organic taste
ECROPOLIS

Summary report on sensory-related socio-economic and sensory science literature about organic food products

Maurizio Canavari et al.

November 2009


Alma Mater Studiorum-University of Bologna (UniBo)

SEVENTH FRAMEWORK PROGRAMME

Summary report on sensory-related socio-economic and sensory science literature about organic food products

Deliverable 1.2

EU Project ECROPOLIS - Contract No. 218477-2 (FP 7)

Maurizio Canavari[1] (WP leader)

with the contribution of
Daniele Asioli[1], Alessandra Bendini[1], Nicola Cantore[1], Tullia Gallina Toschi[1], Achim Spiller[2], Tim Obermowe[2], Kirsten Buchecker[3], Mark Lohmann[3],

with feedback from
Gabriela Wyss[4], Otto Schmid[4], Flurina Schneider[4], Hanna Stolz[4], Mariusz Maciejczak[5], Eliza Kostyra[5], Adriaan Kole[6]

[1]University of Bologna (UniBo), Italy
[2]University of Goettingen (UGOE), Germany
[3] Verein zur Foerderung des Technologietransfers an der Hochschule Bremerhaven e.V. (ttz), Germany
[4] Research Institute of Organic Agriculture (FiBL), Switzerland
[5] Warsaw University of Life Sciences (SGGW), Poland
[6] Agrotechnology and Food Innovations (A+F), The Netherlands

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Alma Mater Studiorum-University of Bologna (UniBo)
Dipartimento di Economia e Ingegneria agrarie
Viale Giuseppe Fanin, 50
40127 Bologna (BO)
Tel +39 051 2096108 and Fax +39 051 2096108
E-mail: maurizio.canavari@unibo.it, Internet: http://www.deiagra.unibo.it

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Seventh Framework Programme for European Research & Technological Development of the European Commission.

For further information see the project homepage at www.ecropolis.eu

Executive Summary

Organic food's initial attraction to the public was that it was perceived to be healthier and tastier, but scientists and policy makers have mainly stressed the benefits to the environment of organic and sustainable farming. Scientific support for marketing actions addressed to those who want to be healthier and who want to enjoy better taste, and are willing to pay more for these benefits is scarce. Past research has produced little clear evidence about the importance of sensory characteristics such as taste, smell, appearance etc in consumers' preferences with regard to organic food. The Ecropolis project, funded by the E.U., was set up with the aim of investigating the role of the senses in consumers' preferences regarding organic food, and leading to research into how best to satisfy those preferences.

This deliverable is aimed at providing a solid basis for such research with an in-depth review of, and two reports on, the relevant scientific literature. The first report (Annex I) regards what consumers expect from organic products in terms of taste, smell, appearance, etc and how these expectations are (or are not) met; the second is about the science of the senses (Annex II).

The first project tasks included creating and agreeing on a glossary of terms, deciding on search criteria (key words, etc.), setting up a bibliographical data base, preparing then circulating the above-mentioned reports, and finally preparing a summary of the reports.

The report on consumers expectations highlights the suggestion that while organic food has traditionally been marketed through specialized retailers, its market share will only grow significantly if it is promoted by multiple retailers. Research literature from all over the world seems to agree in indicating that consumers' choices are largely motivated by health, the environment, price and social status. Other considerations include ethics, the localness of the product and lifestyle choices.

The literature also indicates that the organic market will expand significantly only if consumers are more willing, and able, to recognize quality, but this presents serious issues. When buying the product they cannot personally verify its quality and genuineness and thus must rely on regulation and inspection bodies. The recognition of quality can also be encouraged by effective communication by producers and retailers through appropriate branding, labelling and presentation. There are connections between this information and questions of sense perception, but researchers disagree about how important the latter is in influencing the customer, and in which ways it does so.

The following report focuses, in fact, on the science of the senses, which tries to analyze in detail people's responses to food, despite the many potential pitfalls in carrying out the research which might influence the reliability of the results. There is broad agreement on two points:

- there is no proof that organic food is more nutritious or safer, and
- most studies that have compared the taste and organoleptic quality of organic and conventional foods report no consistent or significant differences between organic and conventional produce. Therefore, claiming that all organic food tastes different from all conventional food would not be correct. However, among the well-designed studies with respect to fruits and vegetables that have found differences, the vast majority favour organic produce. Organic produce tends to store better and has longer shelf life, probably because of lower levels of nitrates and higher average levels of antioxidants. The former can accelerate food spoilage, while antioxidants help preserve the integrity of cells and some are natural antibiotics.

The first conclusion may, however, depend on factors not directly connected to organic farming, such as harvesting and storage methods and the type of land used for growing the food. About the second finding it must be considered that measuring organoleptic quality is difficult and inherently subjective and evaluations may be clouded by the influence of numerous factors on the consumer's perceptions of the food and not just its appearance and taste. Experimental research indicates that the information that a food is organic confers upon it a "halo effect" (making it *seem* better sense-wise simply *because* it is organic) which might make consumers like it more.

Ecropolis researchers will analyze in detail which senses are indeed impacted on, and how, and try to match them to consumer needs and expectations in order to be able to offer suggestions for future policy, including how the food is stored, transported and presented, which is also essential for maintaining sensory properties.

The workpackage WP1 has also produced a specific report on how organic food sensory aspects are regulated. International standards, with some important exceptions, are largely in line with European ones. Differences in standards usually regard whether there is orientation towards freshness "per se" as opposed to increasing shelf-life, or quality standardization as opposed to quality differentiation. Differences in regulations regard such aspects as ingredients, additives, processing aids and methods, packaging, storage and transport.

The lack of harmony among the different regulatory systems often reflects different traditions and market conditions, however, more complicated compliance procedures result in higher costs for importers. Greater homogeneity would not only reduce such costs but would also increase consumer confidence in international standards. Ecropolis will also investigate the effect of different regulations on how people perceive organic goods sense-wise.

The work done to date is seen as a starting point for future research aimed at producing practical results in the organic food market. Ecropolis will try to bring together separate strands of research concerning how organic goods are regulated and marketed with regard to taste, appearance, etc., and how consumers themselves are affected by such factors. The aim is to find

optimal matches between the two, and thus to greatly increase organic food's share of the food market.

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Summary report on sensory-related socio-economic and sensory science literature about organic food products

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Introduction

Growing attention is being paid by policy makers, scientists and consumers to organic farming.The rising concern concerning environmental disasters and the recent debate about global warming are creating the need for agricultural production systems based on sustainable practices, whereas organic farming was also promoted to highlight healthiness and taste attributes.

Many scientists agree on the fact that organic farming generates benefits for the environment and limits the negative impact of human activities on the atmosphere. Accordingly, traditionally, the most important motive for buying organic food has been considered concern for the environment. However, the growing acknowledgement of the positive effects created by organic farming has not currently induced a further rapid expansion of the organic market share, which still attracts only a small segment of consumers around the world.

In fact, the sensory properties of food products are among the most important factors in market success, and should be deemed important especially in the organic market, where many producers and distributors of organic foods claim that their products have a better taste compared to the conventional alternative. This argument should become more important as participation in the organic market is also considered by consumers who do not place environmental concerns among their priorities. Along with the growth of the organic markets and increasing market share in supermarkets and discounters there has been a diversification in the reasons for purchasing organic food: the buying motives of the new target groups are characterized by more "selfish" benefits such as health, wellness, or hedonic attributes like taste, rather than the "altruistic" motives which drove the development of organic food initially. Higher prices for organic products will thus only be justified for the consumer if they provide benefits beyond simply being the result of organic production, next to environment friendly, such as having a higher organoleptic value. Thus, the sensory properties of organic food are now of higher relevance than before. This argument, however, is still the subject of an intense debate from an objective, scientific perspective, but especially from the subjective consumer point of view.

The project "Organic Sensory Information System (OSIS): Documentation of sensory properties through testing and consumer research for the organic industry" (Short name:

ECROPOLIS) has been funded by the European Union (EU) with the aim of exploring the role of sensory characteristics in organic food consumption.

The Ecropolis Project, among its main objectives, includes:

- investigation into consumer sensory expectations and preferences with regard to specific organic food products in 5 European countries
- description of the sensory properties of organic products and the elaboration of preferred sensorial quality presented as a "pan-European" landscape map
- the development of consumer typology based on general sensory preferences and individual importance of sensory characteristics
- the identification of product improvement potential of optimized sensory quality to meet consumer expectations.

This report deals with sensory-related requirements in standards and regulations for organic food, including a comprehensive literature review. In the ECROPOLIS Project, this is the result of the first workpackage (WP1).

From a preliminary analysis of the literature carried out during the preparation of the project, it was apparent that, while quite a vast literature deals with organic food consumption and consumer preferences, only a few of the previous studies took into consideration the sensory characteristics of organic food. Therefore, existing knowledge about sensory perception of organic food products is limited. In addition, research on taste attributes of organic food products gives mixed results and it is not always clear whether organically produced foodstuff has a better sensory quality compared to conventional products.

Methodology and state of knowledge

Seeking a match between what organic products show in terms of nutrient content, taste, color, texture and what consumers expect from products is one of the critical points of the ECROPOLIS project. To come up with interesting findings WP1 was crucial for partners in correctly setting up the research design.

Tasks 1.3, 1.4 and 1.5 of the WP1 were aimed at preparing a state-of-the-art report on knowledge about market needs and consumer expectations with regard to organic food and its sensory properties. For this purpose, a literature review was conducted on market developments (changing market structures and relevance of distribution channels) relevant to supply chain actors

in organic markets, on consumer expectations regarding organic food and on market trends, such as increasing diversification in consumer needs and changing purchase motives.

In order to create a preliminary link between sensory aspects and consumers aspects, a State of the Art Report on Market needs and Consumers Expectations (Annex I) and the State of the Art in Sensory Science Report (Annex II) were compiled. Our aim in the WP1 was to generate the right conditions to continue the work more easily in the subsequent steps of the project and to share the knowledge of researchers with different backgrounds. A wide spectrum of knowledge is crucial to deal effectively with interdisciplinary tasks in the different work packages.

In the following sections, we provide a synthesis and highlight some of the main results of WP1: a review of the socio-economic literature, a review of the sensory literature and the regulatory framework concerning organic agriculture and sensory properties of organic food. In order to avoid duplication, in this synthesis we have not included specific references, which are duly cited in the source reports. The reader who is willing to go more in depth into one of the above mentioned specific topics may consult the Annexes I and II included in this report, and the Deliverable 1.1 (http://ecropolis.eu/images/downloads/deliverable%201.1%20regulatory%20framework.pdf, respectively.

Methodological approach

The literature review was coordinated by the Alma Mater Studiorum-University of Bologna, and the review activities (collecting bibliographic metadata on the available literature, selection of the appropriate papers, comments and summary of the selected papers) were conducted by participating partners, with assistance from FIBL.

Intense preliminary information sharing among partners was undertaken, which gave rise to a fruitful connection among the institutions involved.

The methodological approach, as defined in Task 1.1., was as follows:

- Listing appropriate definitions: a glossary of relevant terms. A set of terms and definitions was proposed, shared, compared, and agreed upon. The glossary circulated among the partners.
- Defining the boundaries for review of scientific and technical literature. The choice of a set of keywords to be used in the search for references and the decision about the relevant journals, repositories and databases of scientific literature to be used in the search for references (IngentaConnect, Wiley Interscience, ISI Web of Knowledge, SpringerLink, Elsevier Scopus,

Informaworld, AgeconSearch, EconPapers, etc.) were made. The query used was as follows: Fulltext=(taste) AND Fulltext=(organic) AND Fulltext=(preference) AND year=(2000-2009).

- Setting up a Bibliographic database tool. Based on the Open Source software platform Aigaion, an Ecropolis bibliographic database was implemented. The database was populated with bibliographic metadata and used to classify, annotate, evaluate and share the bibliography selected in T1.2 and T1.4.
- Preparing two separate reports about the socio-economic (task leader: UGOE) and the sensory literature (task leader: ttz). The reports were circulated among the partners.
- Preparing a summary and a synthesis report of the two task reports which are also provided *in extenso* as separate Annexes to this publication.

As a supporting tool, therefore, we created a shared database of the literature about consumers' expectations, marketing and sensory issues. The tool is based on the Aigaion reference manager software, and its URL is http://www.deiagra.unibo.it/ecropolis. Each reference for each publication includes bibliographic information such as year of publication, authors, name of the journal/book/conference proceedings and in many cases also the abstract of the paper by means of which people can easily verify if a specific paper fits the purposes of his/her research.

Together with these basic options, the Aigaion database presents many interesting features: it enables the quick import/export of references, the agreement of a common reference style for all the partners, opportunities to evaluate each paper by introducing personal comments or even by assigning a score to each publication. Another interesting option provided by Aigaion is the possibility to organize the literature reviewed on the basis of different topics and sub–topics which enables very fast searches of the bibliographic references. By using this Aigaion database researchers can properly organize publications which are needed in order to prepare WP deliverables in the form of a topic tree. Aigaion also enables researchers to select papers easily from the database in order to create a reference list in a Word document with a specific reference style.

Results

Market Needs and Consumers' Expectations

The State of the Art report on Market Needs and Consumer Expectations (see Annex I) describes in depth the literature reporting data concerning macroeconomic indicators related to organic farming. On the production side in Europe the land area increased, in the period 1985 – 2007, from 0.1 to 7.8 millions of hectares with a steady increase over that period. On the market

side, Germany, United Kingdom, France and Italy are the European countries with the highest sales (in 2007 respectively 5.3, 2.56, 1.9, 1.87 billion Euros). Denmark, Austria, Switzerland and Sweden are the countries with the largest market share (in 2007 respectively 6%, 5.3%, 4.6%, 4.3%).

The countries showing the highest market shares in Europe express the highest percentage of general retail trade as distribution channels. In Denmark, Austria, Switzerland and Sweden the impact of specialized retailers is quite low (respectively 5%, 18%, 15.1%, 0%) if compared to countries such as Germany (49%) and the United States (38% of organic food share in conventional stores), where the volume of sales is high but the market shares are lower (in 2007 3.1% in Germany and in 2006 2.8% in the United States). These data would preliminarily suggest that organic markets are likely to grow most where multiple retailers effectively promote organic products and that specialized retailers may not be able to drive the transition from a niche market to higher volumes of transactions. The market data show that the organic market initially penetrates through specialized retailers and, in particular, through the fruits and vegetables sector and in the subsequent stages spreads through traditional distribution channels. On the other hand, it is sometimes questioned whether specialized organic supply chains provide more sustainable or stable distribution channels and promote more quality oriented organic products.

The scientific literature agrees on the fact that more information is still needed to identify factors that inhibit the adoption of organic practices in the case of farmers and the purchase of organic products in the case of consumers. The ECROPOLIS project focuses specifically on the consumer side. Again, the State of the Art Report on Market Needs and Consumer Expectations (Annex I) extensively summarizes the scientific literature about the consumer and organic products.

In particular, it distinguishes between European, United States and Rest-of-the-world literature. The findings of this strand of research seem to be quite similar in many respects. Interestingly, most of the studies agree on the fact that consumers are motivated to buy (or reject) organic products on the basis of the following widely-mentioned motivations:

- *Health*. The consumer would appreciate the fact that organic products are obtained by "natural" production practices, because synthetic agro-chemical inputs are perceived as harmful and because they perceive organic products as being free from genetically-modified (GM) organisms. The former aspect is basicly unquestioned, while the latter is the subject of a vivid debate. The recent decision within the European Union to require that food labels should indicate the presence of GM ingredients, in any kind of food, with a 0.9% tolerance threshold for each single ingredient created perplexities among consumers' associations and scientists who find that there is a positive well-being effect generated by more accurate information about the presence of GM ingredients.

- *Environment*. Many consumers like organic farming because they perceive it as preserving soil fertility, it respects animal welfare, it reduces greenhouse gas emissions, it preserves ecosystem services, improves the landscape and in general meets sustainability requirements. Though the scientific literature is in many cases ambiguous about the real impact of organic farming on the environment (for instance, it still appears ambiguous whether organic farming actually enhances carbon sequestration in the soil), many consumers are motivated by their own ethical beliefs, as well as by perceptions created by the media, social norms, culture and experience.

- *Price.* In many cases organic products are more expensive than conventional ones. Literature demonstrates that organic farming yields less output than conventional and is more inefficient because it cannot rely on higher impact but requires more productive inputs, and because of logistical inefficiencies in the supply chain due to the lower mass of transactions, as well as higher transaction costs. For that segment of consumers which is price-sensitive, rather than quality-oriented a higher price can represent an important obstacle to purchasing organic products.

- *Socio-demographic characteristics.* More educated and more affluent people tend to appreciate organic products more. A role may also be played by other factors such as the presence of children within households, people's ages and status or social class. Though in general we can claim that social and economic characteristics are sometimes important to justify purchase decisions, the literature actually reports mixed results and appears to be quite heterogeneous in identifying specific factors and in measuring the magnitude of their impact.

- *Sensory attributes*. Many consumers are motivated in their purchase decisions by sensory attributes like taste expectations, package appearance, ways in which products are presented on the distribution channel shelves and the design of the labeling information.

Other motivations for buying organic products are mentioned below, together with those listed in the short classification above. A few years after the birth of the International Federation of Organic Agriculture Movements (IFOAM), which spread worldwide principles of organic farming and worked to harmonize among countries norms by which organic techniques of production should be implemented, **ethical issues** and social justice became another ideological building block of the movement and social issues acquired a remarkable relevance in the debate about organic agriculture. The idea was that the simple spread of new sustainable practices could be supported only in a wider context of equitable relationships among individuals and countries. Other attempts to explain consumers' choices are available in the literature. Some authors refer to the need of **localness**, arguing that organic food is not compatible with an economic system based on global

relationships because of the ecological footprint and lack of confidence in quality-control systems. Although the concept of "organic" as a product attribute fits a global approach, global trade could be perceived by consumers as a threat to local production systems and the environment because of long-distance transportation and because of the functional integrity of the organic supply chain. Other non-institutional drivers of organic food consumption such as the need of localness could be represented by the "slow food" concept. Alternative consumption practices are driven by conscious and reflexive consumers monitoring and adapting their behavior according to the predicted consequences of their actions. Organic food would fit in very well with a **lifestyle** in which responsible individuals prefer to think more in depth about what they eat and how they eat. Finally, many researchers try to summarize the set of plausible motivations for buying organic food using lists of personal values which are valid from a cross cultural perspective.

The previous classification is only a simplistic but representative selection of all the findings which have come out regarding the motivations behind consumer purchases from a flourishing strand of literature which produced its results by employing qualitative as well as quantitative techniques. Whereas among qualitative techniques focus groups, Delphi method and face to face interviews are often employed to identify and interpret crucial factors characterizing the organic market, for quantitative methods scientists often use econometric tools (mostly regression methods and discrete choice models) to find causal relations between variables and to calculate the magnitude of the impacts among them. Qualitative and quantitative techniques should not be seen as alternative, but as complementary tools of research, the former providing information about the existence of crucial factors affecting consumer choices and the latter attempting to verify the existence of mechanisms governing and connecting them.

An interesting point arising from our description of the mechanisms behind consumers' choice of food is that the organic market is more likely to expand if consumers are willing to assign a higher value to specific quality attributes and if they can easily recognize quality attributes through effective market mechanisms. This is a pre-condition for any value-enhancement policy. The quality-oriented preferences of consumers depend on the macroeconomic context and on the communication strategies implemented both by food companies and policy makers. Higher levels of household income and effective information channels could encourage the development of a situation in which buyers can privilege quality attributes rather than prices. This virtuous process could be facilitated by a lower price gap between conventional and organic food driven by actions aimed at introducing efficiency. On the production side, agronomic research, which could reduce the productivity gap, could increase the supply and favor a selling-price reduction effect. However, given the high relevance of the marketing bill in food prices, an increase in the efficiency of the

organic supply chain, could contribute even more to the reduction of price gaps at the consumer level.

The process by which consumers acknowledge quality attributes related to organic products is quite a complicated issue and has been widely investigated in the literature. Consumer theory identified three types of goods: search, experience and credence goods. Whereas with search goods consumers can test product quality before the product purchase, with experience goods it can only be verified after consumption. Credence goods are the ones in which the single consumer cannot observe quality either *ex ante* or *ex post*. Organic food is generally considered credence goods, because the consumer cannot directly verify the adopted methods of production and many of its immaterial attributes. In other words there is a problem of information asymmetry, in other words, the producer has more information than consumers can acquire. This is a typical problem identified by the literature which may lead to market failures. The failure consists in the fact that when consumers cannot easily recognize quality goods, their willingness to pay a price premium is lower. As consumers are less motivated to compensate the farmers' effort to produce high quality products, organic producers are penalized and are induced to leave the market. This process is identified by the literature as the adverse selection phenomenon. In this context the producers who remain in the organic market are often moral hazard operators who adopt opportunistic behaviors such as selling products as organic without implementing organic methods of production. In other words moral hazard operators tend to exploit organic price *premia*, without bearing the relative costs, thus being able to unfairly compete against the truly organic producers. The setting up of a reliable certification system is therefore a crucial factor in the strengthening of the market for organic products intended as credence goods which provide health and environmental benefits obtained by environmentally-friendly methods of production.

Alternatively, the organic product can be considered as search goods or experience goods if consumers are able to compare the difference with conventional goods before or after the purchase by using their senses. Before purchase the consumer can verify the visual characteristics and the package appearance, after purchase he can verify other sensory attributes like the smell, texture, and taste of the product. Sellers might accept that consumers can taste the product before the purchase as a guarantee of the product's quality, but, especially in large scale retail channels, this is usually not possible. In addition, for many consumers sensory abilities are weak and poorly trained, therefore in this case sensory attributes are somewhat mid-way between experience and credence attributes. In consideration of this situation, an innovative approach to sensory marketing, based on consumer education and on the delivery of information about sensory characteristics, may be developed.

For organic food intended as credence goods the problem is to implement the best strategies to transfer information from the producer to the consumer by the most effective means and to create independent third party organisms that can verify attributes of products and methods of production with objectiveness. On the other hand, for organic food intended as search or experience goods the problem is to enhance those sensory attributes of products which match consumers' needs. A strand of the literature stresses how information and sensory issues interconnect. The information flow from the producer to the consumer should be managed through appropriate labeling and branding policies. Consumer and marketing science indicate that the way in which information is presented and the ways in which individuals react to impulses deriving from the design of labeling is important in the purchase mechanism. Moreover, the literature is lacking in investigation into people's reactions to the combined designs of several labels containing different sources of information. The issue of multiple labeling and of consumer reactions to more than one quality attribute has already been dealt with in some scientific papers. However, the issue of how a wider amount of information should be presented to a consumer who is more and more interested in saving time during the purchase process because of frenetic life styles, is still at an early phase.

The literature appears quite homogenous in finding that people are willing to pay a price premium if they have reliable information about the health, animal welfare, environmental and equality attributes of organic food. An impressive number of researchers use econometric techniques to calculate consumers' willingness to pay for organic product attributes and their motivations for orienting their preferences towards them. Among the motivations that can induce/discourage the purchase of organic products by consumers, sensory attributes are one of the most controversial issues in the scientific literature. There are still major issues that do not find a unanimous consensus among scholars:

- There is still uncertainty about how much sensory properties matter in the purchase process.
- If we believe, as in the cognitive sciences, that the choice mechanism for a product is determined by different stages (selection, choosing in preference, considering suitable and will), it is not clear in which stages sensory properties play a major role.
- There is no consensus regarding which among the sensory attributes play a prominent role in the purchasing process.
- There is uncertainty about the magnitude of the impact generated by sensory properties on the likelihood of influencing consumer choice.
- There is uncertainty concerning the interdependency arising among sensory products' attributes themselves and among sensory attributes and other organic attributes in generating

individual impulses in terms of purchase choice. In other words: there is still uncertainty about whether the presence of a product attribute can alter consumers' perceptions of the other attributes and consequently influence the buying process.

Sensory Science and organic food

The ECROPOLIS project deals specifically with sensory properties of organic products and is aimed at shedding light on these widely-debated issues. As pointed out by the State of the Art in Sensory Science Report (Annex II) we can distinguish between the objective levels of specific chemical components (playing either a sensory or a nutritional role) in organic products and the organoleptic characteristics arising from the human reaction to these components. Sensory science is a discipline in which specific tests are adopted for the measurement of people's responses to food, minimizing bias in their responses due to the influence of other information provided. Consequently, sensory scientists specifically employ the senses of selected and trained human subjects to identify the individual perceptible characteristics of food and to quantify their intensities.

Different measurement techniques can be adopted to practice sensory tests. Whereas in analytical methods panelists focus on specific aspects of the product as directed by the scales used in the questionnaire and they are not necessarily frequent users of the product; in hedonic methods panelists perceive a product as a whole pattern and must be frequent users of the product. In the latter case tested people are required to express their judgment about the product with a composite opinion based on their immediate reactions, shown by consideration of the "like" and "dislike" options.

Scientists acknowledge the existence of many kinds of error that can affect the reliability of sensory tests:

- Expectation error, which occurs when panelists are given too much information about the samples.
- Stimulus error, which occurs when panelists are influenced by some characteristics of the sample (i.e., size, shape color, etc).
- Suggestion error, which occurs when panelists are aware of the reactions of others during the sensory evaluation.
- Lack of motivation.
- Central tendency error, which occurs when panelists choose the mid range option to avoid extremes.

In spite of all these difficulties, which sensory scientists should normally tackle, the literature seems to agree on two main points. Firstly, numerous studies have found no proof that organic food offers greater nutritional value or more consumer safety. The precise identification of its impact in terms of nutritional content, deriving from organic management practices, is a major challenge. The most important problem lies in the fact that it is difficult to distinguish between the impact generated by organic farming and that generated by other external conditions. The problem is particularly troublesome when scientists want to compare the nutritional content of conventional food with that of organic food. In this case reliable results can be obtained when, other conditions being equal, crops are produced on the same land. Moreover, harvest and storage activities can significantly modify the nutritional content of products and affect studies aimed at isolating the impact deriving from organic management practices.

Secondly, even though many organic consumers often attribute a better taste to organic products to motivate their purchases, most of the available literature does not find taste differences for many products. A critical point in the implementation of these interesting studies is that attributes of food are not totally independent from each other during the formation process of the consumer's perception and the so called "halo effect" can arise. The halo effect is a cognitive bias by which a quality attribute of a product serves to influence and bias the judgment of its other qualities. In other words, many studies show that the organic label increases the consumer's acceptability of the food and can alter perceptions by provoking a more benevolent attitude towards organic products. Exhaustive studies that effectively investigate the "halo effect" on consumer perceptions are still lacking and further research in this field is needed to correctly identify the impact and the consequences deriving from cognitive bias.

When one judges the halo effect from a multiple perspective some considerations arise. On the one hand, the interdependence of products' attributes in inducing individual purchase impulses is acknowledged as a great problem for scientists. The main task of a sensory scientist is to objectively identify sensory properties of food by isolating cognitive bias. On the other hand, from the market operator's perspective the interdependency of attributes could be a positive phenomenon, increasing the acceptability of the food. An example is provided by cosmetic properties, such as the appearance of many organic fruits. It is common knowledge that organic fresh fruit usually does not look as good as conventional fruit because of the absence or minimal use of chemicals aimed at preserving its appearance. Many organic consumers are willing to trade off bad cosmetic characteristics with a higher level of product naturalness. Therefore many consumers are willing to accept bad-looking fruit if they know that the fruit is organic.

Within the ECROPOLIS project researchers will try to find a balance between these two different instances. First, they will provide a reliable profile of the sensory properties of organic products. Then, they will look for the best strategies that can match consumer needs and expectations in order to value enhance the sensory properties of organic products. In the latter perspective it will be important how people perceive the whole set of products' attributes beyond the objective properties that can be tested by sensory measures.

The great challenge will be to come up with a set of policy implications that can be considered equally reliable in different contexts. Many experts agree on the fact that the consumer's behavior depends on a set of sensory impulses deriving from the context in which the organic product is sold. An organic product containing desirable sensory properties might not attract the consumer if the selling point were dirty or if the seller were impolite. Studies show that the setting-up of appropriate shelves in distribution channels and/or the presence of staff showing or describing the product increases the likelihood of people's acceptance of organic food. They also claim that the implementation of appropriate product maintenance, transport and storage is crucial to preserving the sensory properties of food. If we combine these findings with the acknowledgement that the traditional multiple distribution channels will play the greatest role in spreading the use of organic products among consumers it is not difficult to forecast that the future of the organic market will mostly depend on the ability of large scale retail companies to develop a reliable supply chain and to preserve its functional integrity.

A lot will also depend on those producers who in the past showed a positive attitude towards converting to organic practices with the aim of exploiting EU subsidies, rather than that of sharing values of naturalness, health and taste. Sharing a common view throughout the supply chain, from the producer to consumer, could be very helpful in spreading an organic culture and increasing "the acceptability of food".

Finally, since value-enhancement of sensory attributes may involve the participation of certifiers, they will be responsible for maintaining the quality of their evaluations and inspections, upholding their good reputation by privileging the objectiveness of audit activities over market share considerations.

Regulatory framework and sensory properties of organic food

External conditions and management practices that are not strictly related to the definition of organic agriculture can also strongly affect the texture, flavor and color of food as well as the nutrient content. A prominent role will be played by the regulatory framework within which farmers

and market agents operate. The Deliverable 1.1 produced by Schmid, Kretzchmar and Zakowska-Biemans as part of WP1 of the ECROPLIS project is a useful description of this issue.

Currently within the European Union different levels of organic regulationinclude in place:

- The European Regulation (ER) 2092/91, which deals with fruit, vegetables and cereals and ER 780/2006, covering dairy products and meat products. Both regulations have been replaced by ER 834/2007 and 889/2008 which contain detailed rules for implementation. These ERs contain norms about how to produce organic products in terms of substances and procedures as well as rules for the international trading of organic products. With regard to international trading, the rules imply quite complex procedures except for a small list of Third country regulations that are recognized as equivalent by the European Union.
- National State regulations incorporating rules deriving from the European Union. Among the countries included in the ECROPOLIS project countries such as Germany and Poland fully apply the ER without further additions, whereas the Swiss regulations are recognized as equivalent to the ER.
- Private national standards such as AIAB and BIOAGRICERT for Italy, Bioland in Germany, Nature and Progrès in France SKAL in Netherlands, Soil Association in United Kingdom, Ekoland in Poland, BIOSUISSE in Switzerland. In many cases, private national standards preceded and inspired State national standards, but currently they generally present many differences if compared to the ER, because they often contain specific standards for groups of products and more restrictive rules about processing methods, the list of permissible food additives and the use of natural flavorings.
- International national standards such as IFOAM, Demeter International and the Codex Alimentarius Guidelines. Whereas standards set up by IFOAM, the Codex Alimentarius and the ER appear quite consistent, Demeter international implemented standards showing highly relevant differences when compared to the ER.

A quite general, but meaningful, method of interpreting differences among standards is to highlight the following two dimensions:

- standards oriented towards preserving the freshness/authenticity of products vs standards oriented towards preserving the long shelf-life of products.
- standards aimed at providing the standardization of quality vs standards aimed at differentiating quality.

In this context, international private standards seem to be more oriented towards product freshness and long shelf-life; governmental rules are more oriented towards long shelf-life but also attach importance to quality: private national standards attach importance to enhanced quality but are freshness/authenticity-oriented. Finally, the international private standards are freshness/authenticity oriented but more addressed to standardizing quality. When considering more detailed rules contained in standards, differences may involve a wide range of variables:

- Use and origin of ingredients.
- Use of additives.
- Use of processing aids and other substances.
- Processing methods.
- Packaging.
- Storage.
- Transport.

The acknowledgment of the differences among standards, especially focusing on those arising between EU and private standards in terms use of additives and flavors, does not mean that the ER is *per se* at a lower level regarding their requirements. The most interesting implication, arising from the analysis of standards is that they reflect different traditions and that market differentiation has developed to satisfy a wide range of consumers segments.

However, the segmentation of standards cannot be considered only a positive event. An important issue that will influence over time the expansion of the organic market will be the level of homogeneity between the ER and the world's other organic regulations. The scientific literature agrees on the fact that the absence of harmonization, equivalence and mutual recognition among the world's organic regulations increases transaction costs, because importers are obliged to adopt expensive procedures to verify that organic food attributes and production procedures conform to national standards. A wide-ranging policy harmonization effort aimed at decreasing differences in standards at world level would generate an interesting improvement in welfare. On one hand, it would decrease transaction costs by stimulating the mass of international trading, On the other, it would create a common ground for world consumers who could rely on a benchmark of quality.

One of the aims of the ECROPOLIS project is to clarify the impact of organic regulations on sensory properties. Once identified the differences among standards within WP1, the next step will be to associate an impact in terms of sensory properties for each difference. This will be developed

within the context of the other two crucial objectives of ECROPOLIS aimed at creating sensory profiles of organic food and at understanding data from consumer research by involving consumers, retailers, wholesalers and processors.

Through reaching these goals we expect to create a wide range of benefits for the organic market including the supply of information about the "real acceptance of organic products from a sensory point of view", comparison within numerous European countries of different national descriptions of sensory properties and suggestions for companies about the potential for product improvement by considering the sensory properties of food and consumers' expectations.

Further tools and conclusion

The review of the literature and of the regulatory framework enabled us to provide an overview of the main issues that may be relevant during the subsequent phases of the research.

However, despite being a very useful tool and being a necessary step in every research project, each literature review is restricted, limited time-wise in coverage and static. In fact, new literature is made available every day and it may happen that a substantial quantity of research may be excluded from the analysis because it showed up after the selection of the relevant articles to be analyzed had already been made.

For this reason, we deem it particularly important to use the literature database for the project, which may be considered as a sort of dynamic tool to complement and keep this preliminary research work updated.

Currently, the Aigaion database of the ECROPOLIS project counts 235 publications, authored by more than 500 researchers. The publications are organized as a tree referring to the WPs activities. Further publications will be gradually introduced while project activities continue. The bibliographic database is currently accessible to all researchers who can log in to the website (http://www.deiagra.unibo.it/ecropolis) through a username and a password, but the aim is to create a shared complete information network regarding sensory and consumer issues available to all partners during the project's life span and to create a tool that can also be useful to the researchers involved in future work. All partners may be involved in data entry activities for this database and they may make use of entries already recorded by their partners, making the exchange of knowledge and pooling of resources easier and more effective.

Activities aimed at sharing knowledge and information have been completed by the addition of two glossaries which are useful for creating a shared terminology for partners who are from different backgrounds. In particular, the presence of researchers with "sensory science" and

"economics" backgrounds created the need for a socio-economic and a "sensory science" glossary which people involved in different disciplines can use to try and partially close the information gap. Currently, the "sensory science" glossary contains 534 words, defining concepts related to the methodologies adopted for the running of sensory tests, and words describing sensory properties of food. Definitions related to the sensory properties of food are particularly important because sensory science is aimed at identifying objective descriptions of food by minimizing biasing effects that might derive from information, experience and culture. A common work-ground for all project partners is a key pre-requirement for the continuation of all the other activities programmed for ECROPOLIS. The socio-economic glossary contains 54 words and has been set up in order to describe important economic concepts concerning the organic supply chain and, more specifically, the consumer and his/her behaviors from a microeconomic (individual) and a macroeconomic (market) point of view. Also in this case many words specifically concern methodologies that will be taken into account for the design of future research in the subsequent steps of the project.

All definitions are provided in English, contain the exact reference from which they have been taken and the link to the Aigaion database from which the reference can be consulted and analyzed. They will be translated by each partner into their own national language (French, Polish, German, Italian, Dutch), because those glossaries will also be used to create a bridge between companies and researchers in the information process. Since the ECROPOLIS work is aimed at providing policy implications for firms in the agro–food sector, it is very important in our opinion to set up a tool by which the process of information transfer from researchers to market operators may be made easier, more comprehensive and faster.

This considerable amount of work (database creation, setting up of two glossaries, writing up of a deliverable about the regulatory framework, literature review about food sensory properties and literature review about consumers' needs and market expectations) represents the starting point from which we want to go fruitfully on to the next steps of our project by designing research that can be useful for market agents.

The challenge will be to combine methodologies in order to create a bridge between techniques adopted to test sensory properties under different conditions (regulatory framework, agents behavior, supply chain factors) and qualitative/quantitative techniques through which we will be able to investigate how people react to sensory properties of food and how they change their purchase behaviors according to different sensory impulses. On the basis of this valuable information companies will be trained to improve food sensory properties in order to match consumer needs and expectations in a sector which continues to be strategic in meeting environmental and health goals but which has for a long time experienced difficulties in

implementing the transition from a niche to a mature market. Starting from the preliminary work that we are undertaking during WP1, the ECROPOLIS project will attempt to fill this gap in its subsequent phases.

Annex I - State-of-the-art report on market needs and consumer expectations

Achim Spiller, Tim Obermowe

Introduction

The market for organic food is characterized by rapid growth during the past decade (*Spiller*, 2006; *Hamm and Gronefeld*, 2004) . This development is associated with changing market structures and alternating relevance of distribution channels as well as a differentiation of expectations and motives of organic food consumers. Compared to an earlier stage, organic food is nowadays available in common supermarkets and even in discounters . Furthermore, buying motives such as health, taste and wellness have gained importance relative to traditional motives that depend on altruistic reasons like environmental protection and animal welfare. Due to these trends, most costumers are willing to accept higher prices for organic products solely if they feature aspects beyond the fact of being organically produced, such as a unique taste or smell *(Lüth et al.,* 2005). Against the background of this development, sensory properties of organic products can be attached more importance than ever before.

On the one hand, the following state-of-the-art report gives an overview about the results of a literature review on market developments with regard to changing market structures and the relevance of distribution channels. On the other hand, literature on consumer expectations and consumption motives with regard to organic food and its sensory properties will be highlighted. The main focus of this report are European studies, nevertheless results from American and other non-European literature will be taken into account as well. At the one hand, the consideration of non-European literature is regarded as reasonable because of the possible methodological implications. At the other hand, the results of these literature sources also may detect certain principles which can be transferred to the situation of the European organic food market.

Market developments of the organic supply chain in consideration of changing market structures and relevance of distribution channels

All in all, there are many sources dealing with market developments in the supply chain for organic foods. However, only a couple of sources provide data on the current situation of

the organic market. On account of the rapid developments of the organic market, it would not make sense to refer to literature older than five years in the following context.

European literature

Concerning the European situation, there are some reports dealing with a broad overview about the market for organic foods *(Padel et al.,* 2009) and *(Schaer,* 2009). These reports refer to recent developments as well as trends and challenges for the European market for organic foods. Additionally, they provide some statistical data to clarify and to illustrate the findings.

As *Willer* (2009) declared in her report, the production of organic products in Europe is characterized by uninterrupted growth over the past years. Thus, the percentage of the organically managed land area increased by 0.33 million hectares (+4.5 percent) compared to 2007. The overall organically cultivated area in 2007 added up to almost 7.8 million hectares, which approximates two percent of the agricultural land area. It was managed by more than 210.000 farms. Especially, substantial increases in many Eastern and South-Eastern European countries were registered. Figure 1 shows the development of the organically managed agricultural land since 1985.

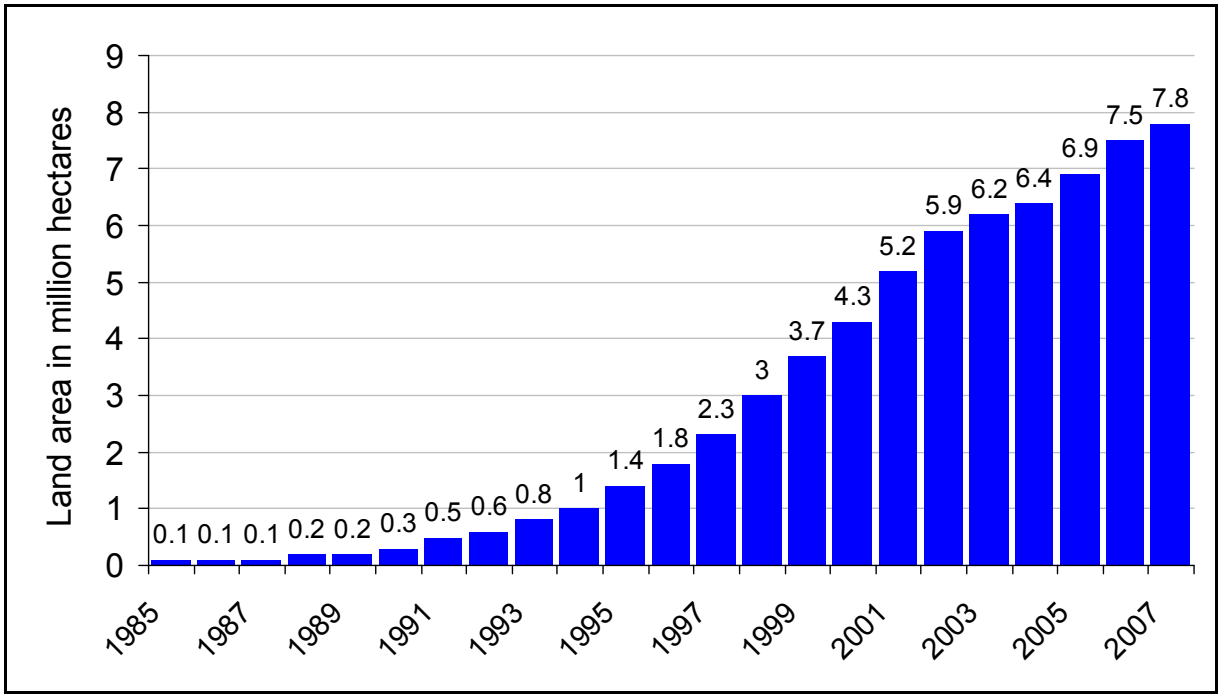

Figure 1: Development of the organic land area in Europe 1985-2007

Source: Willer (2009)

The countries with the highest share of organically managed area are Austria (13 percent), Switzerland (11 percent) as well as Italy and Estonia (9 percent). The highest number of organic farmers, as well as the largest organic land area in Europe can be found in Italy, followed by Spain, Germany and the United Kingdom.

Within the countries of the European Union, the production of organically produced food is subject to a Council regulation. The Council Regulation (EC) No 834/2007 on organic products has come into force on January 1, 2009. With its enforcement, a new set of objectives, principles and basic rules for organic production has been set out. Thus, the European Commission repealed the former Regulation (EEC) No 2092/91 and established a new permanent import regime as well as a more consistent control regime.

In addition to this general information about the production of organic products in Europe, the report from *Padel et al.* (2009) gives a comprehensive overview on the development of the organic market in Europe over the last years. As already mentioned, an extensive growth in the European organic market can be observed. Between 2006 and 2007, the average growth rate across all European countries was over ten percent, with an average per-capita spending of 27 Euros. According to the total value of the organic market estimated at approximately 16.2 billion Euros, an increase of nearly two billion Euros compared with 2006 can be noticed. The largest European countries, e.g. Germany, the United Kingdom and France have the highest total sales of organic products, whereas smaller countries, like Denmark, Austria and Switzerland have the highest market shares of organic food. The following figures show the ten most important European countries with regard to the total value of sales (Figure 2) and the market shares of organic food sales (Figure 3).

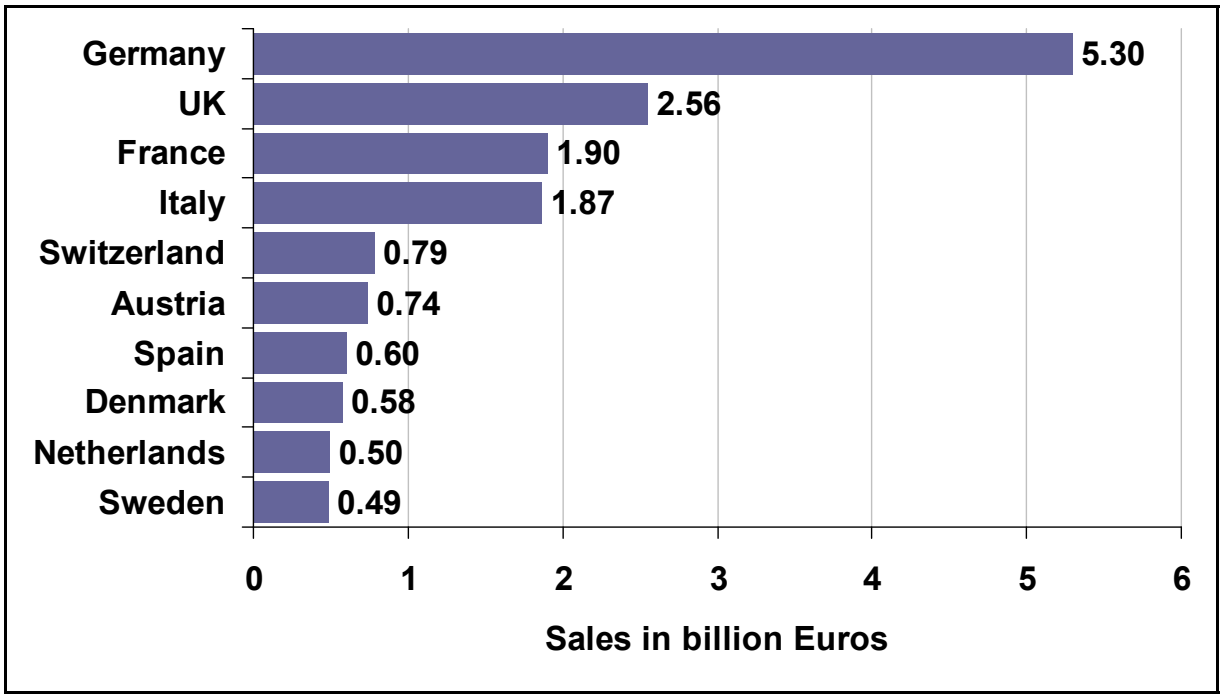

Figure 2: European countries with the highest total value of organic sales in 2007

Source: Padel et al. (2009)

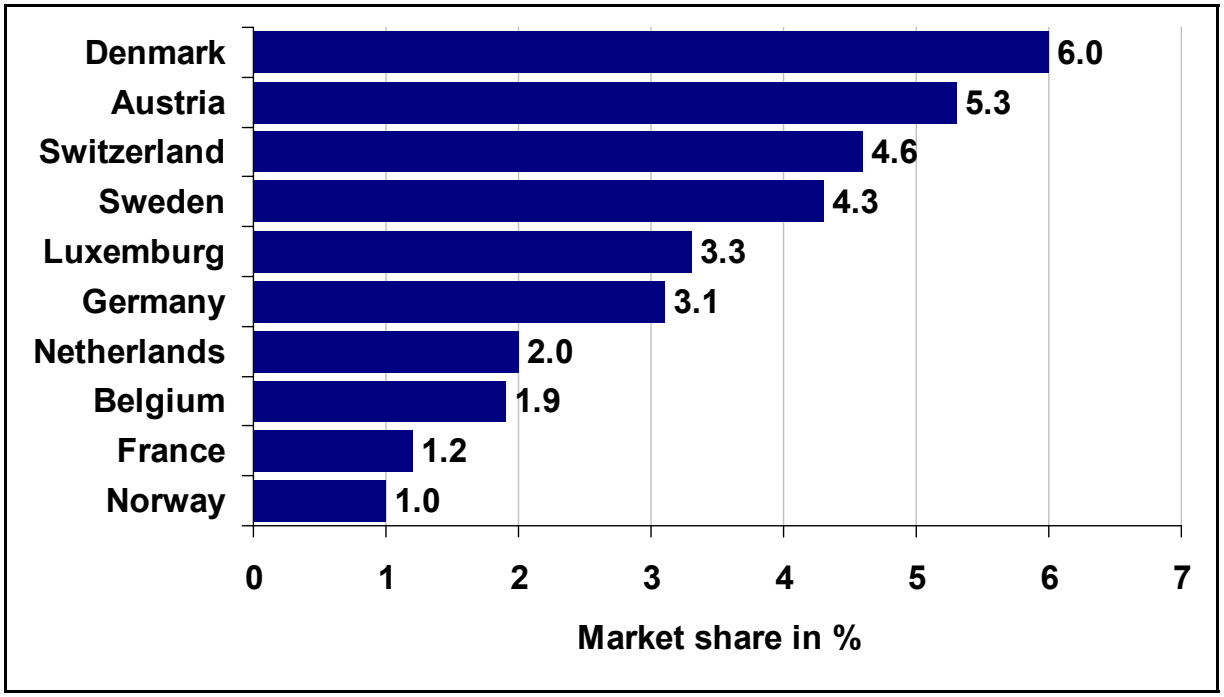

Figure 3: The ten European with the highest market shares of organic products in 2007

Source: Padel et al. (2009)

To give a more detailed description of the organic markets, *Padel et al. (2009)* also highlighted the main market developments in different European countries.

Regarding both domestic production and imports, **Germany** is still the largest retail market for organic products in Europe. The current development is characterised by a boom concerning the demand for organic products along with a notable structural change of the distribution channels. Although the sales of organic products via direct marketing stagnated, multiple retailers became substantially important for organic food sales. Against the background of this development, retailers like supermarkets and discounters accounted for more than 50 percent of organic sales in 2007. German households' average expenses for organic food bought at retailers gained in importance. Particularly, dairy products including cheese (+28 percent) as well as dry products (+27 percent) are very often sold via the retail sector. Irrespective of the distribution channels, the most important organic products in Germany are milk and dairy products, followed by vegetables, bread as well as meat and meat products.

Between 2006 and 2007 the **United Kingdom** retail market for organic products grew by about 10 percent with a total sales value of approximately 2.557 billion Euros. Compared to previous years, the growth of the organic retail market became slower, but is still higher than in the overall grocery sector. According to the relevance of distribution channels, retailers remain the most relevant outlet for organic food sales. However, more specialized stores were able to grow between 2006 and 2007 as well. By contrast, the direct marketing via farmers is less important. It does scarcely account for two percent of the organic sales within the United Kingdom organic retail market. With regard to the total value of sales, vegetables and fruit had the highest share of all products in 2007 (34 percent), followed by dairy products (23 percent). The recent development also shows a remarkable growth of meat and meat products as well as fish. Within the United Kingdom food retail market, organic foods are positioned as premium products. However, the market segment is characterized by a growing competition between different ethical food products like organic, fair trade and locally sourced products.

Similar to the UK, the organic market in **Italy** was able to grow by 10 percent between 2006 and 2007 also. In contrast to other European countries, not all product categories were growing. The market shares of, for example, baby food (+36 percent) as well as fruit and vegetables (+25 percent) increased, whereas the sales of organically produced dietary products and bread decreased. The product categories with the largest market shares are dairy products (20 percent) as well as fruit and vegetables. The Italian market for organic food is characterized by regional discrepancies. Most organic products are sold in Northern Italy (more than 70 percent). Nevertheless, the organic market of Southern Italy shows higher

growth rates. With regard to the distribution channels, the organic retail market is dominated by short supply chain. For example, the number of farms with direct marketing has increased by 37 percent since 2005.

In **Switzerland,** the organic food market has also grown since 2006, although the sales of organic products were stagnating for several years. All relevant product categories were able to realize growth. However, particularly meat and vegetables grew very strong. So did the organic demand in Western Switzerland and the organic sales via direct marketing. Some product groups were able to achieve a notable market share within the total retail market. For example, more than 15 percent of all eggs and bread consumed in Switzerland are organically produced. With regard to the distribution channels, the two most important Swiss multiple retailers Coop and Migros account for about 75 percent of all organic sales.

The **Austrian** food market stagnated as a whole and therefore also the organic food market did not grow either. For example, the demand for vegetables has declined, whereas fruit could realize growth. The organic retail market in Austria is characterized by the dominance of multiple retailers along with an increasing market share of discounters. In 2007, about 64 percent of all organic products were sold by multiple retail stores.

According to the total value of organic sales in **Denmark**, fresh produce such as milk and other dairy products are the most important product categories with 40 percent of sales of the multiple retailers, followed by bread, other cereal products (13 percent) and vegetables (13 percent). Similar to most European countries, multiple retailers are the most important distribution channel for organic foods with a share of approximately 80 percent of all organic sales. In 2007, Denmark was the country with the highest market shares of organic products in Europe.

Between 2006 and 2007 the retail sales of organic products in the **Netherlands** grew, whereas the certified area under organic production decreased. In addition to the distribution through multiple retailers (about 44 percent of all organic sales) specialty outlets (about 44 percent) are very important within the organic retail market. With regard to the total value of organic sales, fruit and vegetables are the most important product categories (26 percent), followed by dairy products and eggs (19 percent). Notable growth could be realized for organic meat (+18 percent), particularly for organically produced poultry (+30 percent), which were mainly sold through multiple retailers. Furthermore, the sales for organic eggs increased. They are exported to Germany for the most part (about 75 %).

Comparable to most European countries, the organic retail market in **Belgium** can be characterized by a strong growth of multiple retailers. These outlets are responsible for about 59 percent of organic sales, followed by specialized organic food shops (about 28 percent). The organic share of the total retail market depends substantially on the product category. For example, eggs (7 percent) as well as vegetables (3.2 percent) have a considerable market share, whereas dairy products (1.1 percent) and meat (0.7 percent) are less important. Although the area under organic cultivation increased in Belgium, a remarkable proportion of organic products is imported, mainly from the neighbouring countries.

In 2007, the organic retail market in **Sweden** grew strongly (between 25 and 30 percent). However, about 50 percent of the total sales of organic products are imported. Nevertheless, the Swedish production of organic foods grew at 15 percent. Multiple retail stores are the predominant distribution channel for organic sales (about 70 percent). The most important product category is dairy (52 percent of the total organic sales), followed by meat (14 percent), eggs (14 percent) as well as fruit and vegetables (10 percent).

Similar to Sweden, the majority of organic sales takes places in multiple retail outlets in **Norway**. They account for more than 80 percent of the organic retail market. However, organic sales approximate a market share of only one percent of the total food market, whereas some product categories have higher proportions, for example baby food (13 percent) and eggs (3.4 percent). Due to climate restrictions, organic fruit and vegetables are imported in many cases, contrary to milk, eggs and meat products, which can mainly be supplied by domestic production.

In **Finland**, the majority of organic products is distributed through retail chains, which account for about 85 percent of the organic market. Vegetables (27 percent of the total value of organic sales), milk and dairy products (24.7 percent) and breads, cereals and flour (18.6 percent) are the most important product categories. The organic meat sector can also be characterized by a remarkable growth.

Following the trend of most European countries, the majority of organic sales takes place in multiple retailers in the **Czech Republic**. These outlets account for about 65 percent of the organic retail market, followed by specialty outlets (22 percent). The most important product category are dry products like breakfast cereals and pasta (45 percent of organic sales), followed by milk and dairy products (21 percent). Most of the organic products sold in the Czech Republic are imported (62 percent of sales), whereas only 4 percent were exported.

The organic food production in **Turkey** is highly export-oriented. Particularly, dry fruit for the German, American and British market is produced. However, the current development shows a slow growth of the domestic market for organic foods.

In addition to the findings described above, *Schaer* (2009) provides recent trends and challenges for the European organic market. Apart from the fact that the organic markets of several European countries differ according to their history or their market structure, the author points out three characteristics, which apply for nearly all European organic markets:

- The organic market in most European countries is determined by a strong growth, with expansion rates of more than 10 percent.
- Contrary to the market development, the growth rate of organic farmland is quite small or, in some cases, even stagnating.
- The organic consumption is strongly influenced by a new group of buyers, who purchase organic foods because of their health-orientation and their environmental awareness. This development can be seen as one of the most important drivers of the organic market growth.

A further conclusion of *Schaer* (2009) is that market structures of the European organic market are heterogeneous and changing. In most European countries, conventional multiple retail outlets account for a share of more than 50 percent of the organic market. Both the specialized organic retail sector and the multiple retailers have been advancing the current development of the organic market by creating more awareness for organic foods through promotion and by giving these products a higher share of their assortment.

Conventional supermarkets are responsible for the growth of the organic market, especially in Scandinavian countries. Currently, these retailers capture new organic markets in several Central and Eastern European countries like Poland and Hungary. However, most southern European countries, e.g. Italy and Greece, remain unaffected by this development, so that specialized organic retailers are still dominating the market and mainly account for growth. Nevertheless, conventional retailers are generally important, but the specialized organic retailers are more successful in penetrating the organic market.

Even so, multiple retailers have substantially gained in importance for the recent development of the European organic market, particularly in Central and Western Europe. In these countries, organic market structures are well developed, determined by an omnipresent supply of organic products along with a high consumers' awareness of organic products. The

current development in these countries is driven by a set of conventional players. To clarify the current development, *Schaer* (2009) gives some typical keywords:

- Increasing competition along with declining prices for organic products.
- The concentration of market power among processors and retailers.
- Increasing importance of discounters.
- Formation of multinational organic holding companies.

Figure 4 illustrates the current developments by displaying the shares of distribution channels in the European countries.

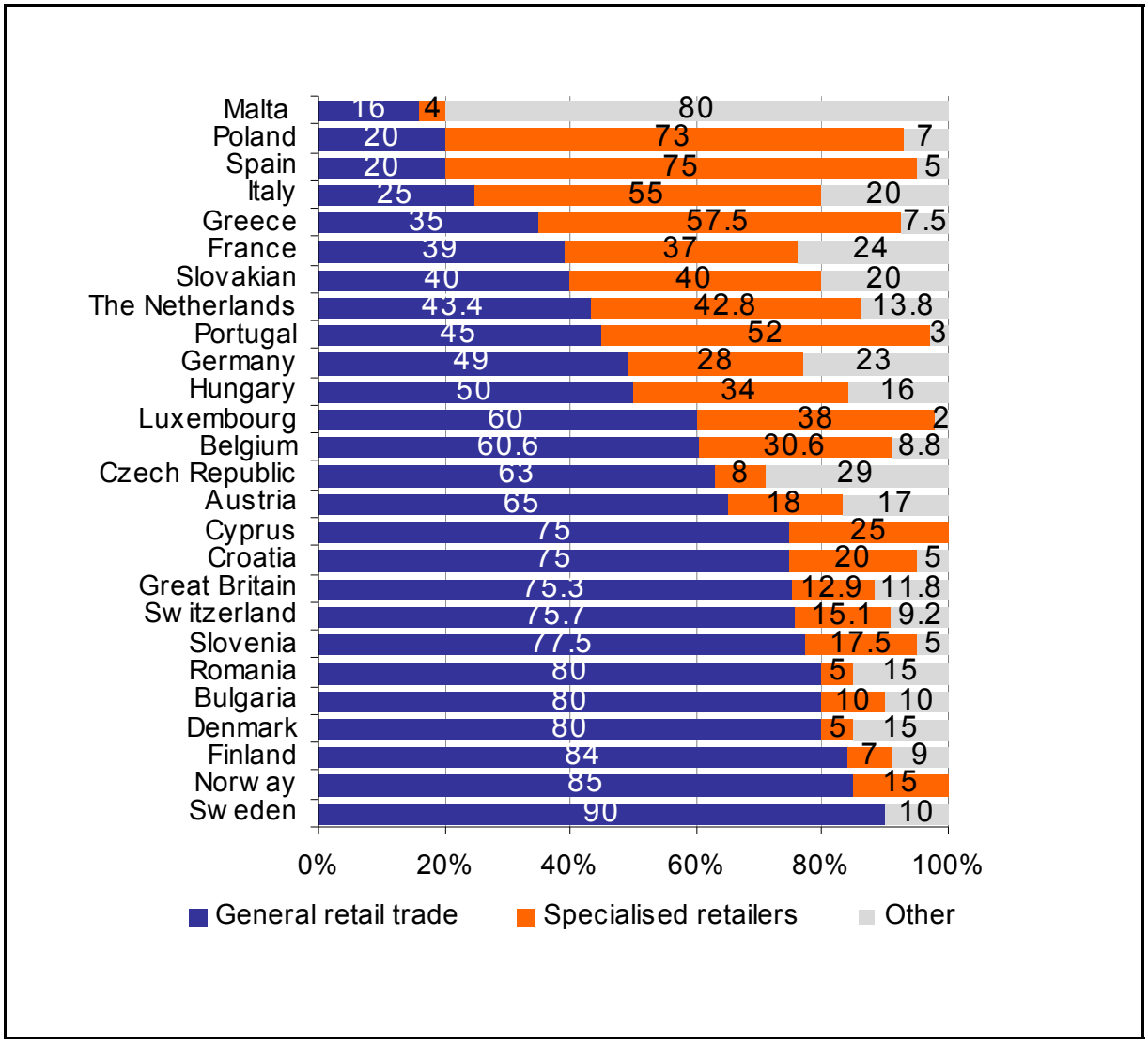

Figure 4: Distribution channels for organic food in Europe

Source: Schaer 2009

Furthermore, *Schaer* (2009) highlights the fact that an increasing number of consumers buy organic food along with growing expenditures per capita in several countries in nearly all European countries.

However, it has become difficult to characterize organic consumers based on their socio-demographic background. Similarly to the United States, a so-called "lifestyle of health and sustainability" (LOHAS) is emerging. These consumers mostly live in urban areas, have a post-material lifestyle, are typically health-oriented and environmentally aware and believe to be able to influence these concerns by buying organically produced foods.

From the perspective of *Schaer* (2009), the current development of the European organic market cannot only be regarded as positive trend, but brings about a critical change in several countries, too. Due to the price-centred competition, particularly in the Western and Central European countries, organic supply chains increasingly resemble conventional concepts. Against the background of this development a unique positioning of organic products is getting difficult.

Some older sources deal with developments of the European organic market as well. As they are not up-to-date, they are less comprehensively discussed within the state-of-the-art report.

In the context of a so called Delphi study [1] *(Padel and Midmore,* 2005) investigated the development of the European market for organic products. The results of their survey are based on qualitative interviews conducted with experts on the organic food market in 18 European countries. Purpose of the interviews was the identification of factors that influence the development of the organic market. Beyond that, the study explored future market prospects as well as the governmental impact on in future market developments.

Padel and Midmore (2005) predicted the current development of the organic market particularly with regard to distribution channels. The authors state that a dominance of short supply chains and a focus on regional organic outlets is characteristic for an earlier stage of the market development. In the course of time, the development of organic markets will be determined by an integration of organic sales into mainstream outlets and the involvement of multiple retailers.

Already in 2004, *Hamm and Gronefeld* (2004) compiled a comprehensive report on the developments of the European organic food market. The report provides an overview on the

[1] Delphi method means a qualitative research approach using expert interviews to refine a an informed perspective on complex or uncertain objectives (Padel and Midmore, 2005)

main aspects of the organic food market, based on both statistical data and expert interviews in 19 European countries. One main target of the study was to measure the degree of maturity in the different European countries depending on the organic share of total food sales value. In this context, one finding is that the market share of organic products is mainly determined by the share of total organic food sales in food retailing. Furthermore, *Hamm and Gronefeld* (2004) underline the relevance of the involvement of multiple retailers in the organic market in order to increase the market share of organic products. The authors emphasize the importance of food shops as a distribution channel by the fact that consumer price premiums were lower in countries with a high involvement of food retailers. One main reason for lower consumer prices is the fact that distribution costs are declining when organic products are transported together with conventional foods to bigger distribution centres, than transporting small volumes of organic products to a multiplicity of small specialized outlets.

Concerning their analysis of the market, *Hamm and Gronefeld* (2004) observed two main market strategies for promoting market growth. On the one hand, there are so called push strategies, which support the increase of organic production with growth in demand seen as an automatic consequence of growth in supply. These strategies are mainly driven by agricultural policymakers. On the other hand, the authors detected so called pull strategies, initiated by the market actors as driving forces. Food retailers or processing companies realise that there is a growing consumer demand for organic food, so that they are interested in developing the organic food market in favour to improve their competitiveness within the organic supply chain.

A paper published by *(Aertsens et al.,* 2009) investigates the differing retail strategies in the organic market in Belgium. The study aims to identify different strategies of retailers who are active in the market for organic products and to explain the driving forces which underlie this development. The retail strategies to market organic products are investigated based on data that has been collected through interviews with the staff of the three most important Belgian retailers as well as observations in retail outlets. Additionally, GfK-household panel data recording the purchasing patterns of 3.000 Belgian households and a postal survey with 529 consumers have been taken into account for the analysis.

The main finding of *Aertsens et al.* (2009) is that the strategies of the different retailers to drive organic food sales mostly go hand in hand with their overall positioning and their marketing strategies. Some retail groups following a first mover strategy could be identified, whereas others prefer an adaptive strategy to market organically produced foods.

Literature from the USA

Concerning the developments of the organic food sector in the United States of America, a report by *(Haumann,* 2009) provides a comprehensive overview about the current market situation. Similar to the European market for organic foods, the U.S. market is characterized by sustainable growth during the last years. Due to increasing fuel and food prices in 2008, many U.S. consumers changed their food purchasing patterns in favour of organic products as part of the solution to environmental issues like global climate change.

Furthermore, the price gap between conventional and organic products is quite small in the U.S. market, based on a lower dependence of organic farming on expensive farm inputs. Considering the results from the Organic Trade Association`s (OTA) Manufacturer Survey in 2007, the total sales value for organic sales grew by 21 percent in 2006, and has been forecast to grow at an average of 18 percent per year between 2007 and 2010. Figure 5 illustrates the development of the U.S. organic market between 1997 and 2006.

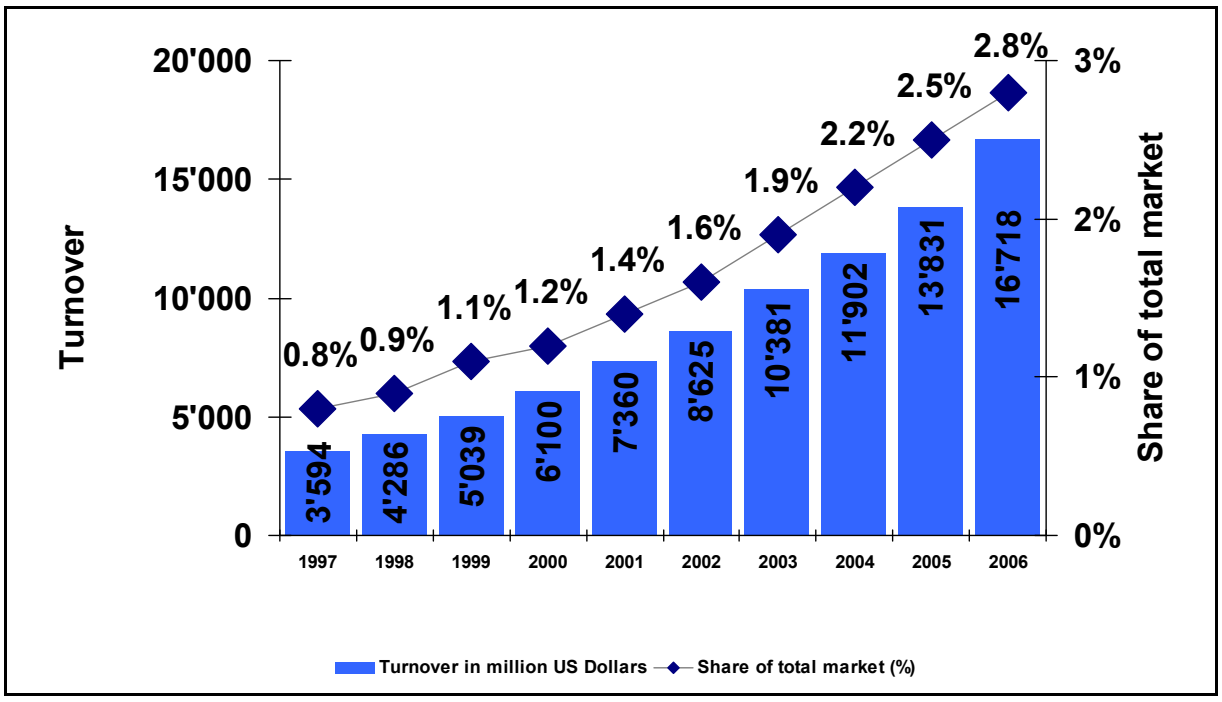

Figure 5: Organic turnover and market share in the USA 1997-2006

Source: Haumann 2009

The small price gap is one main reason for the rapid growth of the U.S. organic food market. It can be put down on the following factors:

- Because of a strong dependence on fossil fuels and historic reliance on government subsidies of artificially low kept prices, conventional food prices were rising faster compared to the prices of organic foods.
- Contrary to the earlier situation of the organic food sector, organic products are omnipresent in most of the large-scale retail outlets and are available at a lower price.
- Currently, the organic market is penetrated by a set of lower-priced private label products, which additionally lower the price gap between conventional and organic products.

The growth of the U.S. organic market is associated with an increasing penetration across six product categories, which has risen by about two percent between 2006 and 2007. This development is based on a growing number of core organic users as well as the high percentage of U.S. consumers (69 percent in 2008) who buy organic products at least occasionally.

Concerning the relevance of several distribution channels of organic products in the USA, *(Johnson,* 2008) provides some more detailed facts, which refer to the results of the Organic Trade Association`s (OTA) Manufacturer Survey in 2007. Similar to the situation in most of the European countries, organic food sales through multiple retailers have sustainably gained in importance. In 2006, conventional outlets were accountable for about 38 percent of all organic food sales in the USA. However, the distribution of organic food through natural food stores remains an important sales channel. The large natural food chains and the smaller independent natural food stores, account for 44 percent of the total organic food sales value. The residual market share is subdivided into other marketing channels, like farmers markets, mass merchandisers and club stores, restaurants and exports.

Consumer expectations with regard to organic food – needs and motives in consideration of sensory aspects

Within the field of consumer research, there is a considerable number of literature dealing with information about consumer attitudes towards organic foods. In this context, particularly the impacts on the purchasing decision in favour or against organic foods as well as consumers' needs and motives are investigated. Another research focus refers to the identification of different customer groups taking into account their organic food consumption.

European Literature

A study executed by *Fillion and Arazi* (2002) revised the sustainability of the common claims, i.e. ascribing a better taste to organic products compared to their conventional alternative. The survey was conducted in the United Kingdom using both sensory analysis with trained panellists and consumer testing with 301 respondents. To determine whether organic products taste better than conventional ones, was tested taking orange juice and milk as an example.

The main finding of the study by *Fillion and Arazi* (2002) is that organic orange juice was ascribed a better taste than the conventional alternative, whereas no differences in taste could be detected between organic and conventional milk. With regard to this result, the authors conclude that the claim of a better taste of organic products should not be considered to be universal. Rather, it strongly depends on the respective product, whether a claim is adequate to underline its uniqueness.

Another study by *Brennan and Kuri* (2002) investigates the interaction of sensory attributes, hidden characteristics and product prices with regard to the impacts on consumer perception of organic foods. The survey, which was conducted in the United Kingdom, was based on a sensory analysis of a range of non-seasonal products. Both, organic and conventional products with similar quality attributes were profiled from semi-trained assessors. Blind testing as well as preference tests and price test were executed.

The main result of the study by *Brennan and Kuri* (2002) is that no significant relationship between panellists' attitudes towards organic foods and their sensory evaluation of these could be determined. The majority of the panellists categorize the prices of organic food as too high, but would prefer organic food if prices were lower. Another finding is that most of the respondents would not change their food consumption patterns, if their product choice is mainly influenced by sensory characteristics. The authors conclude that in addition to the product prices also sensory quality aspects should be taken into account in order to promote repeated purchases of organic foods.

Another article written by *Lehmann* (2007) investigates the question whether organically and conventionally produced foods really differ with regard to the perception of their sensory properties. Within the framework of project under the direction of the Federal Programme Organic Farming, a set of seven different product groups was evaluated by sensory testing. A panel of ten trained tasters developed sensory profiles of both conventional and organic food for each product group.

According to *Lehmann* (2007) the results of the sensory analyses are not able to permit a definite answer to the research question that had been investigated. Instead, the findings of the study indicate that it strongly depends on the individual product whether consumers attribute a certain sensory quality to it. For example, the study was able to identify definite sensory differences between conventional and organic nut-cocoa paste, whereas in the case of tomato ketchup the panellists could not perceive any differences. Furthermore, the results of the study point out that the sensory evaluation of organic food may be influenced by the certain processing restrictions to organic food farming. The main conclusion of the study is that consumer perception of organic foods is not only influenced by their sensory evaluation, but also by other factors such as the image of the product.

The analysis of the behavioural process of parents in the United Kingdom with regard to organic food consumption is the focus of a study executed by *Makatouni* (2002). Within the paper at hand, the author presents the results of qualitative consumer interviews based on the means-end chain approach[2]. In order to identify the key motivating factors, which have an impact on the organic food purchase, 40 laddering interviews with parents of children between 4 and 12 years had been conducted.

The main finding of the qualitative survey of *Makatouni* (2002) is that the motivation of the respondents to buy organic food mainly depends on their desire to achieve individual and social values. In this context, the health factor could be determined as the most important factor, whereas both the health of themselves and their families play a certain role. Additionally, values concerning environmental aspects as well as animal welfare were detected to have an impact on consumer's motivation regarding the purchase of organic food. Quality aspects of organic products such as sensory attributes were not taken into account within this survey.

Padel and Foster (2005) published a paper which examines the values that underlie the purchase decision for organic food. Therefore, data from focus groups in the UK (n=181) were collected and interviews were held.

The authors find that many people associate organic with fruits and vegetables and with a healthy diet. Fruits and vegetables are the 'key entry point' to the organic market and most of the consumers from the focus groups experienced organic food through these eatables. Most consumers give more than one motive as a reason for buying organic food. Health

[2] The means end chain approach is based on the assumption that product characteristics are a means for consumers to obtain desired ends *Makatouni* (2002).

motivation plays an important role, but also food as an enjoyment, environmental concerns, animal welfare aspects and fair trade are relevant. The importance of the different motives varies between different product groups. Regarding the point of sale consumers are ambivalent. A many people purchase organic food in the supermarket but these consumers are mostly no intensive buyers. Higher prices for organic food are still a purchasing barrier, although prices for organic food are not only compared to the disposable income. Mostly, the consumer is willing to pay a premium price if he expects additional gains. In relation to organic food there exists often a lack of knowledge about certification and labelling on the consumers' side. The authors state that the knowledge that the reason for premium prices in the organic market are higher production costs has not reached the occasional consumers yet.

Regarding taste some participants of the focus groups were of the opinion that taste is a very important factor. They suggested that the organic sector should offer more taste promotions in stores to attract consumers.

A report written by *Taylor Nelson Sofres* (2004) summarizes the results of a research study which aimed to determine the attitudes and the purchasing behaviour of organic food consumers in Wales, in order to better understand the consumers' motivational profile. In this context, a survey was conducted taking into account a panel database of about 15.000 households including information about purchasing behaviour and consumer attitudes. Additionally, 4.000 people were questioned via face-to-face interviews to get more detailed information about their attitudes towards organic food consumption. The research question was investigated based on empirical analysis methods.

With regard to the relevance of different consumer groups, *Taylor Nelson Sofres* (2004) points out that medium and heavy buyers are the most important consumers for the growing organic food market in Wales. Those groups have in common that their motivational profile indicates a positive attitude towards organic food. With regard to their purchasing motives, taste and health could be determined as the most important factors driving organic food consumption. The results of the survey show that the number of organic food categories which the households buy is directly correlated with the extent to which consumers believe in the healthy and tasty benefits of organic products. Another finding of the study shows that both consumers' decision to buy organic food for the first time and their encouragement to increase the frequency of organic sales mainly depend on the attributes taste and food safety. However, the results indicate that light consumers only become medium consumers when they also believe in benefits like health, environmental awareness and animal welfare.

Furthermore, the author concludes that a combination of communicating the good quality attributes of organic products and the advantages regarding their taste may expand the number of heavy organic food consumers.

The main objective of a study executed by *Fotopoulos* and *Chryssochoidis* (2001) is to investigate the factors which influence the decision to buy organic food. Using psychometric methods both psychological and socio-economic factors were taken into account in order to determine consumers' purchasing attitudes regarding organic food in Greece. In order to determine the extent to which the investigated factors have an impact on the decision to buy organic foods, empirical analysis methods were used.

Fotopoulos and *Chryssochoidis* (2001) explored familiarity with organic food enhanced by the differences between organic and non-organic food as well as the thoughtful way consumers buy their foods. Furthermore, the results show that the increasing variety of organic products and organic labels are also important with regard to the decision to buy organic food.

Another study executed by *Chinnici et al.* (2002) investigates the mechanisms regulating the consumer market of organic foods. In this context, the use, purchase and sensitivity to the price of organic products related to consumers preferences and the benefits regarding the consumption of organic products were explored by conducting an empirical survey using multivariate statistical methods to identify the factors influencing the organic food consumption as well as homogeneous groups of consumers. To guarantee the necessary data, 552 face-to-face interviews were conducted in the South of Italy.

Concerning the impacts on the organic food consumption, *Chinnici et al.* (2002) found out that there is a considerable interest in organic produce, mainly based on a concern for health issues. Compared to this factor, environmental awareness is less important for the decision to purchase organic foods. In this context, the authors highlight two main problems regarding the organic produce market. Firstly, the difficulties to develop strategies which promote a growth in the retail market as a whole and secondly, the positioning of individual products via the use of alternative distribution along with adequate marketing strategies is regarded as difficult.

When it comes to consumer segmentation, *Chinnici et al.* (2002) identified four homogeneous groups of consumers with different organic consumption patterns. The group with the strongest bias to organic food consumption, referred to as "health conscious", is characterized by high sales frequency of specialized outlets, a health-oriented purchasing

motivation, a higher willingness to pay along with a high family income. Another group, named “pioneer group”, occasionally buys organic food, mainly out of curiosity. The so called “pragmatists” rarely buy organic products due to the price differences between organic and conventional products which they are well-informed about. As they associate organic products with the genuineness and the taste of the past, another group of respondents is named “nostalgic group”. Furthermore, the authors identified a characteristic which all groups have in common: most of the respondents accept the price gap between organic and conventional products, which can be interpreted as a positive attitude towards organic products because of their quality.

A paper published by *de Magistris and Garcia* (2008) deals with the decision-making process among organic food consumers in Italy. The used data is based on a survey with 200 Italian consumers from Naples, conducted in 2003. Build on this, a structural equation model is used to determine the influencing factors on the purchase decision.

De Magistris and Garcia (2008) state that for organic food consumers health and environmental attributes are the main factors influencing their purchase decision. Additionally, the more consumers are informed about the organic food market, the more positive is their attitude towards organic products. Therefore, people who care about a healthy diet, and/or are more concerned about environmental damage or are of the opinion that organic food provides a better quality, have a higher intention to buy these food.

To help implementing organic food policies in Europe, *Garcia and de Magistris* (2008) published a paper about factors influencing the demand for organic foods in the south of Italy. The data, conducted through a questionnaire in Naples in 2003, is analysed with the Lancaster consumers demand theory, which assumes that the consumer chooses the product that provides the greatest utility, and the data is analysed within a random utility discrete choice model.

According to *Garcia and de Magistris* (2008) none of the socio-demographic aspects has a significant impact on the consumer´s decision-making for organic food. However, economic factors do have an influence. A higher income increases the probability of buying organic food. Therefore, economic factors are a limiting factor to the growth of the organic food market. Moreover, health and environmental benefits from organic food increases organic food demand, with health benefits having a greater impact. Quality aspects and knowledge are also influencing the purchase decision. The higher the expected quality (taste and appearance, health, convenience and process) of the product, the higher the probability of

being a regular consumer of organic food. Self-reported knowledge about organic products also has a positive influence on the purchase decision.

Idda et al. (2008) released a paper dealing with consumer motivations supporting their purchase decision for organic foods in Italy. A survey was conducted in some specialised organic food stores in Sardinia. To interpret the collected data, a Multiple Correspondence Analysis and a Logit regression were used.

The authors classified four consumer motivational profiles of organic food consumers: the certified true organic consumer, the extemporaneous organic food consumer, the solidarity driven organic food consumer and the selfish organic food consumer. Furthermore, other findings were made. Safety of the food is the most important factor for the consumer of organic food. Besides environmental issues, farm income support and family as well as gender aspects have an impact on the purchase decision. Taste is also mentioned to be a relevant requirement of organic foods. New customers could become curious of organic food because of taste arguments. 39 percent of the sample believe that organic food is tastier than conventional food.

A paper published by *Zanoli and Naspetti* (2002) deals with the motivation of organic food consumers in Italy. They determined consumer perception and knowledge of organic food by using a means-end chain model to analyse the data from 60 participants of semi-qualitative interviews.

Pleasure and wellbeing are the most important factors for consumers to buy organic food. For this reason they want organic food to be healthy, tasty, easy to use, not perishable and nourishing products. Therefore, organoleptic quality standards and better packaging systems should be implemented. Furthermore, they are interested in knowing the differences between organically and conventionally produced products. Consumers consider organically produced eatables to be expensive and hard to find, but all in all they judge them positively.

To investigate the preferences for attributes of extra virgin olive oil in Italy *Cicia et al.* (2002) developed a survey instrument to find out preferences of regular organic food consumers. A sample of 198 regular consumers was interviewed in organic food stores in Naples. Each participant had to rank-order nine product profiles affecting price, origin of production, type of certification and visual appearance.

The preferences were significantly heterogeneous concerning price and origin of production. It was not possible to split the sample into different consumer clusters. *Cicia et al.* (2002) find that most consumers regard price as a quality symbol. Origin of production is also

a strong determinant of choice, also linked to quality expectations. The outward appearance of olive oil is not considered to be very important.

An article from Denmark is published by *Millock et al.* (2004), related to the question whether stated values can predict the purchasing decision of consumers in the organic food market. Therefore, data from 2.000 households was collected between 1997 and 2001. Furthermore a survey was conducted in 2001 with the same panel. To analyse the data, simple Logit and multinomial Logit models were used.

The authors differentiate between use values of organic food such as health, taste and freshness attributes, and non-use values such as environmental and animal welfare attributes. The consumer often states to prefer non-use values, while his statements compared to his purchasing behaviour show that the probability to buy organic food increases when use-values gain importance. *Millock et al.* (2004) find that use-values are the main drivers of purchasing behaviour in the real market, although consumers often state to prefer non-use values. However, the highest willingness to pay premium prices for organic food exists when the consumer appreciates both values.

The investigation of the Danish market for organic food consumption with regard to the household purchasing behaviour as well as consumer motives and values affecting their attitudes towards organic food are in the core of a study executed by *Wier et al.* (2005). Based on statistical data taking into account more than 2.000 household purchases between 1997 and 2001 combined with survey data, which is focused on consumer perceptions, values and attributes with special regard to organic foods, empirical methods are used to investigate the research question. As to the attributes and values, the authors distinguish so called "public good attributes" such as environmental awareness and animal welfare from so called "private goods attributes" such as personal health or other quality attributes like taste.

One main finding of *Wier et al.* (2005) is that the willingness to buy organic foods increases significantly with the relevance which consumers attach to "private goods attributes", which means a very important impact on market participation of organic products. According to *Wier et al.* (2005) the decision to buy organic foods is mainly influenced by "private goods attributes", whereas most consumers also assign values to "public good attributes". Another finding of the authors is that the attitudes towards organic products and the willingness to purchase them vary between different family types and their respective household characteristics. In this context, a higher level of income, age and education were identified as factors which significantly increase organic consumption, whereas for example

the presence of older children (aged 15 to 20 years) negatively influences the organic budget share.

Furthermore, *Wier et al.* (2005) point out that additional product information such as branding, labelling or information about origin or production and processing promote the consumer's decision to buy organic foods. The authors underline the relevance of additional information for Denmark in the context of the high level of organic sales through multiple retail stores with a lack of direct personal contact.

Shepherd et al. (2005) published a paper regarding the determinants that are related to the consumer behavior of organic food buyers. Therefore, two surveys among Swedish consumers have been conducted in 1998 and 2001. Additionally, the CONDOR project ("Consumer Decision Making on Organic Products") with partners from eight EU-countries was taken into account.

The authors find that there exists a discrepancy between the attitude and the behavior of Swedish consumers among organic food. Consumers think that organic food does not surpass conventional food with regard to shelf-life and taste, although these attitudes were high rated to be important. Regarding health benefits, these are more linked with behavior and attitudes than environmental benefits. In the case of health motivations behavior-behavior correlations seem to be stronger than belief-behavior correlations. However, the purchase of organic food seems to be predicted by environmental friendly behavior. The results from the CONDOR-project show that motivations for the purchase of organic food are mainly health, quality (including taste) and expense. Processed organic products seem to be less trustable than fresh organic foods.

Bruhn and von Alvensleben (2001) highlight the impact of food scandals on consumer attitudes towards organic foods in Germany. Based on the results of five consumer surveys between 1984 and 2001, which provide information about organic food consumption, the changes of the organic food market between 1999 and 2001 were explored in order to determine the impacts of the appearance of several "mad-cow-diseases" in Germany.

The results of the study show that in consideration of the scandals in the food sector, customers have extended their organic food consumption, particularly for products with a high perceived risk such as meat, sausages and milk products. Furthermore, a higher willingness to pay for organic products could be detected between 1999 and 2001. With regard to consumer attitudes towards organic food, *Bruhn and von Alvensleben* (2001) point out that beliefs in better quality of organic food as well as the perception of health advantages

of organic products have gained in importance since “mad-cow-diseases” received public attention. Another finding of the study is that consumer perception of food risks considering scandals is only a short-lived reaction. Against the background of this result, the authors conclude that security aspects cannot be seen as a sustainable driving force within the organic food market. Hence, further impulses from the organic supply chain actors are necessary to promote organic food consumption.

Riefer and Hamm (2008) present the results of a study which investigates changes in the organic food consumption with families in Germany with regard to the theoretical concept of family cycle. In this study extent to which organic food consumption in families underlies changes examined based on problem-centred interviews which were transcribed according to standard orthography and analysed by special software that refers to the Grounded Theory approach. Furthermore, the reasons which may be responsible for these changes were determined.

One main finding of *Riefer and Hamm* (2008) is that consumers do not perceive organic food consumption as a continuous process. Rather, organic food consumption can be characterized by changes in terms of its decreases and increases. Regarding the reasons which underlie these changes, pregnancy, the feeding of babies with complementary food, children’s adolescence, a new partner as well as a new household situation could be detected.

Grebitus et al. (2007) published an article about the influences on the purchase of organic and conventional pork, potatoes and milk. The article is based on a survey in Germany in the year 2004, where 260 people were questioned. For analysing the data an ordered Logit model was used.

The authors find that the consumption of organic pork is positively affected by the provision of service in smaller specialty shops. Quality aspects of food safety and organic processing also increase the purchase decision for organic pork meat. Furthermore, household sizes, the presence of children and education have a positive effect. Providing special prices for conventional pork is very effective. Freshness does have an impact on the buying decision and is connected with appearance and fat content. Regarding the quality of potatoes, food safety and health have a great impact on the consumer. The authors find that the consumer would prefer more information on the nutritional ingredients of potatoes. Due to the fact that for milk there are many brands, these have a significant impact on the buying decision for both, organic and conventional milk. It is even higher for organically produced milk. Consequently, the brand is the factor that consumers use for recognizing the organically

produced milk. As a final remark the authors find, that organically produced pork, potatoes and milk have a positive effect on consumption.

Regarding sensory attributes, taste of pork is very important for 70percent of the respondents, the taste of potatoes for 82 percent and the taste of milk is ranked as very important by 58.5 percent of the respondents. Additional, appearance and freshness are also ranked as very important by most of the respondents. Only for milk the appearance is not that much important.

Sanders and Richter (2003) investigate the influence of socio-demographic factors on consumption and purchasing motives with respect to organic dairy products. As data sources, the results of the "Household budget survey from the Swiss Federal Statistical Office" was exploited, which provides information about income and consumption of 3.642 private households. Furthermore, data from a Swiss household panel was used dealing with information on consumption, market development, brand sales, retail trade and competition. Additionally, 105 interviews based on the laddering approach were conducted and interpreted.

One main finding of the study of *Sanders and Richter* (2003) is that the most important motive for buying organically produced dairy products is animal welfare, followed by personal health. Furthermore, environmental concerns as well as positive sensory attributes (genuine taste) and the preference for organic food in general could be identified as relevant buying motives.

With regard to socio-demographic impacts, the results show that the buying decision and the motivational profile depend on income and the existence of children. Households with a high income buy organic food mainly due to altruistic and hedonistic reasons such as environmental awareness and animal welfare as well as food quality and taste. Compared to this, households with a lower income primarily buy organic food for animal welfare and health reasons. Contrary to other consumer studies, the results of *Sanders and Richter* (2003) were not able to confirm the finding that families with children buy organic food in order to improve the health of their children. However, households with children have in general a wider range of motives when it comes to their organic food consumption.

The authors conclude that animal welfare is in general the most important motive for the consumption of organic dairy products, whereas the motives vary for different groups of consumers.

A paper published by Stolz et al. (2009) deals with the question how the consumer recognizes and judges different quality criterions in the case of organic food products.

Therefore, three explorative studies with group discussion (two from Germany and one from Switzerland) from the last three years had been taken into account. As organic products eggs, apples, bread, tomatoes and yoghurt had been discussed. To analyse the data qualitative analysis and the Cross-Case-Comparison-Analysis had been used.

The consumers' perception is based on a selective system of information collection and assimilation. Therefore, consumers prefer specific characteristics of organic food products, like animal welfare more than the whole organic agricultural system. Complex circumstances like organic farming are only communicable in a limited way. Furthermore, *Stolz et al. (2009)* find that the consumers' examination of food is focused mainly on the last step of the production process. In both countries, Germany and Switzerland, sensory attributes are ranked as important for the food products. Therefore, taste is the most important criteria in all regarded products, apart from eggs. The quality of eggs is not determined mainly through sensory attributes but the system is more important. In the case of apples the consumer links the taste to the sort while in tomatoes the sort is mostly not given. The consumers in all discussion groups had different opinions about organic yoghurt: some consumers think organic yoghurt to be tastier than conventional one, others do not think that there is a difference in taste. Sensory attributes are also very important for bread and the participants described the ingredients as the most determining factors.

Based on the results of the CONDOR Project, *Thøgerson* (2006) presents a model of consumer decision-making and behaviour. The process of decision-making with regard to organic food consumption in eight European countries is investigated. In order to explain consumer behaviour via multivariate statistical methods, 1.000 respondents in each of the eight countries were interviewed. The sample was split into two sub groups of about 500 persons. One group had to answer a questionnaire focused on the purchase of organic tomato sauce, the other one with a focus on fresh tomatoes.

After *Thøgerson* (2006) the main finding of the study is that consumers' organic food consumption depends on similar motivational backgrounds in the eight analyzed countries. In all of the involved countries, individual attitudes towards organic foods are mainly influenced by beliefs about their benefits such as health, taste and environmental sustainability, whereas beliefs about costs or risk are less important for the consumers' decision-making. Another result of the study was that the process of decision-making not only depends on individual attitudes. In this context, social reasons could be identified as more important than personal motives. Furthermore, the fact that some consumers have reservations with regard to the

definition and availability of organic products bars them from trying out organic products. As to the differences of the analyzed countries, the results of the study pointed out, that the predictive capability of consumer behaviour in the north is better tan in the Southern European countries.

In order to give a better overview about the results of the different European literature Table 1 summarizes the main information.

Title	Author (year)	Location	Methodology	Type of product	Conclusions
Does organic food taste better? A claim substantiation approach	FILLION, L. and ARAZI, S. (2002)	United Kingdom	Sensory analysis with trained panelists and consumer testing with 301 respondents.	Orange Juice and Milk.	Organic orange juice was characterized to taste better than conventional one, while in milk there were no differences in taste detected between organic and conventional products.
Relationship between sensory attributes, hidden attributes and price in influencing consumer perception of organic foods	BRENNAN, C. S. and KURI, V. (2002)	United Kingdom	Sensory analysis of organic and conventional products through blind testing as well as preference tests and price tests.	A range of non-seasonal products.	There is no significant relationship between panellists' attitudes towards organic foods and their sensory evaluation of these products. Most panellists categorize the prices for organic food as too high but would prefer this food, if prices were lower. Most people won´t change their consumption patterns if the product choice is influenced by sensory characteristics but sensory quality attributes should be taken into account in order to promote repeated purchases.
Wissenschaft & Forschung - "Öko" oder "konventionell" - eine Frage der Sensorik?	LEHMANN, I. (2007)	Germany	Sensory testing through ten trained testers. Sensory profiles for organic and conventional food for every product group were developed.	Seven different product groups.	It depends on the individual product whether consumers attribute a certain sensory quality to it or not. Sensory differences were conducted between conventional and organic nut-cocoa paste but in the case of tomato ketchup there were none. The sensory evaluation can be influenced by the processing restrictions for organic food. Consumer perception of organic foods is not only influenced by their sensory evaluation, but also by other factors

					such as the image of the product.
What motivates consumers to buy organic food in the UK	MAKATOUNI, A. (2002)	United Kingdom	Consumer research. Qualitative consumer interviews based on the means-end chain approach. 40 laddering interviews with parents of children between 4 and 12 years had been conducted.		The motivation of organic food buyers depends on their desire to achieve individual and social values. The health factor is the most important, followed by the concerning of environmental aspects and animal welfare. Quality aspects and sensory attributes were not taken into account in this survey.
Exploring The Gap Between Attitudes And Behaviour: Understanding Why Consumers Buy Or Do Not Buy Organic Food	Padel and Foster (2005)	United Kingdom	Consumer research. Data from focus groups (n=181) and interviews.		Fruits and vegetables are the "key entry point" for most consumers to the organic market. Health motivation, food as an enjoyment, environmental concerns, animal welfare aspects and fair trade are motivations for the consumer to buy organic food. The importance varies between different product groups. The consumer often does not know why higher prices for organic food are necessary, because there is a lack of knowledge with regard to production systems. Some participants regarded taste as very important and suggested more taste promotions for organic foods in stores to attract consumers.
Organic Food: Understanding the consumer and increasing sales	Taylor Nelson Sofres (2004)	Wales	Consumer research. Survey with a panel database of 15.000 households and		Medium and heavy buyers are the most important groups for the growing organic sector. They have a positive attitude towards organic food. Taste

			4.000 face to face interviews. Empirical analysis methods were used.		and health are the driving factors for their organic food consumption. The consumers' decision to increase organic food purchases depends on the attributes taste and food safety. Communicating good quality aspects and better taste of organic food products could expand the number of heavy buyers.
Factors Affecting the Decision to Purchase Organic Food	FOTOPOULOS, C. and CHRYSSOCHOIDIS, G. (2001)	Greece	Psychometric methods and empirical analysis methods.		Familiarity with organic food enhanced by the differences between organic and non-organic food as well as the thoughtful way consumers buy their foods. The variety of organic products and organic labels are important with regard to the buying decision for organic food.
A multivariate statistical analysis on the consumers of organic products	CHINNICI, G., D'AMICO, M. and PECORINO, B. (2002)	Italy	Consumer research. 552 face to face interviews. Multivariate statistical methods were used.		Health issues are the most important aspects influencing the purchase decision for organic food, followed by environmental awareness. Adequate marketing strategies to promote growth as well as individual products in the organic market are difficult to develop. Four consumer groups with different consumption patterns were identified. All consumer groups accept higher prices for organic food which can be interpreted as a positive attitude towards organic foods and their quality.
The decision to buy organic food products in Southern Italy	MAGISTRIS, T. D. and GRACIA, A. (2008)	Italy	Consumer research. Survey with 200 consumers from		Socio-demographic aspects don´t have an impact on the purchase decision for organic foods, while economic factors

			Naples in 2003. The data was analysed with the Lancaster consumers demand theory and within a random utility discrete choice model.		do influence the decision and limit the growth of the organic market. Health and environmental benefits from organic food increases organic food demand. Quality and knowledge aspects have also a positive influence on the purchase of organic foods.
The Motivational Profile of Organic Food Consumers: a Survey of Specialized Stores Customers in Italy	IDDA, L., MADAU, F. A. and PULINA, P. (2008)	Italy	Consumer research. Survey in some specialized organic food stores in Sardinia. A Multiple Correspondence Analysis and a Logit regression were used to interpret the data.		Four motivational profiles of organic food consumers were classified. For the organic food consumer safety plays an important role but other factors are also influencing the purchase decision. New customers could be interested in organic food because of better taste. 39% of the sample believes that organic food is tastier compared to conventional one.
Consumer motivations in the purchase of organic food: A means-end approach	ZANOLI, R. and NASPETTI, S. (2002)	Italy	Consumer research Semi-qualitative interviews with 60 participants. A means-end chain model was used to analyse the data.		The organic food consumer wants his food for pleasure and well-being. The organic product needs to be tasty, easy to use, not perishable and a nourishing product. Therefore, organoleptic standards should be implemented. The consumer is interested in the difference between organic and conventional production systems. All in all, the consumer judges organic food positively.
Consumers' perception of quality in organic food	CICIA, G., DEL GIUDICE, T. and SCARPA, R. (2002)	Italy	Consumer research. 198 regular consumers were interviewed in	Extra virgin olive oil	The authors couldn´t split the sample into different consumer clusters because of their heterogeneity. Price is seen by the consumer as a

			stores in Naples. Nine product profiles affecting price, origin of production, type of certification and visual appearance should be ranked.		quality symbol. Also origin of production and quality expectations are determinants of choice, while the outward experience is not to be considered very important.
Consumer demand for organic foods – attitudes, values and purchasing behaviour	MILLOCK, K., WIER, M. and ANDERSEN, L. M. (2004)	Denmark	Consumer research Data from 2.000 households has been collected between 1997 and 2001 and a survey in 2001 was done with the same panel. Simple Logit and multinomial Logit models were used to analyse the data.		The consumer often states to prefer non-use values (environmental and animal welfare), but compared to his purchasing behaviour the probability to buy organic food increases when use-values (health, taste and freshness attributes) gain importance. Use-Values are the main drivers for the purchase of organic food, although the highest probability exits if the consumer appreciates both values.
Perceptions, values and behaviour: The case of organic foods	Wier et al. (2005)	Denmark	Consumer research. Data from 2.000 households has been collected between 1997 and 2001 and a survey in 2001 was done with the same panel.		The willingness to buy organic foods increases with the relevance which consumers attach to “private goods attributes” (personal health or other quality attributes like taste). However, the consumer also assigns values to “public good attributes” (environmental awareness and animal welfare). Attitudes towards organic products vary between different family types and their household characteristics. Additional product information promotes the consumer’s decision to

					buy organic foods.
Determinants of Consumer Behavior Related to Organic Foods	SHEPHERD, R., MAGNUSSON, M. and SJÖDÉN, P.-O. (2005)	Sweden	Consumer research. Two surveys with Swedish consumers in 1998 and 2001. The Condor Project has been taken into account.		Consumers think that organic food does not surpass conventional food with regard to shelf-life and taste, although these attributes are high rated to be important. The purchase of organic food seems to be predicted by environmental friendly behavior. Results from the Condor-Project show that motivations for the purchase of organic food are mainly health, quality (including taste) and expense.
Verbrauchereinstellungen zu Bioprodukten: der Einfluß der BSE-Krise	BRUHN, M. and VON ALVENSLEBEN, R. (2001)	Germany	Consumer research. Five consumer surveys between 1984 and 2001.		In consideration of food scandals consumers increased their purchases of organic food in the case of products with a high perceived risk such as meat, sausages and milk products. Since “mad-cow-diseases” received public attention believes in better quality and health advantages of organic food have gained importance. The authors conclude that security aspects cannot be seen as a sustainable driving force within the organic food market because they are mostly short-lived.
Changes in Families´ Organic Fodd Consumption	RIEFER, A. and HAMM, U. (2008)	Germany	Consumer research. Problem-centred interviews which were transcribed according to standard orthography and analysed by special		Organic food consumption can be characterized by changes in terms of its decreases and increases. Pregnancy, the feeding of babies with complementary food, children’s adolescence, a new partner as well as a new household situation could be detected to underlie these changes.

			software that refers to the Grounded Theory approach		
What Affects Consumption Patterns of Organic and Conventional Products?	GREBITUS, C., YUE, C., BRUHN, M. and JENSEN, H. H. (2007)	Germany	Consumer research. Survey with 260 people in 2004. For analysing the data an ordered Logit model was used.	Organic and conventional pork, potatoes and milk.	The provision of service in smaller specialty shops, quality aspects of food safety and organic processing increase the purchase decision for organic pork meat. Freshness, appearance and fat content also have an influence on the buying decision. In the case of potatoes food safety and health have a great impact on the consumer. For milk, brands are influencing the purchase. Taste of pork is very important for 70% of the respondents, taste of potatoes for 82% and taste of milk for 58.5% of the respondents. Appearance and freshness are also important factors, although for milk the appearance is not very important.
Impact of sociodemographic factors on consumption patterns and buying motives with respect to organic dairy products in Switzerland	SANDERS, J. and RICHTER, T. (2003)	Switzerland	Consumer research. Information about income and consumption of 3.642 private households from the "Household budget survey from the Swiss Federal Statistical Office". 105 interviews based on the laddering approach	Organic dairy products	The most important motive for buying organically produced dairy products is animal welfare, followed by personal health. Environmental concerns as well as positive sensory attributes (genuine taste) could be identified as relevant buying motives. Families with children do not buy organic food to improve the health of their children, but they have a wide range of motives. Families with higher income buy organic food due to altruistic and hedonistic reasons like environmental awareness, animal

			were conducted.		welfare, food quality and taste, while families with lower incomes buy organic food because of animal welfare and health reasons.
Predicting Consumer´s Choices of Organic Food: Results from the Condor Project,	THØGERSON, J. (2006)	Eight European countries	Consumer research. Based on results from the Condor-Project. 1.000 respondents in each of the eight countries were interviewed, split into two subgroups of 500 people. Multivariate statistical methods were used.	Organic tomato sauce and fresh tomatoes	Consumers' organic food consumption depends on similar motivational backgrounds in the eight analyzed countries. In every country attitudes are influenced by beliefs about their benefits such as health, taste and environmental sustainability, while costs or risk are less important. The decision-making process also depends on social reasons. The predictive capability of consumer behaviour in the north is better than in the Southern European countries.
Lebensmittelqualität aus der Verbraucherperspektive – eine Synthese qualitativer Studien zur Wahrnehmung und Beurteilung verschiedener Qualitätskriterien bei Öko-Produkten	Stolz, H., Bodini, A., Stolze, M., Hamm, U. and Richter, T. (2009)	Germany and Switzerland	Consumer research. Three explorative studies with group discussion. Qualitative analysis and the Cross-Case-Comparison-Analysis were used.	Eggs, tomatoes, apples, bread and yoghurt.	Consumers prefer specific characteristics of organic food products more than the whole organic agricultural system. Mainly the last step of the production process is examined by the consumer. Sensory attributes like taste are ranked as important for the regarded food products, only for eggs other criterions are more important. The different quality aspects for the regarded food products are described more detailed in the study.

Table 1: Overview about the European literature

Literature from the United States of America

A compilation of the published literature on organic food consumption has been made by *Hughner et al*. (2007).

The authors find that health often is the primary reason for consumers to buy organic food. The consumer wants to avoid chemicals in his food and some think that organically produced food is more nutritious. Often the consumer, found in the existing studies, think organic foods to be more environmental friendly than conventional food. Environmental concerns influence the attitudes towards organic foods but it is often not a driving factor. Concerns about food safety are also mentioned to influence the purchase decision, although the meaning of food safety is often not clarified. Apart from this, some studies find that consumers want to support the local economy by purchasing organic foods.

One of the themes of consumer motivation in that paper is dealing with the question of a better taste of organically produced food. The authors find in the existing literature that many consumers associate 'organic' with a higher quality and therefore, they perceive a better taste. Indeed, a better taste, tested through blind taste-tests is only valid for some categories of food. Often the premium prices for organic food suggest a better quality and a better taste from the consumers' perspective.

As implication of the literature review *Hughner et al.* (2007) point out that consumer often cannot distinguish between organic and conventional foods. Therefore, it is not surprising that organic food is not consumed at higher rates. The supply chain needs to communicate more information to the consumer. A strategic and active marketing has to be developed. Consumers are often confused about what is trustable and about food safety. With the growing market for organic food and the extension of organic lines in large corporation the consumer begins to doubt the authenticity of organic labels. The producers need to be more active in the value chain to protect the credibility of their products in the food market. The authors conclude that further research has to be done to better understand the consumer and to better implement marketing strategies.

Another study executed by *Zhao et al.* (2007) focuses on the research question whether organically grown vegetables differ significantly with regard to their sensory properties from conventionally grown vegetables. To this end, sensory tests were conducted in which consumers had to evaluate both conventional and organic vegetables with regard to their overall liking and the perception of intensity of flavour as well as bitterness. Additionally, panellists had to answer some questions with regard to their overall perception of organic

foods and demographic characteristics. By conducting several periods and sessions of consumer sensory testing with a total of 206 panellists, sensory evaluation and consumer research of seven different types of vegetables was examined.

Zhao et al. (2007) show that the overall liking as well as the perception of the sensory quality did not differ significantly between organically and conventionally produced vegetables, although in parts considerable differences could be found. Furthermore, the results indicate that panellists categorize health and environmental concerns as the most important characteristics of organic produce, followed by taste.

Within a state-of-the-science report *Theuer* (2006) highlights the results of several studies which investigate the sensory quality of organic fruits and vegetables compared to their conventional alternative. Furthermore, the report gives an overview about different approaches to investigate sensory quality of organic products in order to avoid an inadequate interpretation of the published literature.

Theuer (2006) points out that the results of the studies investigating the sensory quality of organic foods compared to conventional products, have to be seen in consideration of the research question. Therefore, the author differentiates four possible ways to interpret or rather to highlight this question:

- With regard to organic labelling.
- Considering the distribution channel of organic products (organic markets or conventional grocery stores).
- Regarding the climatic and geographical impacts on organically grown products.
- With a focus on different cultural practices fruits and vegetables are grown by.

With regard to the results of the published research on the sensory quality of organic food compared to conventional products, *Theuer* (2006) concludes that altogether most studies are not able to substantiate significant differences in the perception of sensory attributes. Another finding of his literature review is that nearly all studies reporting differences in sensory quality between organic and conventional food point out that organic products are preferred when they are compared to conventional alternatives, or products which are grown using so called integrated production systems. According to this, there are just few studies which resume a poorer taste of organically grown fruits and vegetables compared with a conventional alternative.

Regarding the consumers' food choice, *Chang and Lusk* (2008) determined the influence of concerns about the distribution of benefits across the agricultural supply chain and the preferences for organic food. Therefore a conjoint-type experiment was conducted via mail survey with a random sample of 207 respondents in the US. Furthermore, the extent of explaining food choice with fairness models given by the general literature is determined.

It can be seen, that consumers prefer small farmers and themselves to gain the greatest benefit across the supply chain. Apart from this, every participant in the supply chain but themselves should gain the same outcomes. The authors point out that the willingness to pay a premium for organic food can be aroused with the allocation of benefits more to the producer's side. Though, inequality aversion models could not explain food choices satisfactory, unless they are modified to fit in the context of food.

A paper published by *Zepeda and Li* (2007) deals with the characteristics of organic food shoppers in the USA. For this purpose, 680 data sheets from a national household survey from 2003 were analysed using Probit and ordered Probit models, including elements of Lancaster's product attribute model and Weinstein's precaution adoption process.

The authors point out that the organic food purchase is limited by a lack of availability of shopping venues. This aspect seems to be connected with income issues. When there is an adequate access to organic food stores because of more affluent neighbourhoods, the probability to buy organic food rises. Inferential, a better availability of organic food in conventional shopping venues would increase organic food purchases. Enjoyment of cooking and educational attainment also increases the probability of buying organically produced food. Furthermore, the lack of religious affiliation, food beliefs and youth have an impact on the purchase decision.

Many individuals express a preference for organic food but have different shares of their purchases. *Durham* (2007) investigates the share of the purchases of organically produced food and which factors are influencing this rate. The data has been collected in three different shopping venues in the USA. At each location 100 people were questioned.

Durham (2007) states that personal health and environmental protection are influencing the purchase decision for organic food. Environmental motivations are more increasing the buying than health motivations. Individuals with a low self-responsibility for their health do not prefer organic food less than individuals with a high responsibility, but they actually buy less organically produced food. Households that do not prefer organic food but have children

within the household overcome their lack of preference by buying more organic food than they first declared.

To investigate a demographic profile of organic food consumers *Dettmann* (2008) published a paper about organic food purchasers in the USA. Therefore, purchase and demographic household data has been used to characterize the organic food consumer. Produce purchase information from 41.000 households from Nielsen's 2006 panel has been used. To analyse the data a Heckman two-stage model has been utilised.

The author states that the findings of his study support and contradict past works at the same time. Education and income are two significant factors influencing the purchase decision. Consumers with a higher education are more willing to buy organically produced foods and they would spend a greater share of the income for fresh fruits and vegetables. Higher incomes increase the likelihood to purchase organic food at a first stage, because money for premium prices is available. However, these households do not spend as much money on organic vegetables as they extent their vegetable consumption. It can be seen that they are likely to try organic vegetables but that they do not buy as much organic vegetables as they buy at all. The author indicates that minorities are less likely to purchase organic vegetables. African American and Hispanic households do purchase less organically produced vegetables compared to Caucasian households. To conclude, well educated Caucasians with higher incomes are the most likely to purchase organic foods.

To help organic farmers and retailers through providing information about demand and the preferences for organic milk and apples in Vermont, USA, *Wang and Sun* (2003) published a paper. They conducted a conjoint analysis based on data collected from 519 consumers in 2002.

In the state of Vermont there is a larger consumer basis for organic food compared to the rest of the USA. In the case of organic apples, production method and location are very important factors considering the buying decision, while for organic milk production location and certification play an important role. For organic food consumers the attribute of local production seems to be more important than the price. On the other hand, higher prices of organic products were the determining factor for non-organic food buyers. Regarding the demography of the organic food consumers, younger people with higher income, smaller household size and fewer children were willing to pay more for organically produced products. Finally, *Wang and Sun* (2003) declared that there is a niche market for organic

apples and milk that are produced locally and are certified. Nearly half of the consumers buy organic food because they hold that organically produced products taste better.

In order to give a better overview about the results of the American literature Table 2 summarizes the main information.

Title	Author (Year)	Location	Methodology	Type of product	Conclusions
Who are organic food consumers? A compilation and review of why people purchase organic food	HUGHNER, R. E. S., MCDONAGH, P., PROTHERO, A., SHULTZ, C. J. and STANTON, J. (2007)	USA	Compilation of the published literature on organic food consumption.		Health is often the primary reason for consumers to buy organic food. The consumer thinks that organic food is more environmental friendly than conventional food. Environmental concerns influence the attitudes towards organic foods but they are often not a driving factor. Sometimes consumers want to support their local economy through organic food purchases. Many consumers associate 'organic' with a higher quality and with a better taste. A better taste, tested through blind taste-tests is only valid for some categories of food. However, consumers often cannot distinguish between organic and conventional foods. The supply chain needs to communicate more information to the consumer and the producers need to be more active in the value chain to protect the credibility of their products in the food market.
Consumer Sensory Analysis of Organically and Conventionally Grown Vegetables,	ZHAO, X., CHAMBERS, E., MATTA, Z., LOUGHIN, T. M. and CAREY, E. E. (2007)	USA	Sensory test with conventional and organic grown vegetables and questionnaires concerning the overall perception of organic foods and demographic	Seven different types of vegetables.	The overall liking and the perception of the sensory quality did not differ significantly between organically and conventionally produced vegetables, although in some parts differences could be found. The panellists rated health and environmental concerns as the most important characteristics of organic products, followed by taste.

			characteristics. 206 panellists had taken part.		
Do organic fruits and vegetables taste better than conventional fruits and vegetables?	THEUER, R. (2006)	USA	Literature review.	Organic fruits and vegetables.	Results of the existing studies investigating the sensory quality of organic foods have to be seen in consideration of the research question. Most studies are not able to substantiate significant differences in the perception of sensory attributes between organic and conventional grown ones. Nearly all studies reporting differences in sensory quality between organic and conventional food, point out that organic products are preferred compared to conventional ones. There are just few studies which resume a poorer taste of organically grown fruits and vegetables
Concerns for Fairness and Preferences for Organic Food,	CHANG, J. B. and LUSK, J. L. (2008)	USA	Conjoint-type experiment via mail survey with a random sample of 207 respondents.		Consumers prefer small farmers and themselves to gain the greatest benefit across the supply chain. The willingness to pay a premium for organic food can be aroused with the allocation of benefits more to the producer's side.
Characteristics of organic food shoppers	ZEPEDA, L. and LI, J. (2007)	USA	Data sheets from a national household survey from 2003 were analysed using Probit and ordered Probit models, including elements		The organic food purchase is limited by a lack of availability of shopping venues. This seems to be connected with income issues. A better availability of organic food in conventional shopping venues would increase organic food purchases.

			of Lancaster's product attribute model and Weinstein's precaution adoption process.		Enjoyment of cooking and educational attainment also increases the probability of buying organically produced food, as well as the lack of religious affiliation, food beliefs and youth.
The Impact of Environmental and Health Motivations on the Organic Share of Produce Purchases	DURHAM, C. A. (2007)	USA	Data has been collected in three different shopping venues. At each location 100 people were questioned.		Personal health and environmental protection are influencing the purchase decision for organic food. Environmental motivations are more increasing the buying than health motivations. Households that do not prefer organic food but have children within the household overcome their lack of preference by buying more organic food than they first declared.
Organic Produce: Who's Eating it? A Demographic Profile of Organic Produce Consumers	DETTMANN, R. L. (2008)	USA	Produce purchase information from 41.000 households from Nielsen's 2006 panel has been used. To analyse the data a Heckman two-stage model has been utilised.		Education and income are two significant factors influencing the purchase decision. Higher incomes increase the likelihood to purchase organic food at a first stage but these households do not spend as much money on organic vegetables as they extent their vegetable consumption. African American and Hispanic households do purchase less organically produced vegetables compared to Caucasian households. Well educated Caucasians with higher incomes are the most likely to purchase organic foods.

Consumer Preference And Demand For Organic Food: Evidence From A Vermont Survey	WANG, Q. and SUN, J. (2003)	USA	Consumer research. Conjoint analysis based on data collected from 519 consumers in 2002.	Organic milk and apples.	In the case of organic apples, production method and location are very important factors considering the buying decision, while for organic milk production location and certification play an important role. For organic food consumers the attribute of local production seems to be more important than the price but higher prices of organic products were the determining factor for non-organic food buyers. Younger people with higher income, smaller household size and fewer children were willing to pay more for organically produced products. Nearly half of the consumers buy organic food because they hold that organically produced products taste better.

Table 2: Overview about the literature from the USA

Literature from other non-European countries

A study executed by *Lockie et al.* (2002) is in the core of a paper which presents the results of a survey investigating the attitudes and motives which underlie the consumption of organic food in Australia. The analysis of this research question is based on both qualitative and quantitative consumer research methods. In this context, a series of qualitative interviews was conducted with at all 13 focus groups of eight to ten participants involved in each group. The aim of this part of the survey was to determine consumers overall associations with foods and to explore their construct of ideas with a special regard to organic foods. Additionally, telephone interviews with about 1.200 Australian consumers were conducted in order to collect information about their actual organic food consumption, their motives and attitudes which have an impact on their food choice, their bearing towards contemporary food-related issues and their demographic characteristics. Contrary to most of the other reviewed studies, the motivational profile of this study was not directly questioned. Rather, the motivation according to the overall motivation of the selection of food was investigated and then related to the extent of organic food consumption.

With regard to the purchasing motives of organic food consumers, *Lockie et al.* (2002) state that organic consumers generally expressed stronger views and motivations related to environmental concerns, whereas their views did not substantially differ from the views of most non-organic consumers. However, the authors indicate significant differences between organic and non-organic consumers with regard to their socio-demographic characteristics. Particularly, a strong correlation between consumers increasing educational level and organic food consumption was detected. As to their overall food choice, organic consumers rated health and natural content of foods as the most important impacts, followed by price. In this context, it is remarkable that organic consumers attributed a similar relevance to animal welfare and environmental protection as well as price. The authors conclude that the decision to buy organic food is not only based on environmental concerns but also depends on factors such as personal and family health as well as convenience.

According to the sensory aspect, *Lockie et al.* (2002) resume that there are no significant differences between organic and non-organic consumers. Furthermore, the results show that the sensory appeal for both groups is not much less important than health, natural content, price and animal welfare and more important than environmental protection.

In order to give a better overview about the results of the non-European literature Table 3 summarizes the main information.

Title	Author (Year)	Location	Methodology	Type of product	Conclusions
"Eating green": Motivations behind organic food consumption in Australia	LOCKIE, S., LYONS, K., LAWRENCE, G. and MUMMERY, K. (2002)	Australia	Qualitative interviews with at all 13 focus groups of eight to ten participants involved in each group. Additional, telephone interviews with about 1.200 Australian consumers were conducted.		In the interviews organic consumers generally expressed stronger views and motivations related to environmental concerns, whereas their views did not substantially differ from the views of most non-organic consumers. But there are differences between these groups regarding the socio-demographic characteristics. There is a strong correlation between consumers increasing educational level and organic food consumption. The decision to buy organic food is not only based on environmental concerns but also depends on factors such as personal and family health as well as convenience. The sensory appeal for both groups is not much less important than health, natural content, price and animal welfare and more important than environmental protection.

Table 3: Overview about the non-European literature

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Annex II - State-of-the-Art in Sensory Science

Kirsten Buchecker, Mark Lohmann, Alessandra Bendini, Tullia Gallina Toschi

Today's consumers expect a wide choice of food that is safe, enjoyable to eat, nutritious and of high sensory quality. If these criteria are not fulfilled, there is sufficient choice in a commercially competitive environment for consumers to change their allegiances and find alternative products. Food and beverages do not only serve as „propellant“for maintaining the metabolism but also stand for enjoyment and life quality. If food does not taste well it will be rejected by the consumer. Therefore, organoleptic properties are relevant markers for quality assessment. In general, measuring and describing the organoleptic characteristics of a food are much more difficult than measuring and describing its levels of specific chemical and nutritional components. In the future it may become routine to use an “electronic nose or tongue” to provide objective and quantitative data (Müller et al., 2003) but this methodology is not yet well established.

The primary role of sensory scientists is to employ the senses of selected and trained human subjects to identify the individual perceptible characteristics of food, and to quantify their intensities. These characteristics are defined by the chemical composition of the food, and the structural organisation resulting in a special form and texture. All the important senses in determining consumer liking are scored: appearance, odour, taste, trigeminal response, touch and hearing. Sensory evaluation can be regarded as a quantitative science comprising a set of test methods for accurate measurement of human responses to foods and minimizes the potentially biasing effects of brand identity and other information influencing the consumer perception. As such, it attempts to isolate the sensory characteristics of foods themselves and provides important and useful information to product developers, food scientists, and managers about the sensory characteristics of their products.

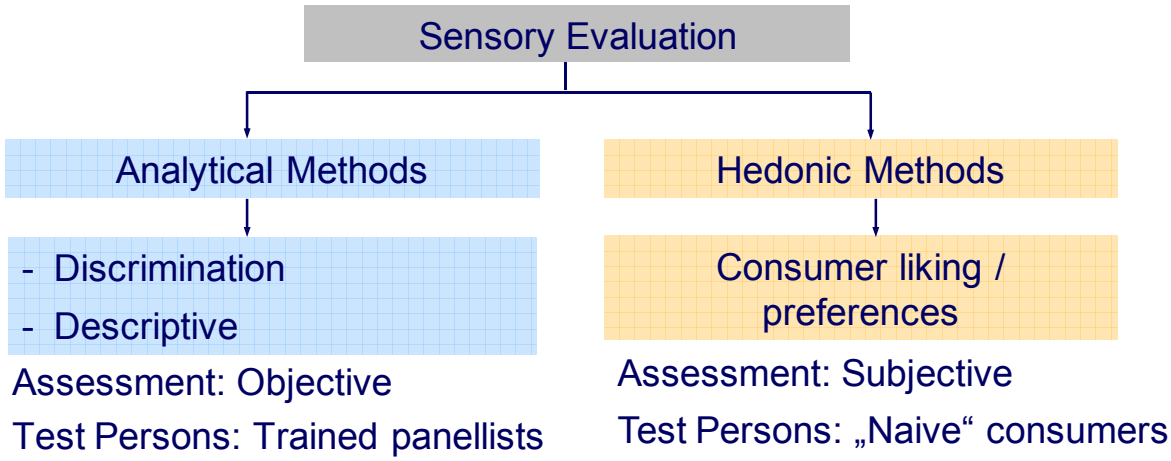


Fig. 1 Sensory methods are divided in analytical tests, including discrimination and descriptive methods and affective or hedonic tests such as those involved in assessing consumer liking or preferences

Analytical Methods

For the analytic tests, panellists are selected based on having average to good sensory acuity for the critical characteristics of products to be evaluated. They are familiarized with the test procedures and my undergo greater or lesser amounts of training, depending on the method. In the case of descriptive analysis, they adopt an analytical frame of mind, focusing on specific aspects of the product as directed by the scales on their questionnaires. They are asked to put personal preferences and hedonic reactions aside, as their job is only to specify what attributes are present in the product and what levels of sensory intensity, extent, amount, or duration. Furthermore, they have not necessarily been selected to be frequent users of the product, so they are not part of the target population to which one would like to generalize hedonic test results.

QDA- A common used objective analytical method in sensory science

As a major representative of an analytical test method which finds routinely it´s application within the „ECROPOLIS“ project the Quantitative Descriptive Method QDA is described in a more detailed form:

Descriptive sensory analyses are generally useful in any situation where a detailed specification of the sensory attributes of a single product or comparison among several products or a comparison is desired. Quantitative descriptive analysis (QDA) method relies

heavily on statistical analysis to determine the appropriate terms, procedures, and panellists to be used for analysis of a specific product.

Method

This test procedure contains the most sophisticated sensory methodology. The objective of descriptive analysis is to provide quantitative descriptions of products based on the perceptions of a group of trained panellists. Quantitative Descriptive Analysis (QDA) is the most commonly used technique because it is product-specific, measures all properties, is accurate, reproducible and may be adapted and applied in a wide range of experimental situations. Data obtained from QDA have been used to relate to physical and chemical analyses, product formulations, preferences, and other kinds of consumer measures of concepts, pricing and so forth. The technique relies on statistical techniques to determine appropriate descriptors, procedures and panellists to be used for the analysis of a specific product. QDA panellists undergo a rigorous screening, training and selection process to form a final panel of 12 for each specific food product. QDA involves individual development and panel agreement in generating a list of descriptors, establishing the order of descriptor occurrence and measuring the relative intensity for each descriptor. The technique uses a continuous line scale, 15cm in length for each descriptor. A line scale is considered to reduce any bias in scaling which might occur from using discrete number scales. The scale endpoints are represented as anchor points, located at approximately 1.5cm from each end and the scale direction always goes from left to right with increasing intensity. Panellists evaluate the intensity of each descriptor by placing a vertical line at the point which best reflects their perception of the relative intensity for that attributes. To yield a numerical value, the distance along the scale to the vertical line/mark is measured.

Data Analysis

Data obtained by QDA may be analysed and/or presented by a variety of means. The results from QDA may be presented graphically as a "spider's web" (referring to Fig. 2), with lines radiating from the centre representing an individual descriptor and the distance from the centre point to a plotted point representing the measured intensity of that descriptor. Plotted points are joined together to provide a "spider's web"/product profile. The graphic representation of QDA data has been reported to be one of the unique features of QDA (compared to other descriptive techniques) and has proved to be a popular and easy-to-understand format for the presentation of data. QDA data may also be statistically analysed to determine if products are significantly different and to what degree the differences exist.

Practical four step procedure

1. The first stage in QDA training is product orientation, where individual panellists evaluate a typical product and try to generate descriptors which describe the total product. Future sessions focus on the development of descriptors specific to organoleptic categories, such as flavour, texture, aroma and appearance of the product. The QDA methodology remains one of the few methods that does not use standardised terminologies and excludes the panel leader from directly participating in the language development. The development of descriptors is a necessary stage in summarising what the panellists perceive; instead of teaching panellists what it is they should perceive, i.e. "behaviour modification).

2. The second stage in QDA training is the development of a consensus language, where all descriptors are listed on one score sheet, duplicate descriptors are eliminated and decisions on descriptor order, definitions and the total number of descriptors are agreed. The use of reference samples, such as the raw material from which the product is produced, has been reported to promote the generation of descriptors. Such reference materials can help highlight a particular sensation that is not easily detected or described, such as an aroma or volatile flavour. They can also be used to provide documentation for descriptors and establish intensity ranges, which help to alleviate any descriptors which may cause disagreement. The ideal reference sample is one which is simple, reproducible, identifies only one attribute, can be diluted without changing character and does not introduce sensory fatigue during the training process. In QDA, the use of reference samples to promote descriptor understanding is permissible, as opposed to training panellists to provide identical scores for a reference sample, i.e. "behaviour modification".

3. The third stage in QDA training is an introduction to using the QDA scale and developed descriptors. This stage ensures that panellists are competent in using the horizontal line scale to best reflect the relative intensity of descriptors and that the developed language covers all perceived attributes in test products. A range of products, such as a standard product and fully defined product variants produced either in-house or purchased commercially, may be used to validate the developed score sheet.

4. The final stage of training involves panellists evaluating products similar to the test product. Examination of the practice scores obtained during this stage allows

evaluation of individual panellist performance, in terms of consistency, discrimination and reliability of response. The duration of a QDA training course cannot be predetermined but rather relies on the complexity of the product and the objective of the final testing. In practice, the duration of many QDA training courses is determined by the time taken by the panel members in reaching a consensus on a suitable range and number of descriptors.

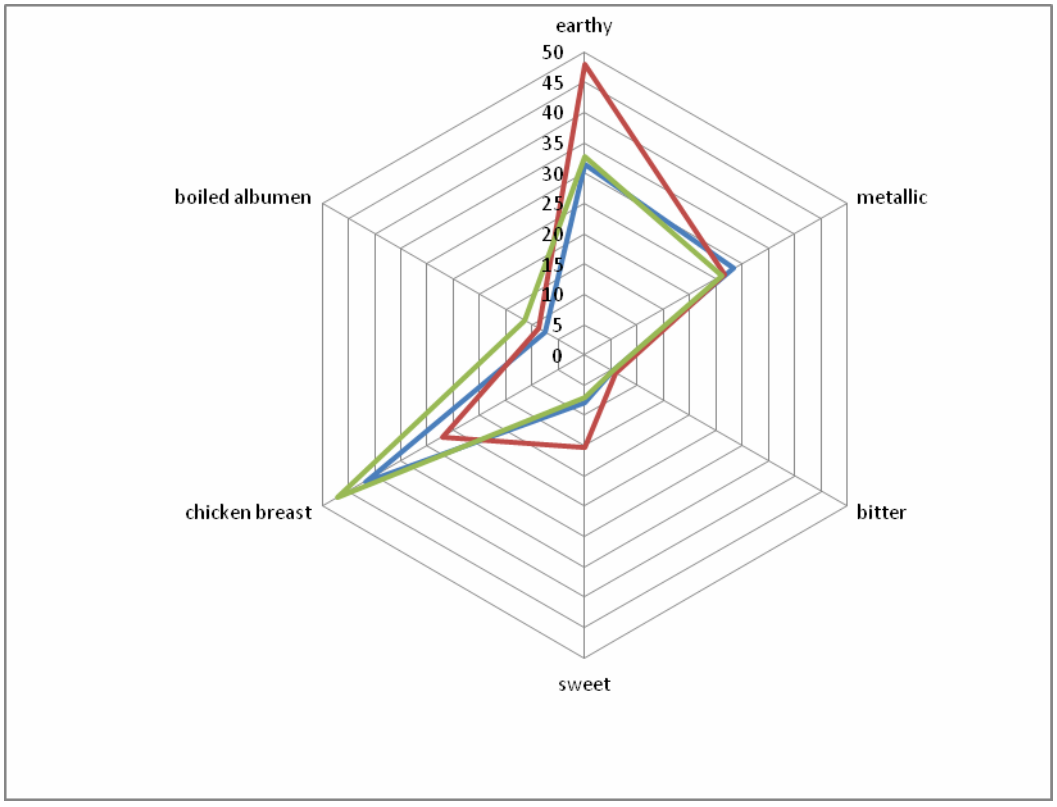


Fig. 2 "Spider-Web" example of the taste profile of three different fish species- a result of the QDA test

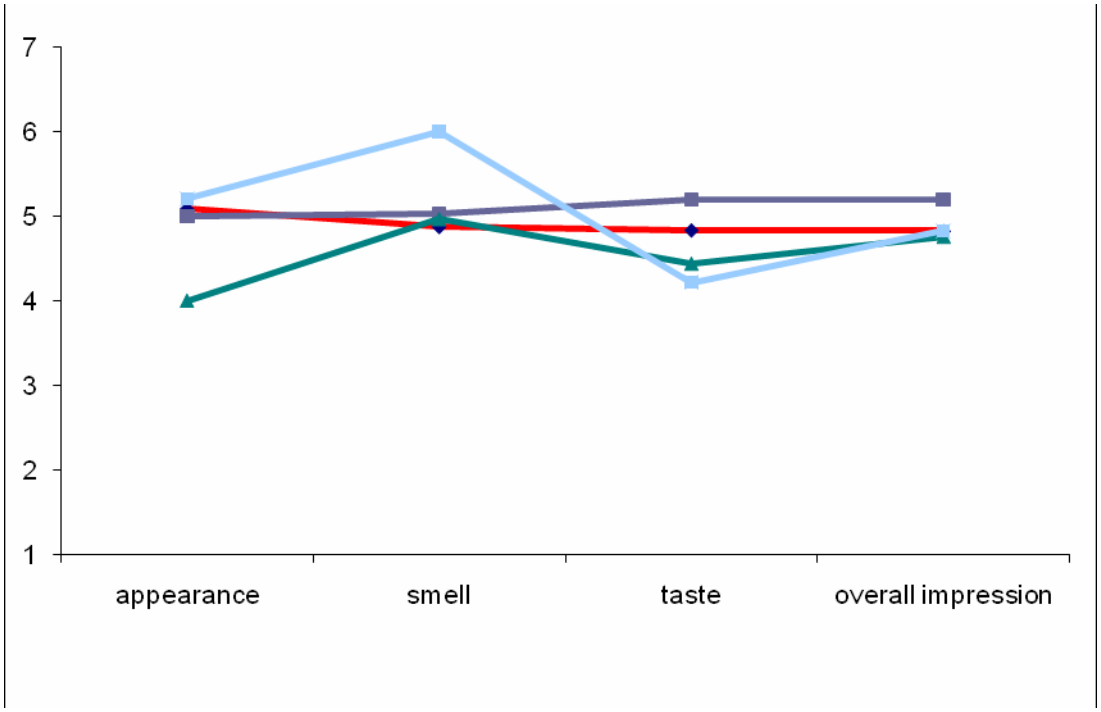
Hedonic Methods

In contrast to this analytical frame of mind, consumers in an affective test act in a much more integrative fashion. They perceive a product as a whole pattern. Although their attention is sometimes captured by a specific aspect of a product their reactions to the product are often immediate and based on the integrated pattern of sensory stimulation from the product and expressed as liking or disliking. Consumers are effective at rendering impressions based on the integrated pattern of perceptions. In such consumer test, participants must be chosen carefully to ensure that the results will generalize to the population of interest. Participants should be frequent users of the product, since they are most likely to form the target market

and will be familiar with similar products. They posse's reasonable expectations and a frame of reference within which they can form an opinion relative to other similar products they´ve tried. Problems arise when consumers are asked to furnish very specific information about product attributes. Consumers not only act in a non analytic frame of mind, but also they often have very fuzzy concepts about specific attributes, confusing sour and bitter tastes, for example. Individuals often differ markedly in their interpretations of sensory attribute words on a questionnaire. While a trained texture profile panel has no trouble in agreeing how cohesive a product is after chewing, one cannot expect consumers to provide precise information on such a specific and technical attribute.

scale from 1 (very bad) to 7 (excellent)

very bad	bad	not satisfied	satisfied	good	very good	excellent
1	2	3	4	5	6	7



scale from -2 (too pale, too dry) to +2 (too dark, too juicy)

too pale/dry	slightly too pale /dry	optimal	sligthly too dark/juicy	too dark /juicy
-2	-1	0	1	2

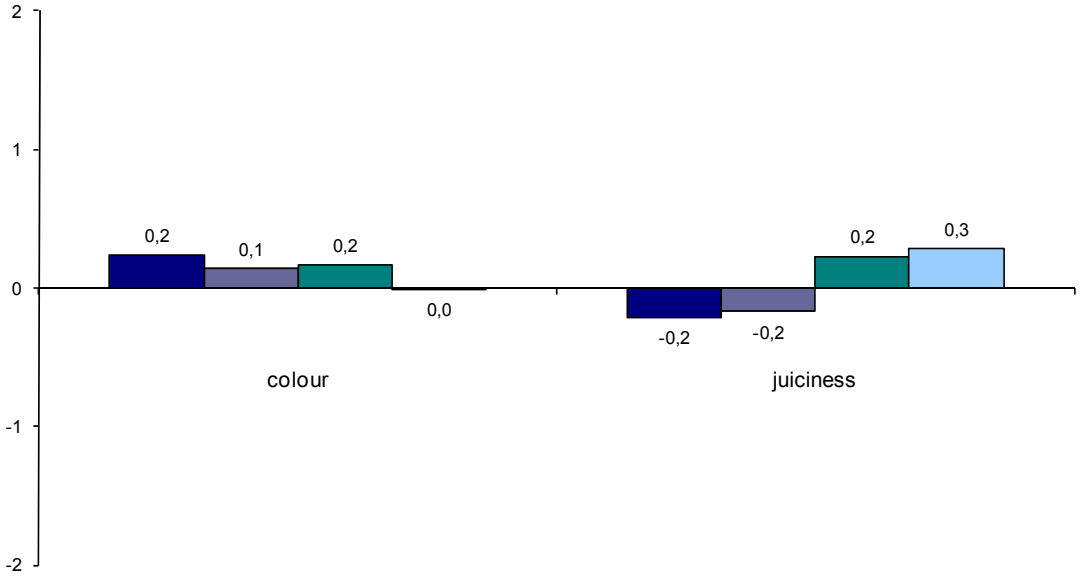


Fig. 3 Example of a typical questioning for a hedonic acceptance test and corresponding visualization of the results

The sensory test design involves not only the selection of an appropriate method but also of appropriate participants and statistical analyses.

Analytic tests in the lab with specially screened and trained judges are more reliable and lower in random error than consumer tests. However, one give up a closer connection to real-world results by using artificial conditions and a special group of participants. Conversely, in the testing of products by consumers in their own homes, one has a lot of real-life validity, but also a lot of noise in the data. Every sensory test is a compromise between reliability and real-life scenario.

Data generated from human observers are often highly variable. There are many sources of variation in human responses that cannot be completely controlled in a sensory test. Examples include the mood and motivation of the participants, their innate physiological sensitivity to sensory stimulation, and their past history and familiarity with similar products. To assess whether the relationship observed between product characteristics and sensory responses are likely to be real, and not merely the result of uncontrolled variation in responses, the methods of statistics are used to analyze evaluation data.

However, data and statistical information are only useful when interpreted in the context of hypotheses, background knowledge, and implications for decisions and actions to be taken. Conclusions involve consideration of the method, the limitation of the experiment, and the background and contextual framework of the study. The central principle for all sensory evaluation is that the test method should be matched to the objectives of the test. Is the important question whether or not there is any difference at all among the products? If so, a discrimination test is indicated. Is the question one of whether consumers like the new product better than the previous version? A consumer acceptance test is needed. Do we need to know what attributes have changed in the sensory characteristics of the new product? Then, a descriptive analysis procedure is called for.

The statistical should correlate with the nature of the data. For discriminating tests, involving choices and counting numbers of correct responses, statistics derived from the binomial distribution or those designed for proportions such a chi-square are appropriate. Conversely, for most scaled data, we can apply the familiar parametric statistics appropriate to normally distributed and continuous data, such as means, standard definitions, t-test, analysis of variance etc.

General “difficulties” with published research on taste

Tasters, as measuring instruments, are quite variable over time, very variable among themselves, and very prone to bias; to account for these adequately requires that measurements be repeated, that enough subjects are made available so that verdicts are representative, and that the sensory analyst respects the many rules and pitfalls which govern panel attitudes. Subjects vary innately in sensitivity by a factor of 2 to 10 or more (Pangborn, 1981) and should not be interchanged halfway through a project. Subjects must be selected for sensitivity and must be trained and retrained until they fully understand the task at hand. The annals of sensory testing are replete with results which are unreliable because many of the panellists did not understand the questions and/or the terminology used in the test, did not recognize the flavour or texture parameters in the products, or did not feel comfortable with the mechanics of the test or the numerical expression used.

The following test errors or effects are ever-present when performing sensory studies and should be systematically excluded for data generation:

- Expectation Error

  This occurs when panellists are given too much information about the samples

- Stimulus Error

  This occurs when panellists are influenced by some characteristics of the sample (i.e.. size, shape, colour, etc)

- Suggestion Error

  This occurs when panellists are aware of reactions of others during the sensory evaluation

- Lack of Motivation

  Lack of motivation may be present among the panellists due to a number of reasons

- Central Tendency Error

  Panellists may choose the mid range to avoid extremes

- Order Effect

  This may affect the panellists if the sensory samples are provided in a defined order

By screening research reports with respect to comparative sensory characteristics of organic and conventional food it is remarkable that there is often a lack in the description how the studies have been performed.

For example, results from sensory tests can vary depending on whether or not the taste panellists are trained vs. untrained. Trained panellists typically provide more consistent and objective data than untrained tasters. Unfortunately, many studies often do not clearly explain whether panels are trained, and if so, how and of what degree.

Another factor that avoids drawing definitive conclusions is the incomplete specification of both the sensory techniques used (which tests, definition of terms, etc.) or the interpretation of results. As one example, reporting only that organic tomatoes had a higher "taste quality" as measured by a trained panel provides little useful information.

Furthermore, the kind of preparation and presentation of food influences the data interpretation enormously.

Rembialkowska reported that taste differences in one study were found in raw carrots but not when the carrots were cooked (Rembialkowska, 2000). In another study performed by Wszelaki a preference for organic potatoes disappeared when the cooked potato sections were peeled (Wszelaki et al., 2005).

There are many studies that suggest a better or at least equal keeping quality of organically grown produce. However, there are some cultivar and production parameters which make a direct comparison between organic and conventional food very difficult. An agriculturally valid study that reported inconsistent or not significant differences between organic and conventional fruits and vegetables found that taste was more dependent on the level of ripeness or maturity of the samples (Basker, 1992). Overall, he produced 460 assessments of 29 samples covering five organic and conventional fruits and four vegetables. In the end, he found no significant pattern of preference between organic and conventional products. However, after analysis, Basker discovered that the fruits and vegetables were not all at the same stage of ripeness, which might seriously affect their taste, and thus the results of the experiment (Basker 1992).

Typical differences between organic and convention products related to their ingredients make it difficult to come to common conclusion of such comparative studies. For example, very often non-organically grown vegetables contain more water than the organics variants. Thus, a dilution of the flavour could influence the sensory impression which comes along

with the fact that the levels of some aromatic compounds may be higher in organically grown produce.

In vegetables such as carrots, where high water content is preferred, organic vegetables may rate lower in preference tests.

It has also been shown that organic produce has sometimes a higher natural sugar content (Lampkin, 1990) which may be perceived as a better or worse taste, depending on the product.

It is also clear that plant genetics and farming practices can alter organoleptic quality, but it is difficult to isolate these impacts from those linked to soil quality, the weather, the overall health of the crop, and how and when a crop is harvested and handled (Bourn, 2002)

Test methods in sensory science and their application in comparison studies organics vs. conventional food products (modified with respect to Bourn 2002)

Three primary kinds of sensory tests focus on the existence of overall differences among products (discrimination test), specification of attributes (descriptive analysis), and measuring consumer likes and dislikes (affective or hedonic testing).

Discrimination studies

Valid discrimination techniques allow determinations of the presence of sensory differences, irrespective of the quality of that difference.

Ideally, such studies would be the first step in establishing whether consumers can distinguish organic from conventional foods, because until differences of any sort can be reliably shown, preference and descriptive studies might be considered premature. A small number of studies have opted to use discrimination methods, although their findings are mixed. Using similarity judgements, a group of 18 consumers (Oude, 1988) failed to discriminate between organic and conventional carrots. Using a trained panel, which performed a series of triangle tests, also failed to show a difference between organic and conventional spinach (Maga et al, 1976). In contrast, the group of Basker did find differences for spinach and grapes, but not for grapefruit and sweet corn (Basker, 1992). A study of several vegetables found a similar mixed pattern of results with organic/ conventional differences evident for beetroot and carrots, but not for curly kale (Hansen, 1981)

There are two important considerations, relating to whether differences are present or not, which have an impact on interpretations of the failure to find a pattern of results in such studies.

First, failure to find differences with one fruit or vegetable type or variety does not necessarily imply that such differences will not be found in studies of other types or varieties. This, of course, will make definitive generic conclusions regarding organic vs. conventional produce difficult to make until large numbers of studies have been undertaken.

Second, interpretations of one, or a few differences in the context of large numbers of comparisons, need to be made with consideration of the possibility that the positive findings are spurious.

Descriptive Analysis Studies

As with discrimination tests, those studies that have measured responses to specific sensory qualities have failed to produce consistent results, and in some cases produced results that are difficult to interpret. For example, although Weibel (Weibel et al., 1999) found that organic apples had a "higher sensory score" than apples from an "integrated farm", it is difficult to know what this means.

Another study, of Macintosh and Cortland apple varieties, had more clearly interpretable results, finding no differences for *juiciness*, *sweetness*, *tartness,* and *off flavor*, but concluding that "organically grown" Macintosh apples were more *firm*. (DeEll&Prange, 1992)

Three studies have compared the sensory properties of organic and conventional tomatoes. Porretta (Porretta, 1994) showed that a cluster analysis of "all parameters" (including results of chemical analysis) discriminated between organic and conventional tomatoes. Although the contribution of sensory characteristics to this process was not specified, it was noted that conventional products had better sensory characteristics, particularly with respect to *color* and *natural taste*. By contrast, Vogtmann et al. found that organic versions of two out of three tomato varieties had higher "taste quality", again, a conclusion that is difficult to interpret (Vogtmann et al., 1984). A clearer result was obtained by Johansson (Johansson et al. 1999) in which trained panels assessed organic and conventional tomatoes for a variety of different attributes. They found no differences in *acidity*, *sweetness*, and *bitterness*, but did find that organic tomatoes were less *firm*, less *juicy* and *redder*. This same group (Haglund et al. 1999) also compared organic and conventional carrots from two growing seasons. The results show little in the way of a consistent pattern. In

the first year, organic carrots had less *sweetness*, *crunchiness,* and *flavour*, but were *harder*. There were no differences in *aftertaste* and *bitterness*. In the second year, they were again *harder* and had less *flavor*, but more *aftertaste*. There were no differences for *sweetness*, *crunchiness* or *bitterness*.

Preference Studies

Is organic produce preferred to conventional produce? As with other types of sensory studies, the research on this issue does not provide an unambiguous answer. Using a consumer group, Schutz & Lorenz found no differences in ratings of liking between organic and conventional lettuce and green beans Schutz&Lorenz, 1976. On the other hand, organic broccoli was preferred, as were conventional carrots. Basker undertook preference tests with groups of consumers, finding that organic bananas were preferred, as were conventionally grown mangoes and juice from conventionally grown oranges. There were no differences in preference for grapefruit, grapes, corn, spinach, carrots, or tomatoes from the two sources despite, in the case of spinach and grapes, there being perceived differences (Basker, 1992). (A small panel (12 test persons) preferred the *color* and *texture* of conventional potatoes, but there were no differences in liking for *appearance* or *flavor*. With tomatoes, the panel showed a preference for the organic product on all of these sensory attributes (Svec et al., 1976). Using a much larger group of consumers, (Johansson et al. 1999) reported a preference for one organically grown tomato variety but the conventional version of another variety. Given a general failure to report consistent ability to discriminate the sensory properties of organic and conventional produce, it is not very surprising that studies of preference also fail to show a consistent pattern of results.

Taste, a major motivation factor for purchasing organic food?

According to the Food Standards Agency, "Consumers may choose to buy organic fruit, vegetables and meat because they believe them to be more nutritious than other food. However, numerous studies have found no proof that organic food offers greater nutritional values or more consumer safety.

Consumers of organically foods often believe that these products taste better than conventional produce. 43% of consumers of organic food give “better taste” as a major reason for purchasing organic fruits and vegetables (Theuer, 2006).

Kumpulainen reviewed the literature and found no taste difference in potatoes, lettuce, green beans, broccoli and spinach (Kumpulainen, 2001). He noted that most of the studies showing differences in flavour were studies of leafy vegetables. Bordeleau et al. reviewed sensory comparisons and earlier reviews of organic and conventional foods (Bordeleau et al., 2002). They concluded that, in general, there is no trend of better taste in organic fruits or vegetables. In vegetables such as carrots, where high water content is preferred, organic vegetables may rate lower in preference tests. Bourn and Prescott provide a detailed and extensive analysis of the sensory qualities of organically and conventionally grown food (Bourn & Prescott, 2002). After reciting the many issues with sensory evaluation techniques – discrimination tests, descriptive analysis techniques, and preference/acceptability measures – they concluded that there is yet to be convincing evidence that organic produce differs in sensory terms from conventional produce, let alone that there is any taste advantage. Tauscher et al. evaluated food produced by different methods and found a slight advantage for organically grown produce (Tauscher et al., 2003).

Many some studies revealed that the so called „halo effect“, a cognitive bias whereby information about one quality attribute of a product serves to influence and bias the judgment of its other qualities, is contributed to the clear studies outcome that labeling a food as “organic” increases the consumer acceptability of the food.

In two independent studies (Schutz & Lorenz, 1976; Johansson, 1999) the impact of information about growing method on consumer preferences for organic and conventional vegetables was investigated. In both studies, this information influenced acceptability, in that relative to these same foods unlabeled, products labeled as organic generally showed increases in measures of preference. Thus, both studies suggest that consumers have expectations regarding the superior taste of organic produce. It may be that this derives either from a rationalization of the higher cost of organic produce or a belief that chemical fertilizers are more likely to impart unacceptable sensory qualities. Important also in the effects of labels on food acceptability is the fact that consumers can bring their actual perceptions and preferences into line with such expectations (Deliza&McFie, 1996). Hence, such beliefs may be reinforced by repeated consumption of organic produce. One other reason for the popular belief in the flavour superiority of organic produce that should be considered here though is the possibility that organic produce might be consumed in a more optimal state of freshness. This could be due to any of the following reasons:

- 1. Some organic producers may be distributing primarily locally, rather than using more elaborate distribution systems;
- 2. There may be a greater emphasis on more natural forms of ripening, prior to harvest;
- 3. Organic farming may use different varieties of the same food than conventional farming.

At least in the case of the first two factors, even those systematic studies making well-controlled comparisons, may fail to take into account commonly used distribution and ripening practices.

There is no study available which brings clearly face to face the influence of the „halo effect“and taste properties in consumer's statement that organic food tastes better than conventional food. It is reported that in organic fruits and vegetables one substance group is responsible for the generation of the unique flavour of certain fruits. There is talk of specific phenolic compounds. It is known that the levels of these compounds are higher in organic fruits and vegetables than in conventional ones (Benbrook, 2005). Plants create phenolic compounds mainly to make tissues less attractive to herbivores, insects, and other predators. Some phenolic compounds actually taste bad (Drewnowski&Gomez-Carneros, 2000; Lesschaeve&Noble, 2005). The bitter taste and the tactile sensation of astringency in tea, cider, red wine, and chocolate are caused primarily by the flavonoid phenolics, including flavanols and flavonols (Lesschaeve & Noble, 2005).

Accordingly, it is important to sort out if higher levels of phenolic compounds affect the taste of organic fruits and vegetables when compared to conventionally grown produce.

Organic and conventional agricultural practices and their influence on sensory properties

Among the claims made about organic growing methods is that they produce more flavourful ("better tasting") fruits and vegetables. A number of studies comparing organic and conventional production methods have included sensory tests of one form or another along with chemical, agricultural, or nutritional analyses. These studies suffer from utilizing a variety of meanings (sometimes unspecified) of "organic" as well as study designs that differ in their suitability to make the appropriate comparisons.

The review of many studies revealed the problematic to select truly matched-pairs of organic and conventionally farmed fields where the differences in organoleptic food quality

can be attributed solely to the unique characteristics of organic production. . Cultivation tests try to determine whether there is a linkage between a given farming practice and one or more organoleptic qualities.

Most published surveys of this type provide limited information on soils, climate, and farming systems and the accuracy of reported information typically cannot be verified.

In such studies, scientists usually alter only one variable at a time, in the hope that such a study design will make it possible to isolate specific linkages. Even when weather and soil type are properly matched, other differences may exist, such as plant genetics, the effectiveness of irrigation practices, and harvest timing (Woese et al.,1997).

In addition, different situations and different production seasons can require different practices. Different practices can have specific effects on food quality. Likewise, conventional management practices also have evolved over the years, and continue to do so, and include more and more sustainable and eco-friendly practices. Experience and skill levels also matter greatly on conventional farms.

Woese et al. published an extensive literature review for the German Federal Institute for Consumer Health Protection and Veterinary Medicine in which they summarized and evaluated the results from more than 150 investigations comparing the quality of conventionally and organically produced food, or of foods produced with the aid of different fertilization systems (Woese et al., 1995). Most of the studies evaluated were investigations of concentrations of desirable and undesirable ingredients, pesticide residues, and contaminants, sensory analyses, and feed experiments with animals. Nutritional studies in humans were reviewed, as were novel, holistic methods of analysis (for example, the ascending-imaging method, copper chloride crystallization and ultraweak photon emissions; these methods are not generally used or understood by U.S. scientists). Despite great variability in the types of studies reviewed, some quality differences in food produced using conventional and organic farming methods were identified (Woese et al., 1997). These quality differences include a lower protein content in organic wheat, leading to an undesirable impact on baking quality; a desirable trend toward higher Vitamin C and lower nitrate values in organic potatoes related to use of manure rather than mineral fertilization; much lower nitrate levels in organic leaf, root, and tuber vegetables; and higher dry matter and a trend toward slightly more Vitamin C, particularly in leaf vegetables (lettuce, cabbage, spinach, and chard). There was no clear trend in sensory properties between organic and conventional vegetables. Many studies have found

that lower yields, better taste, more VitaminC, and higher antioxidant levels in organic fruits and vegetables are correlated with lower levels of readily available nitrogen.

Nitrogen economy

A major focus on many organic farms is increasing the supply of nitrogen for crops, in order to narrow the differences in yields between conventional and organic production systems.

Organic cultivation is a low-nitrogen input system. This probably is responsible for the generally lower yields of organically cultivated produce, even by technically capable organic farm managers. For example, organic citrus cultivation is expanding in Corsica, but yields can be 50% less than under traditional cultivation. Berghman et al. found that the low yields were related to inadequate nitrogen assimilation by roots from plant compost (Berghman et al., 1999). To achieve satisfactory yields it was necessary to use two complementary nitrogen source products: seabird guano rich in soluble nitrogen and castor oil cake rich in organic carbon.

These workers established that providing more nitrogen, and more timely applications of nitrogen, increased total leaf nitrogen levels and yields of organic citrus trees to the normal range observed on conventional farms. It is established that high levels of nitrogen fertilizer applied in conventional cultivation of apples can have negative effects on fruit color and storage quality (Saitoh, 1995). Increasing the application rates of nitrogen by using more composted manure in organic cultivation has been shown to better meet the nitrogen demands of organic corn and tomato crops, and also to increase yields (Poudel et al., 2002).

Several researchers have concluded that maturity at harvest and storage methods generally trump production systems with respect to organoleptic quality

Organic management involves diverse practices applied as specific solutions to specific on-farm problems. “Cultivation studies” are the tool to study the impact of these practices. Evaluations of specific organic management practices should include measurement of tissue nitrate levels and organoleptic quality, including product firmness and taste testing. Regular periodic assessments can provide useful public information about trends in quality. Survey research, where neighboring farms or experimental plots are compared, should assess alternate organic or conventional practices, in order to reduce the number of variables impacting study results. For example, Lombardia-Boccia studied the influence of different agronomic practices on yellow plums grown conventionally and organically on the same farm

(Lombardi-Boccia et al., 2004). The conventional plums were grown on tilled soil. Three organic cultivations were performed: tilled soil, soil covered with trifolium (clover), and soil covered with natural meadow. Ascorbic acid, alpha-, gammatocopherols, and beta-carotene levels were higher in organic plums grown on soil covered with natural meadow. Carbonaro et al. studied peaches and pears organically grown on three different ground covers: subterranean clover, spontaneous weed cover, or tilled soil (Carbonaro and Mattera, 2001; Carbonaro et al., 2002). Conventional peaches and pears were produced on tilled ground. All organic peach samples showed a highly significant increase in polyphenols compared with conventional peaches, while, of the three organic pear samples, the weed cover and tilled samples displayed an increased polyphenol content with respect to the conventionally grown sample. None of these studies included organoleptic testing. The vast majority of research on the impact of harvest timing and storage technology on organoleptic food quality has been conducted with conventional foods. Research is needed to develop practices to enhance the organoleptic quality of organic fruit and vegetable crops at harvest.

The simplest statement would be that there is yet to be convincing evidence that organic produce differs in sensory terms from conventional produce, let alone that there is some taste advantage. However, as noted earlier, without considerably more well-controlled research, it cannot be proposed that such differences may not be apparent for some foods under some growing conditions. In reviewing those studies that dealt with the sensory aspects of organically grown foods, the authors note that there was no clear evidence for sensory differences between organic and conventional versions of potatoes, vegetable or vegetable products, or apples. They did note “greater fluctuations.... in quality characteristics” (p. 256) for bread produced with organically grown grain, although they suggested that this might be due to different baking methods or recipes. The review also examined studies that compared produce from animals that had been fed organically grown feed to those conventionally fed. These products included milk and dairy products, meats, eggs, and honey. In none of the studies reviewed was there evidence for differences in the sensory properties of products associated with organic and conventional growing methods.

Selected product related comparison studies and their results

Apples

Postharvest quality and sensory attributes of organically and conventionally Grown Apples

Postharvest quality and sensory attributes of organically and conventionally grown „McIntosh“ and „Cortland“ apples stored at 3°C in ambient air or in controlled atmosphere were evaluated. The percentages of marketable apples remaining after four and eight month's storage were higher for none organically grown apples than organically grown apples (mainly dependent on external appearances and linked by the authors to fungicide use by the non-organic orchards). No significant differences due to production methods were found for core browning or weight loss in storage. However, senescent breakdown, 'the browning and softening of apple flesh beginning immediately under the skin associated with ageing and advanced maturity', tended to be less in the organically grown than the non-organically grown apples. Organically grown „McIntosh“ were perceived by sensory panellists as firmer than conventionally grown „MC Instosh“at harvest but not after storage. No significant differences were perceived in juiciness, sweetness, tartness, and off-flavour of apples at harvest or after storage (DeEll & Prange, 1992).

Are organically grown apples tastier and healthier?

Golden Delicious apples were analyzed from five pairs of a biologic (organic) and a neighbouring integrated fruit farm in Switzerland. Organic orchards were less than a kilometre away from the matched conventional orchard. No other details of production are described. Organic apples had significantly firmer fruit flesh (14% at harvest; 12% higher after 40-43 days of cold storage) and 19% higher phenolic content (mainly flavanols) than integrated apples. Trained taste panelists gave organic apples 15% higher taste marks (Weibel et al ,2000).

Effects of organic and conventional growth management on apple fruit quality at harvest

The quality of organically and conventionally grown Fuji and Golden Delicious apples in Lleida, Spain were compared. No details on the farms or management practices were disclosed. Golden Delicious apples were harvested at two different dates and the differences in total antioxidant activity were determined at harvest and related to the changes in color, firmness, acidity and soluble solids content (SSC). No differences in antioxidant activity were found between organic and nonorganic Golden Delicious apples at harvest. However,

significant differences in quality were found. Organic Fuji apples showed a significant increase in firmness, acidity, SSC, and were brighter and more yellow based on the readings from a HunterLab Colormeter. Organically grown Golden Delicious apples exhibited the same increases but only when the fruit were picked at a more mature stage (2nd harvest date). At both harvest dates, organic Golden Delicious apples were significantly less mature (lower starch index) than conventional Golden Delicious, but organic and conventional Fuji apples did not differ in terms of maturity. Collectively these results showed that organic management may delay on-tree fruit ripening and also improve fruit eating quality (Reig et al., 2006).

The Effect of Growing System on the Storability of Apple

Four apple cultivars were grown in experimental organic or integrated orchards at Debrecen University in Hungary. Acoustic stiffness (a non-destructive measure of firmness) was used to measure the same apples before and after six months of cold storage. There were no significant differences between the growing systems. The Liberty cultivar, a scab-resistant cultivar popular for organic orchards, had the least change in firmness during storage (Róth et al., 2004).

The postharvest quality of integrated and organically produced apple fruit

It has been examined whether there was a difference in the quality (texture, taste, flavour) and post-harvest behaviour of apples from integrated versus organic orchards in three different regions of Belgium. In each region organic and integrated orchards had the same climatic and soil capabilities. Apples were harvested at the end of September in 2004 and stored in air and also under ULO (ultralow oxygen) conditions (1% O2, 2.5 % CO2) for 6 months. Acoustic stiffness (firmness), soluble solids content, acid content, sugar content and the aroma profile were studied. Quality parameters were analyzed immediately after harvest and after storage. At both times an additional shelf-life experiment (14 days) was carried out, simulating retail store conditions. There was a considerable softening during storage in air and a reduction in shelf-life, but not under controlled atmosphere conditions. Apples coming from different regions and different production systems did not differ in the studied parameters. Freshly harvested apples had high malic acid, quinic acid, and sucrose contents and were clearly different from stored apples that had high glucose and citric acid contents. Fresh apples had a different aroma profile compared with apples that had been on the shelf for 14 days, except for air-stored apples immediately after storage. The volatile compound responsible for the typical apple aroma, (2-methylbutyl-acetate), had the highest relative abundance at harvest,

after shelflife and storage in air. The authors concluded that the effect of storage condition is much greater than that of the production systems on the quality of apples. (Róth et al., 2006).

Sustainability of three apple production systems

Organic management yielded sweeter and less tart Golden Delicious apples in Washington State compared with conventional and integrated systems. The apples were grown in four replicate plots for each management system in a randomized complete block design (Reganold et al., 2001).

Orchard productivity and apple fruit quality of organic, conventional, and integrated farm management systems

Peck studied Gala apples grown during the ninth and tenth growing seasons under organic, integrated, or conventional management in the Yakima Valley of Washington State. Organic apples had 6- 10 Newtons (N) units higher flesh firmness than conventional apples, and 4-7 N units higher firmness than integrated apples. Additionally, consumers consistently rated organic apples to be firmer and to have better textural properties. Few consistent results were found for fruit flavor as measured by soluble solids concentration or titratable acidity, and this was also reflected in consumer panels. These Gala apples were slightly smaller in some years but were as firm, or firmer, and had consistently superior storability compared to conventionally grown apples. After six months of controlled atmosphere storage, only 10% of the organic apples failed to meet the minimum firmness standard, compared to 36% of conventional management apples and 54% of integrated management apples (Peck, 2004, 2006).

A comparison of organic and conventional fruits and vegetables

Bordeleau et al. compared specific internal and external quality parameters for organic and conventional Golden Delicious apples purchased in shops in Denmark. The conventional apples were 24% bigger, averaging 156.5 mL in volume compared to 126.7 mL for the organic apples. Soluble solids (sugars, Brix) and acid levels did not differ significantly but the ratio of Brix to acid was slightly higher in the organic apples. There was no difference in flesh firmness in this market survey. (Bordeleau et al., 2002).

Sensory and health-related fruit quality of organic apples. A comparative field study over three years using conventional and holistic methods to assess fruit quality

In a 3 years lasting field study with the 'Golden Delicious' cultivar, fruits of 5 pairs of organic/integrated fruit farms were compared. The orchards were similar in microclimate, soil conditions and planting system. The most significant differences were found in year one of the study, and were by tendency confirmed in the following two years. In year one all fruit samples of organic orchards had significantly firmer fruit flesh (14%), a 10 % higher index of inner quality (on basis of sugar and malic acid content and fruit flesh firmness), and 15% higher taste scores than conventional ones. Phosphorus content of the fruit flesh was 31% higher in organic apples and closely correlated with the index of inner quality and sensory score. Phosphorus in the fruit flesh correlated with the microbial activity of the soil expressed as the ratio of microbial-bound Nitrogen and Carbon in the soil. With a value of 3.85 the C_{mic}:N_{mic} ratio was 44.5 % lower (thus more favourable) in organic tree strips. Flavanols, with 65.7 % of the total polyphenol content were the dominant group of polyphenols. The content of flavonols was 22.7 % higher in organic apples in the first year and 15.6 % in the average of the three years. The self-degradation test didn't provide significant differences. Laboratory rats, showed a tendency to prefer IP apples probably due to their advanced ripeness. Thus rat behaviour did not correspond with the sensory panel judgement. The picture forming method provided a correct reproducibility with repeated blind samples before and after storage, and distinguished 100 % correctly organic an IP fruit in the first year. In the second year there was one miss qualification. The average value over three dates of the index for «vitality quality», which was especially created for this study, was 44.6 % higher with organic apples The picture forming methods correlated well with sensory scores and standard quality in the first year. (Weibel et al ,2004)

Strawberries

Organically and Conventionally Grown Strawberries

Ecologically cultivated strawberries and conventionally cultivated strawberries were grown in adjacent plots in Spain under identical environmental conditions (Cayuela et al., 1997). The conventional plots had a 76% greater yield. The ecologically grown fruit had superior quality to the conventionally grown fruit, showing a more intense color, higher sugar and dry matter contents, and better organoleptic characteristics. Ecologically grown fruits had a higher resistance to deterioration during simulated marketing conditions, and thus better

keeping quality. Organic strawberries grown in California were slightly smaller but sweeter, better-looking, and preferred by consumers compared to conventionally grown strawberries. (Andrews and Reganold, 2006).

Potatoes

Potatoes were among the earliest organically produced vegetables subjected to comparative evaluation. Of 22 published studies that evaluated the nutritional value and/or sensory properties of potatoes from conventional and organic cultivation, or from different fertilization systems, only six compared the sensory qualities of potatoes using trained panelists. Some sensory differences were noted between different kinds of potatoes but no clear statements could be made on the whole in favor of one kind of cultivation or another (Woese et al., 1997).

The most recently published comparative sensory testing of organic and conventional potatoes does not improve our understanding of the relative taste of organic potatoes. In research at Ohio State University, triangle tests were used to determine if taste panellists could distinguish cooked wedges of potatoes grown organically, either with or without compost, and conventionally (Wszelaki et al., 2005). When the skin remained on the potatoes, panellists detected differences between conventional potatoes and organic potatoes, regardless of soil treatment. However, they did not distinguish between organic treatments with or without compost when samples contained skin, or between any treatments if wedges were peeled prior to preparation and presentation.

The quality of plant products under conventional and bio-dynamic management

Organically grown potatoes had 29 per cent lower storage losses than non-organically grown potatoes (14.9 versus 20.9 per cent respectively) (Dlouhy, 1981)

Product quality and fertilization - minerally, organically,biological-dynamically (translated from the German title)

Forced-storage degradation tests on carrots, beetroots and potatoes indicated better product quality from lower fertilisation levels or organic fertilisation than non-organic fertilisation, while under optimal storage conditions only small differences occurred (Abele, 1987)

Organically grown potatoes had better storage qualities (percentage dry matter loss and darkening) than non-organically grown potatoes, while storage qualities of organically and

non-organically grown beetroots were inconsistent (similar percentage dry matter loss but less spoilage losses for non-organically grown beetroot: four per cent compared to 13–19 per cent for organic). (Raupp, 1997)

Long-term field experiment in Sweden: Effects of organic and inorganic fertilizers on soil fertility and crop quality

Organically grown potatoes suffered 15 per cent fewer storage losses (due to respiration and fungal damage) than the non-organically grown potatoes (averaged 22.7 vs. 26.7 per cent respectively) (Granstedt & Kjellenberg, 1997)

Carrots

Enhanced food quality: effects of composts on the quality of plant foods

Organically grown carrots and cabbage performed better in storage (measured by dry matter losses, colour, appearance, fungal growth, maintenance of structure, smell) than non-organically grown carrots and cabbage. Vogtmann et al (1993)

Tomatoes

Postharvest quality of tomatoes produced in organic and conventional production systems

Organic and conventional tomatoes grown in Florida in December 2003 and January 2005 were harvested at the breaker stage and ripened at 20ºC. When tomatoes were determined to be fully ripe by visual inspection, samples were collected for quality analyses (color, firmness, total soluble solids, pH and total acidity). In each year, no significant differences in color or total soluble solids were detected between treatments. In 2003, total acidity was the only quality parameter that differed significantly (0.40% vs. 0.44% total acidity) between conventional and organic fruit, respectivey. In 2005, conventional tomatoes had significantly higher soluble solids (4.4 vs. 4.0 °Brix) and were firmer (2.5 mm vs. 3.4 mm deformation) than organic fruit. Sensory evaluation (duo-trio test with balanced reference) was conducted in 2005 to determine whether consumers could perceive a difference between tomatoes grown conventionally or organically. Panelists could perceive a difference between conventional and organic tomatoes by smell or taste with high reliability ($P<0.001$). Organic tomatoes were perceived by some of the panelist to be softer, and were preferredbecause of their taste, flavor, texture and juiciness. Alternatively, conventional tomatoes were described as “not as ripe”, “dry”, and having “less aroma”

Nitrogen form affects yield and taste of tomatoes

Heeb et al. compared conventional tomatoes fertilizedwith varying ratios of nitrate and ammonium nitrogen with organically grown tomatoes fertilized with manure or grass and clover mulch. Significantly higher scores were achieved for sweetness, acidity, flavor, and acceptance for the tomatoes grown with the organic or the ammonium-dominated treatments compared with the tomatoes grown with the nitratedominated nutrient solution. They suggest that tomato plants supplied with reduced nitrogen levels, or slower-release forms such as ammonium or organic nitrogen have improved tomato fruit taste (Heeb et al., 2005).

Impact of organic and inorganic fertilizers on yield, taste, and nutritional quality of tomatoes

In a greenhouse experiment, tomato plants were grown in sand culture to test whether different fertilization regimes (mineral or organic fertilizers) at *low* (500 mg N plant–1 week–1) and *high* (750 mg N plant–1 week–1) nitrogen levels´affected yield, nutritional quality, and taste of the fruits. In the mineral-fertilizer treatments, nitrate- or ammonium-dominated nutrient solutions were used. Organic fertilizer was supplied as fresh cut grass-clover mulch (a total of 2.4 kg and 3.6 kg were given per plant at low and high N level, respectively) without (*orgN*) and with additional sulfur fertilization (*orgN+S*). Yields of red tomatoes from the organically fertilized plants were significantly lower (1.3–1.8 kg plant–1) than yields from plants that received mineral fertilizer (2.2–2.8 kg plant–1). At the final harvest, yields of green tomatoes in the organic treatment with extra sulfur were similar (1.1–1.2 kg plant–1) to the NO_ 3 -dominated treatments at both nutrient levels and the NH_ 4 -dominated treatment at high nutrient level. Organic fertilizers released nutrients more slowly than mineral fertilizers, resulting in decreased S and P concentrations in the leaves, which limited growth and yield in the *orgN* treatments. Analysis of tomato fruits and plants as well as taste-test results gave no conclusive answer on the relationship between sugar or acid contents in the fruits, macronutrient content of plant leaves and fruits, and perceived taste. Sugar contents were higher in the fruits given mineral fertilizer, whereas acid contents were higher in the fruits given organic fertilizer. Preference in taste was given to the tomatoes from plants fertilized with the nitrate-dominated nutrient solution and to those given organic fertilizer with extra sulfur. Thus, a reduction in growth, which was expected to lead to a higher concentration of compounds like sugars and acids, did not result in better taste. Overall, it can be concluded that an appropriate nutrient supply is crucial to reach high yields and good taste. (Heeb, 2006)

A comparison of caotenoid content and total antioxidant activity in catsup from severla commercial sources in the United States

Organic catsups contained significantly more of the carotenoid lycopene than conventional catsups. The authors concluded that organic catsups could typically be distinguished from conventional catsups by comparing the deepness of the catsups' red color. No information was provided on the tomato cultivars used to make the catsups. Different tomato cultivars can have different lycopene levels. (Ishida and Chapman, 2004).

Juice/Milk

UHT orange juice (14 different products) was chosen as an initial test product. Of the 14 orange juices, three were organic, one was premium (pressé) organic, one was premium (pressé), six were standard quality, and three were economy products. Results from the descriptive sensory analysis showed strong evidence supporting the claim that organic UHT orange juice tastes different from conventional UHT orange juice. There is also evidence indicating that there is a perceivable difference between all product categories – premium (pressé) products being very different, and also economy products being perceived as different from most standard quality products. In a next step a consumer hall test was carried out with 301 consumers, tasting eight of the original 14 orange juices which show that organic products were significantly preferred to conventional products. Separately, twelve milks were assessed – five organic and seven standard quality. The study revealed that the organic products were not separated from the conventional products on the basis of any particular sensory characteristics, so there was no evidence supporting the claim that organic pasteurised whole milk tastes different from conventional pasteurised whole milk (*Fillion, L. & Arazi, S.* (2002).

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