are produced. These are the most widely enforced laws by regulatory authorities. Inspection and certification is required in many ACP countries before a processor is given a licence to manufacture foods, which covers the design and construction of premises and correct hygienic procedures for food handlers. Other codes and regulations aim to ensure that processing, transport and storage of food are carried out in a way that produces products that are wholesome and safe. These health, hygiene and sanitation laws cover the following aspects:

- Preventing processing in unsanitary conditions or exposing foods to the risk of contamination.
- Ensuring that equipment, utensils, and containers are clean and maintained in good condition to allow proper cleaning and disinfection.
- Ensuring that people who handle foods take responsibility to protect them from contamination.
- Hygienic building design and construction, including: water supplies; drainage and removal of wastes; toilet facilities; wash-hand basins; separate places to store clothing and cleaning chemicals; facilities for washing equipment; adequate lighting and ventilation; and protection against infestation by rodents and insects.

Previously, enforcement in many ACP countries used spot checks of processing operations and random sampling of products, but many authorities now take a more preventive approach to control, requiring producers to identify food safety hazards and put safety controls in place using the HACCP system. HACCP records are used by inspectors to assess compliance over a period of time rather than only on the day of an inspection.

4.4.2 Composition and labelling

There may be regulations on specific foods, such as their composition, the use of additives and the presence of contaminants in foods. Food additives are chemicals that are intentionally added to food during its preparation, processing or storage and include colourings, preservatives, artificial sweeteners, flavour enhancers, emulsifiers and stabilisers. In most ACP countries, the regulatory authorities produce lists of permitted additives, the foods in which they may be used and the maximum levels, if any, often based on Codex standards (see Codex, 1995). Any chemical that is not on these lists cannot be used. In the EU, permitted additives are given an 'e-number' (see Jukes, 2011 and FSA, 2010). Regulations also describe the composition and quality of food grade additives. If no limits are set for an additive, GMP should be used to ensure that only levels necessary to achieve the desired effect are used.

Contaminants are chemicals that are not intentionally added to food but may enter during its production, preparation or storage, and include herbicides, pesticides, mycotoxins and poisonous heavy metals. The use and storage of agri-chemicals is often regulated by national agricultural legislation, whereas food legislation sets a maximum residue limit (MRL) for each chemical in specified foods. Microbial contamination is often controlled by national law using an over-riding clause, for example, 'the product should not contain pathogenic micro-organisms such as (named species) or any toxic substance originating from micro-organisms'. However, product specifications from commercial buyers and international standards for specific foods may contain more specific maximum limits for named micro-organisms, mycotoxins and other contaminants.

Food labelling

Retail labels provide consumers with information about the nature and characteristics of foods and many prosecutions of food companies are due to incorrect labelling. Label design is a complex area and professional advice should be sought from graphic designers, a Bureau of Standards or other responsible government organisation. In most ACP countries, general labelling regulations require the following information to be included on a label:

- Name of the product.
- A complete list of ingredients, with the ingredient having the highest amount listed first and others in descending order by weight (but not the actual amounts of ingredients used). Water is an ingredient if the product contains >5%. Additives that are used only as a processing aid and have no functions in the final product need not be included. Essences do not need to be individually identified, but may be described as 'flavourings'. Other additives may be identified by category, name or European system of 'e-numbers' (e.g. preservative: sorbic acid' or 'preservative: e-200).
- Name and postal address of the producer.
- Net weight or volume of product.
- A date mark for products that have a shelf life of < 12 months. This may be: 1) a 'Best-before' date that shows the shelf life before changes take place to its flavour or other qualities; 2) a 'Use-by' date that shows the length of time that a product is safe to eat; or 3) a 'Sell-by' date that is an instruction to retailers when to remove the product from sale. In most countries, the first two are a legal requirement and the third date is optional - see FSA, 2003 for further information on date marking.
- Optionally in most ACP countries, the label may also contain nutrition information, instructions or recommendations for storage and use, the country of origin and a bar code.

There may also be detailed laws concerning for example: the positioning of information on the label, with the name of the food, the date mark and the net weight all in the same field of vision; the relative print sizes of different information; the use of claims for health-giving properties (a label can make claims about the health benefits of a food, but not if it gives false or misleading information or describes a food as being able to prevent, treat or cure an illness); rules for labelling organic foods and displaying logos of certification bodies; and place of origin (geographical indications may also be covered by laws on trademark protection. The World Trade Organisation 'Agreement on Trade Related Aspects of Intellectual Property Rights' (TRIPs) recognises geographical indicators as an intellectual property right and requires authorities to take action if their use is likely to mislead the public over the true place of origin of a product).

4.4.3 Water supplies and waste disposal

Some ACP countries have water legislation to protect water sources from pollution by pesticides and fertilizers or animal manure, or to control the treatment and use of waste water to prevent risks to health. Public health legislation controls the quality of drinking water and may also include testing procedures, protection of drinking water sources and maintenance of water supply systems. The water supply company or ministry is often responsible for its quality up to the point that the supply pipe enters a building. The processor is responsible for water quality in its operations. This is covered by food legislation that requires food businesses to have a potable water supply for use as an ingredient, for washing food, or for cleaning and disinfecting equipment. In ACP countries that do not have specific water legislation, water may be included as a food in food laws.

4.4.4 Weights and measures

Legislation on weights and measures requires all foods to be sold by weight, volume, measure or number, with the amount of food that is declared on the label being the same as that in the pack. However, the law recognises that not every pack can be filled with exactly the specified weight or volume because both machine-filling and hand-filling of containers creates some variability. 'Average weight' legislation allows some variability provided that the average amount in packs is above the declared minimum weight. The other system is 'minimum weight' legislation, in which all packs must be at or above the declared weight/volume; to achieve this all packs should be slightly over-filled (e.g. by 1%) to avoid the risk of prosecution.

4.4.5 Licensing and control

Licences issued to individuals and companies to process, sell, transport, import or export foods are covered by licensing legislation, often implemented by ministries of trade, industry, commerce or health as well as locally by municipal authorities. The authorities that have responsibilities for food safety can include ministries of commerce, environment, agriculture, fisheries, tourism, trade and municipal authorities, but in many ACP countries, it is the ministry of health that has authority over food safety issues. The ministry of commerce or trade usually controls the establishment of food standards, labelling and weights and measures. In most countries, it is an offence to produce or sell food without a licence and legislation may allow licences to be suspended or revoked where processors fail to meet prescribed standards. Inspection of locally produced foods may come under one ministry, such as health or agriculture, whereas control of import and export licences and inspection systems may be the responsibility of another, such as a customs and excise authority or ministry of commerce or trade.

Box 4.15. Examples of regulatory procedures needed to establish a food processing enterprise (Adapted from Fellows, 2013).

The number of registration procedures that are needed before a processor can begin production vary in different countries in their degree of complexity and the time, effort and expenditure required to complete them. Processors may need assistance from advisers to guide them through the process, which may involve some or all of the following actions:

- Notify the tax authorities (e.g. sales tax commissioner or VAT office) and complete 'notification of business intention' forms or their equivalent.
- Notify another branch of the tax authorities to get an 'approval certificate' to show that no unpaid income tax is outstanding.
- Apply to the local government office (e.g. Town Council or District Council) for a business licence.
- Apply to the Ministry of Health, Bureau of Standards or equivalent, requesting that a food inspector visits the premises to examine the facilities. When a satisfactory inspection has been made, apply for registration as a food premises and get a 'food producer's licence' or certificate.
- Send a sample of product for analysis to the Bureau of Standards or other government approved laboratory to show that it conforms to national legislation on food composition. If it conforms, a 'product approval certificate' or similar is issued and a standards authority symbol may be placed on the product label to show it has been approved.
- Apply to the Ministry of Finance, Department of Customs, and local government tax authority or VAT office if there are opportunities for

remission of taxes on imported ingredients, packaging materials or equipment. This is also necessary to reclaim VAT or other types of sales tax.
- Register the business at a bank and open an account for trading.
- If processors are considering export of processed foods, it is also necessary to apply to the National or Central Bank and/or the Export Development Authority for an Export Licence and to the Customs Department for export clearance.

4.4.6 *International regulations on exported foods and other high-value ingredients*

The composition and quality of most foods and some nutritional supplements are controlled by legislation in industrialised countries and ACP processors who wish to export their products to these countries should be aware of the legislation and standards in order to produce products having the required quality to enter these markets. The regulations are complex and may require processors to seek assistance to interpret and understand them in relation to their specific products, but a summary of the main standards is given below.

International food standards

Codex standards cover the composition of 200 individual processed, semi-processed or raw foods that are traded internationally. Codex standards that apply to all foods include seven standards on food labelling, five codes on food hygiene, five guidelines on food safety risk assessment, 14 standards on contaminants in foods, maximum limits for 213 pesticide residues and 44 veterinary drugs, limits for 222 food additives, as well as standards and guidelines on sampling, analysis, inspection and certification procedures. More than 170 countries have Codex Contact Points and some countries have established National Codex Committees that act as a national forum for food processors, consumers and relevant government authorities to advise on standards and regulations (see Codex, 2013).

The International Standards Organisation (ISO) has published ≈ 14 000 international voluntary standards across a range of sectors on specific products or services. Standards may be adopted as national food laws or used by processors to gain access to export markets (some buyers make ISO standards a requirement for suppliers). Another standard, ISO 22 005 describes traceability in the feed and food chain, ISO 26 000 is the standard on social responsibility of businesses and ISO 14 000 series of standards is concerned with environmental management (see ISO, 2013, search for standard number). The ISO management system for environmental issues is ISO 14 000. An international management system for social responsibility in business is SA 8000 (SAI, 2008).

An important EU regulation (EU, 2013) integrates controls at all stages of food production (from 'farm to fork') and describes how the food laws are interpreted and implemented to harmonise national food control systems and develop a common approach to imports of food. There are also proposals to cover contaminants and residues, food hygiene and food labelling and the Commission is developing rules on foods containing or derived from genetically modified organisms (GMOs).

In Europe, the origin of products, such as wine and cheese, is normally certified, for example, D.O.C. (Dénomination d'origine contrôlée) by a government-private sector consortium. Increasingly, high value edible non-wood forest products, such as wild mushrooms, are also certified through such documentation of origin systems. The provisions of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) forbid trade in endangered species and regulate trade of threatened species. The lists of species are available at Cites, 2013.

Food supplements

The EU Food Supplements Directive (Jukes, 2013) includes vitamins and minerals, and natural products such as plant and herbal extracts. The directive states that no medicinal indications are allowed; only nutritional claims, and only non-pharmaceutically active dosages of herbs are permitted. However, individual EU countries apply directives differently: food supplements (including herbal supplements) are included under laws that cover food products in some countries, whereas in others they are authorised as dietary supplements for particular nutritional uses or as ingredients with nutritional or physiological functions that fall under the food supplements directives.

Organic foods

The EU Council Regulation EC 834/2007 (EU, 2007) covers organic production and labelling. This is intended to guarantee that a product is produced with reduced impact on the environment and provides information about the origin, preparation, processing and packaging of the product. Organic production systems mainly deal with production of cultivated plants, but also include wild-crafted plants and plant products, which can be organically certified when they are gathered from areas that are free from chemical treatments. Forest management certification programmes cover the sustainability of wild-crafted plants and plant parts and some have developed guidelines for the management of non-wood forest plants (e.g. the Forest Stewardship Council (FSC, 2013), the Rainforest Alliance (Rainforest Alliance, 2013) and the Soil Association (Soil Association, 2013)).

Regulations on novel foods, health and nutritional claims

The EU regulation 1997/258/EC concerns novel foods (EU, 1997). To market a food within the EU, it must have been sold to a significant degree in at least one member state prior to 15 May 1997. If this is not the case, the product is considered a 'novel food' and must normally go through an expensive process to prove its safety. However, there is a simplified procedure if novel foods or food ingredients are considered as 'substantially equivalent' to foods or food ingredients that are already sold in the EU.

The European regulatory framework on nutrition and health claims defines the meaning of claims, contains a positive list of generic nutrition claims that may be made, and sets threshold limits (e.g. 'rich in dietary fibre' is allowed providing that the product contains at least 6g of fibre per 100g). Reduction of disease claims are also allowed providing that they have been proven.

Regulations on medicinal products and herbal remedies

Nearly all countries have laws on the supply of medicinal products and herbal remedies and those for the EU are described as an example below. The EU directive 2001/83/EC (EU, 2001) defines the basic criteria for medicinal products. Preparations are considered to be a medicinal product if they are not intended to be used as food, cosmetics or for other uses, and are sold for treating, preventing or diagnosing diseases. Before it can be sold, a medical product must be authorised by the European Agency for the Evaluation of Medicines (EMEA) or the national authority of an EU member state. This requires the product to be pure and contain defined ingredients, which require testing, clinical trials and detailed documentation showing quality, safety and efficacy. This is difficult, due to the complexity of plant substances, extremely expensive and time-consuming, and would prevent the legal distribution of most traditional herbal remedies. For this reason, an additional directive (2004/24/EC (EU, 2004)) created a simplified procedure for traditional herbal medicinal products. A precondition is that the product has been used for pharmaceutical purposes for at least 30 years and at least 15 of those have been within the EU or its territories. If this can be proved, a simplified registration is possible as a traditional herbal medicine that may be sold within all countries of the EU. The Committee for Herbal Medicine Products, which is part of EMEA, has developed procedures for SMEs to develop and register new medicinal products (CHMP, 2013). The World Health Organization (WHO) has developed Guidelines for Good Agriculture and Collecting Practice of Medicinal and Aromatic Plants (GACP) (Europam, 2006). They provide quality standards to ensure that microbiological loads are reduced to a minimum and that any negative effects on plants are limited during cultivation, processing and storage. The GACP guidelines also include requirements for packaging and labelling. The WHO Good Manufacturing Practice (GMP) guidelines for medicinal plants have been harmonised with the EU directive 2003/94/EC (EU, 2003). They concern the preparation of processed raw materials and the aim is to set standards that minimise the risks that cannot be eliminated through final product testing.

Regulations on cosmetics

In 2013 the EU 1223/2009 Cosmetics Regulation came into force, strengthening the safety of cosmetic products and streamlining the framework for all operators in the sector (EU, 2009).
The legislation determines access to EU markets for cosmetic products and their ingredients, which includes lists of products and ingredients in the Inventory of Cosmetic Ingredients as defined by the International Nomenclature on Cosmetic Ingredients (INCI, 2013). Cosmetics manufacturers are responsible for the safety of non-regulated novel ingredients and they must detail the qualitative and quantitative compositions of their products, as well as the chemical and microbiological specifications of the raw materials.

Other products

Products such as candles made from beeswax (section 3.5.1) are not legally controlled, although the quality of design and materials demanded by consumers may be high. These are much easier for ACP producers to sell successfully in industrialised countries through a commercial or fair trade buyer in the importing country, or directly using the internet.

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Entrepreneurs' checklist

Have you:

❏ Found out the detailed quality requirements for your product?

....

❏ Researched international quality standards and discussed individual requirements with buyers?

....

❏ Developed a quality assurance scheme that includes elements of international safety management guidelines and covers all processing and warehouse operations?

....

❏ Included raw material suppliers in your QA scheme?

....

❏ Ensured that all staff are properly trained in implementation of the QA scheme?

....

❏ Put in place procedures to manage and regularly review the QA scheme?

....

❏ Made sure that your product complies with laws on composition, labelling and weights and measures?

....

Reader's notes

Please use this space to write your own notes on Chapter 3.

Annex A
Further reading

CBI, (Centre for the Promotion of Imports from developing countries) is an Agency of the Netherlands Ministry of Foreign Affairs. In 1998 it has become an EU Agency. It supports producers/exporters and business support organisations to improve their capabilities. The website (www.cbi.eu) provides detailed market information on a wide range of foods and a comprehensive and highly flexible set of 22 differentiated services.

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Annex B
Glossary and acronyms

Glossary

Additive	Chemical added to food to improve the eating quality or shelf life
Adulterant	Substance that is intentionally added to food which is forbidden by law
Adulterate	The addition of a foreign, inferior or inert substance to food, or the removal of a valuable or necessary ingredient, designed to give a false impression of value or to hide defects in food
Advertisement	Any written or pictorial representation made for the purpose of promoting the sale of a food
Aflatoxin	A particular type of mycotoxin produced by some strains of the mould Aspergillus sp. that causes damage to the liver
Air waybill	Equivalent to a bill of lading for goods imported by airfreight
Antioxidant	A chemical that slows down the development of rancidity in oils and fats
Asset	Something owned by a business, or available for use in the business
Audit	A formal examination and verification
Bill of lading	A receipt for goods and contact for carriage by an ocean carrier. It gives title to the goods and proof of ownership
Bloom	Unstable cocoa fat crystals on the surface of chocolate that produce dullness or grey specks
Brand image	The information and expectations associated with a product created within the minds of people
Cashflow	The amount of money coming into and going out of a business

Commercial invoice	Sales document which includes information on name and address of buyer and seller, description of goods, unit price, number of units, terms of delivery and payment
Competitor	Another business selling similar types of products to the same target customers
Compound coating	A coating material in which cocoa solids and hardened vegetable oils are used to replace cocoa butter
Consumer	The person who consumes a food or is the final buyer of a product
Contaminant	Any substance in a food that is not intentionally added
Critical control point	A processing factor or point in a process where lack of control would result in an unacceptable food safety or quality risk
Cryogenic freezer	Equipment that uses subliming or evaporating carbon dioxide or liquid nitrogen directly in contact with food to freeze it
Customer	A person, company or institution that buys a product
Decortication	Removal of the outer coat from seeds
Demand	The amount of goods that customers want or need to buy
Emollient	A substance that makes skin feel smooth and soft
Enrobing	Coating food pieces with chocolate or other materials
Essential oil	(or essence) oil used to give aromas to foods and cosmetics
Expeller	A machine that continuously extracts oil from seeds or nuts
Extractor	Equipment used to extract food components using solvents
Feasibility study	Systematic investigation of an idea for a product or process to see if it can work (i.e. to see if it is feasible)
Ferment	The action of micro-organisms on food to produce alcohol, acids, flavours, or aromas
Focus group	A group of individuals who belong to the target market
Food chain	All stages of food production from harvest to sale and consumption
Food service outlets	The collective term for restaurants, take-aways, hotels and cafés
Free fatty acid	Chemical formed by the breakdown of oil that causes rancidity

Functional foods	Foods that have enhanced benefits in addition to their nutritional value, often related to health promotion or disease prevention, by adding new ingredients or more of existing ingredients
Grading	The assessment of a number of attributes to indicate the overall quality of a food
Hazard analysis	The identification of potentially hazardous ingredients, storage conditions, packaging, critical control points and relevant human factors that affect product safety or quality
Hygroscopic	Able to absorb moisture
Ingredient	Any substance used as a component of a manufactured food and present in the final product
Investment	Money, fixed and current assets put into a business
Invoice	A bill requesting payment
Label	Any written, pictorial or other descriptive matter written, printed, embossed or impressed on, or attached to, a container of food
Low-acid food	A food with a pH greater than 4.6 and a water activity of 0.85 or higher
Market research/ survey	The process of identifying market segments
Market segment	A group of similar consumers
Market size	The weight or volume of food sold per month or year
Market value	The amount of money spent on a food per month or year
Marketing	Activities to identify customers and satisfy their needs by providing the products they want
Marketing mix	The combination of where a product is sold, its price, its characteristics and its promotion
Mycotoxins	Poisons produced by some types of moulds
Neutraceutical	(Or ‘functional’) food that provides benefits other than the nutrients required for normal health
Niche market	A small specialised section of the a market
Oilcake	The solid part of the crop remaining after oil extraction
Order	A written request for goods or services

Panning	The process of building up thin layers of sugar or other coatings in a controlled way to make confectionery products
Pasteurisation	A relatively mild heat treatment, in which food is heated to below 100°C to preserve it
pH	A scale from 1-14 that is used to measure acidity (below 6), neutrality (7) and alkalinity (8-14)
Phytosanitary certificate	Certificate required by customs for some types of products (e.g. plants, seeds and some types of foods)
Prebiotic	Food that contains ingredients that are not digested but stimulate the growth of probiotic bacteria in the colon
Probiotic	Food that contains probiotic bacteria that promote gut health
Proforma invoice	A cost estimate
Promotion	Activities to raise awareness of a product and increase sales
Rancidity	Development of off-flavours due to the oxidation of oils and fats
Receipt	A written acknowledgement of payment
Refining	The process of removing flavours, colourings, free fatty acids and gums from oil
Screen	A sieve
Soil	A generic term used for all types of contaminating materials on foods or equipment
Sorting	The separation of foods into categories on the basis of a measurable physical property
Survey	A method of gathering information from a number of individuals
Taste panel	A group of people, usually trained, who assess particular quality characteristics under controlled conditions
Tempering	A process of re-heating, stirring and cooling chocolate to remove unstable fat crystals
Thermogenic	Causing an increase in body temperature
Trommel	A rotating cylindrical sieve
Unsanitary conditions	Conditions that could cause contamination of food or make it injurious or dangerous to health

Water activity	The ratio of vapour pressure of water in a solid to that of pure water at the same temperature
Wholesome	To be clean, safe and not adulterated
Windrow	A row of piled crop
Yield	Weight after a process compared to the weight before a process

Acronyms

CAC	Codex Alimentarius Commission
CCP	Critical Control Point
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
FDA	Food and Drug Administration (USA)
FFA	Free fatty acid
FIFO	First-In-First-Out (system of stock management)
GDP	Good Distribution Practice
GHP	Good Hygienic Practice
GM	Genetic Modification/Genetically Modified
GMP	Good Manufacturing Practice
GRN	Goods Received Note
GVC	Global Value Chain
HACCP	Hazard Analysis Critical Control Point
IMF	International Monetary Fund
ISO	International Organization for Standardization
NGO	Non-Government Organisation
ppm	Parts per million (equivalent to mg/kg)
PRP	Prerequisite programme
QA	Quality Assurance
SME	Small and medium scale enterprise
SWOT	Strengths, weaknesses, opportunities and threats
TQM	Total Quality Management
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
US/USA	United States of America

WHO	World Health Organisation
WTO	World Trade Organisation

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Reader's questionnaire

Please help us to improve future books by completing this questionnaire and sending it by post to CTA, Postbus 380, 6700 AJ, Wageningen, The Netherlands (Fax + 31 317 460067).

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....
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This final book in the Opportunities in Food Processing series shares the overall aim of previous books: to enable small-scale ACP processors to improve their access to markets and increase sales of high quality foods. The focus of this book is the production and sale of high-value foods that have a premium sale price, above that of 'normal' processed foods. It is believed that this is the first time that information on the demand for high-value foods produced from raw materials found in ACP countries, their production, marketing and quality management has been gathered in a single publication.

This volume differs from the previous books in a number of respects: it does not have a single commodity focus and it groups together foods (or ingredients for cosmetic or medicinal products), that have a high value; it assumes that the intended beneficiaries in ACP countries are already moderately successful in their food processing businesses, and as a consequence it is written using 'higher level' language than previous books; and because high-value markets are often in industrialised countries, the book has a focus on how ACP processors may benefit from entering export value chains for these products. The book therefore illustrates potential opportunities for producing high-value foods in ACP countries, rather than being a handbook on how to do this. It is the result of a collaborative effort by practitioners who support small-scale food processing in ACP countries.

Other titles in the series include:

> Setting up and running a small food business

> Setting up and running a small meat or fish processing enterprise

> Setting up and running a small flour mill or bakery

> Setting up and running a small-scale dairy processing business

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> Setting up and running a small-scale cooking oil business.

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