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Health-Functional Foods in Foodwebs

Developing Products in Food Specific Networks

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Health-Functional Foods in Foodwebs

Developing Products in Food Specific Networks

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Abstract. A new category of health-promoting foods has emerged on food markets. This study examines the background of the development of the products that belong to this category. It aims for a more holistic view to the subject area than what has been typical in the previous studies. The key framework used in the study, the foodweb, is based on the model of industrial networks. The model is adapted for the purposes of this study.

The study has an empirical basis. Product related cases are examined. These five Finnish cases are: Benecol, Hyla, LGG, Xylitol, and Yosa. The study is mainly based on findings made from these cases. Some aspects of the international markets are also brought up.

It was found that this new food product category has brought with it many new questions that previously have not been of major significance in the food context. The basic characteristics of foods and the relationships of health-promoting foods with other product categories were examined under a new framework for foods: body-centred foods. It was observed that foods are linked to different body linked purposes under which foods can be functional. Health-functionality is one of the respective functionalities.

Empirical development processes described using the foodweb as conceptual framework showed the interdependency of the development process from many activities, actors, and resources that usually cannot be captured if the development is viewed from a single organisation point of view. It also seemed that development of these products is a multi-layered process of many concurrent and sequential interactions.

There are many obstacles within food system that hinder the development processes of these specific foods. There are many unresolved questions and questions that have not yet explicitly been asked that have to be encountered before it is relevant to expect goal oriented smooth development processes for health-functional foods.

Keywords: functional foods, new foods, food and health, food product development, product cases, industrial networks, food economics, food markets, food marketing

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1. Introduction

1.1. Health-promoting foods – a new research approach is needed

A new category of health-promoting[1] foods has emerged on food markets[2]. Even though it can be said that all foods promote health, the market segment is characterised by a more specific orientation to health subjects than has been typical in food context. It has been cautiously[3] estimated that the market value of this category would in Europe be US$ 2.5-3.3 billion by the year 2003 (Hilliam 1998). When divided by the population of the EU countries (~ 300 millions), it would mean that by that time every European consumer would spend approximately 8-11 euros yearly on these specific foodstuffs. This would still be a small share of the total per capita expenditure on foods.

What characterises these new products? They could be considered as high-technology products because often there are links to new technologies. However, technology, even in its broadest sense, would probably give a wrong image of the product group as a whole. It is not the technology but the effect of foods on bodily health that matters. If a simple label would be needed as a sign of the modernity of these foods, it could be something like high-health foods.

What is the research base of the new growing market segment? Most of the scientific research concerning these foods has taken place within the natural and technological sciences. In Finland alone scientific research in this area is being done in several institutions and a considerable amount of resources are being allocated to the research. Much less resources are being used to study the new market segment within the sciences of applied economics and management.

There is an economics and management based study field that has a specific focus on foods. It consists of subjects such as food economics, food business, food (industry or service) management, and food marketing. Even within this area of research there are not many studies concerning the new market segment. There are a few studies where production point of view has been chosen (e.g. Göransson and Kuiper 1997). In most studies concerning the phenomenon a consumer point of view is the dominant one (e.g. Poulsen 1999, Morten and Beckman 1998). A more holistic view to the subject area is missing.

Another gap in the current research is evident as an attempt is made to position the health-promoting foodstuffs within foods in general. It concerns the essence of foodstuffs themselves. There are studies that describe the emergence of traditional foods from a historical point of view (see e.g. Mennell 1986) or foods from a nutrition policy point of view (e.g. Mennell et all 1992). There is however no such a framework that would make it possible to position the new health-promoting foodstuffs within the context of modern foods. Food-as-a-commodity approach or from-medicines-to-foods -dimension are not very helpful in this respect.

Besides foodstuffs themselves, another question concerns the context of these new foods. How should they be described and conceptualised? This is an important subject because it is difficult to understand these new products if they are isolated from their context.

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[1] Health-promotion means here a specific positive effect of a foodstuff on health of a human body
[2] Food markets refer to the price-valued exchanges of foodstuffs in general.
[3] Harkki & Miller (1997) estimated US$ 3-10 billion by the year 2001.

Given the background of the study, it would appear natural to assume that foodstuffs are considered as products on markets. This was an approach used in the beginning of the introduction as estimates were given concerning the expected price-values of products on the markets in the near future.

However, there are reasons why a market approach may not be the best alternative. In the following a very narrow and simplified picture of the relationship between a product and a market is given. It is assumed that it corresponds sufficiently to a general idea of markets. The problem here is that although the same concept –market- is used, the content given to them varies in different disciplines. Markets in economics[4] has not necessary the same content as markets, for example, in marketing science.

A common starting point for markets in economics is to assume that products already exist. Values and respective volumes of products are emphasised. Given a certain price an optimal product volume can be determined. The development of products is not an issue compared to these. If exchange phenomena is at the forefront in marketing science, the relationship aspects are emphasised (see e.g. Easton and Araujo 1994, Houston and Gassenheimer 1987, Bagozzi 1975). This can be interpreted to mean that products are simply caused by relationships. As soon as there are relationships there are also products. Products do not have any independent role and the development of products is subordinate to the development of relationships.

In case of health-promoting foodstuffs the situation is different. There are exchangeable products not only on a limited scale but also on a limited scope. There are, however, expectations of utilities of future products. This means that product development aspects are emphasised. Products are not hidden in general relationships but there are special relationships based on these expectations. Both the above mentioned starting points do not adequately take these aspects into consideration. They emphasise other aspects than those that are important in development of health-promoting foods.

There is also a question of who are the relevant actors in markets. According to one widely respected view market products are bundles of attributes (Lancaster 1966). Those bundles are typically linked to two types of actors in the markets: firms and consumers. The role of a firm has traditionally being emphasised. A firm is an interpreter of consumer needs and actually a maker of a product. The development of a product in turn takes place inside a firm before it is launched to markets.

A different approach is to consider products as services. In that case both a firm and a customer concurrently develop and make the product (see e.g. Glynn and Lehtinen 1995, Grönroos 1990). From the traditional exchange point of view it either means that there are no market partners until an exchange takes place or that there are many exchanges (and market partners) and a product emerges gradually. In the former case the development of a product does not take place in markets. In the latter case the assumption of a single product corresponding to a single exchange is not valid as a service product consists of several marginal products.

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[4] " A **market** is an arrangement by which buyers and sellers of a commodity interact to determine its price and quantity." (Samuelsson 1989,39)

What is typical both in traditional and service market approaches is that the producer-consumer axis is emphasised. In the case of health-promoting foodstuffs it is however not necessary realistic to assume that this dyad can decide all the characteristics of a product. If product development is for example based on many separate exchanges between a producer and a customer it could also be thought that in-between these exchanges there are exchanges with other actors that are of relevance from a development point of view.

There is also a question related to positions of actors in markets. In imperfect markets it can be assumed that there is a market space where actors locate on vertical and horizontal dimensions. Horizontal positions could be linked to product substitution and vertical positions to value differences in products. As the interest is especially in the development of a product, vertical dimension is of special interest. It can be assumed that there is a vertical chain linked to a certain product in which different actors perform different tasks that add to the market value of a product. This chain can be called a value chain of a product.

There is a special model, called the food chain, that has been used as a descriptive framework in food systems (see e.g. Street 1990, Spedding 1989). The idea of a food chain has close relationship with vertical market relationships. Vertical arrangements are basically the business arrangements between buyers and sellers. These relationships are often said to be between upstream parties, such as the original producers of goods, and downstream parties, meaning final users or distributors (Azzam and Pagoulatos 1999). The food chain can also be linked to the idea of a supply chain, which is a term used very often in technological contexts (see e.g. King and Phumpiu 1996).

The basic simple food chain (Figure 1) can be considered to be a representation of a product based view as a product has an important role in it even though it is not a part of the explicit structure. To a large extent the product defines the links and relationships between actors. It can be said that the food chain is a specific food product based governance form.

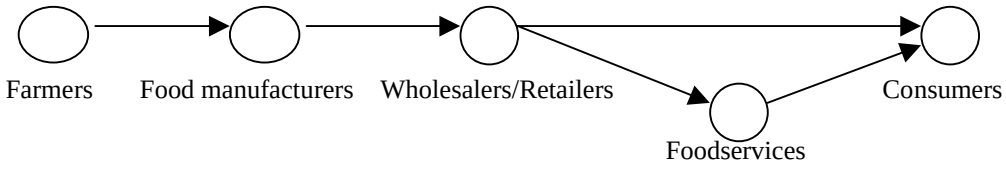

Figure 1. The traditional basic food chain

What makes a food chain different from a value chain of a product is that a food chain is based on technical changes taking place in a food product as all the actors in the food chain are specialised to certain technologically differentiable operations. In the market context it is the change in market value that is of importance. When it comes to the development of health-promoting foods it is realistic to assume that both market value and technological aspects direct product development. Simple market value can not capture all the development aspects.

The food chain model has weaknesses when it comes to the description of the development of health-promotional foodstuffs. There are at least two issues. Firstly, to what extent it is valid to link the development of products to such a predetermined order of influence by certain actors as the food chain model describes? Are all these actors influential only at one single phase as the products are being developed? Secondly, for the health-promoting foodstuffs it is also questionable whether the above mentioned actors are the only important ones. It would seem more reasonable to assume that it is difficult to anticipate who are the actors and in which order they contribute to the development of a product. The more turbulent and changing is the food context the more there are uncertainties. In such a situation it is not realistic to fix these variables in advance.

What has been typical in food context is that the depth of product development process has not typically been very deep, if deepness is measured by the extent of how much foods are altered in a material sense. In most cases product development has meant only small incremental changes. Changes have commonly taken place within those characteristics of a product that can be linked to the variability seeking behaviour of consumers (see e.g. Kujala 1994). This tendency to incremental development is also evident as the product development process in food context is described (see e.g. Graf and Saguy 1991). In general product development is described as taking place on a relatively short-term basis in a context dominated by a single organisation (see e.g. Urban et.al. 1987). This is typical even in those cases where the multifunctional approach is emphasised (see e.g. Jones 1997). There are some studies where a more long-term perspective on product development is prevalent (see e.g. Utterback and Abernathy 1975, Lindman 1997).

When product development is linked to more radical changes the situation is different. There are reasons to expect that for health-promoting foods in many cases it is a matter of more innovative products [5]. In such cases it is not relevant to focus only on direct producer-consumer relationships. There are probably also other parties involved. This is not contrary to the view that it is ultimately consumers who decide whether a development process is successful. It means that direct consumer influence does not extend over the whole development process. It is also relevant to assume that the early stages in the development of such a food product are important because they will to large extent establish the basis for a consumer product.

Especially in case of more radical changes the development process can be thought to initially take place between few key actors. In this sense the situation is actually closer to a situation where a small amount of independent partners interact together than to a situation where there is a single organisation and a large number of individual consumers. It is also probable that the former contains links that are typical for industrial and inter-organisational relations.

An environment where the traditional firm-consumer based view is a too limited cluster type of an approach has also been used. Clusters contain elements (e.g. non-profit organisations, knowledge as resource) that have not traditionally been included in market types of frameworks. Clusters have typically a strong national or geographical basis (see e.g. Porter 1998). Usually they are used to describe very general potentialities. They have not usually been applied to specific product contexts and their analytical structure is not usually very well suited to that.

[5] Something that is innovative introduces changes and new ideas in the way things are done or made (English Language Dictionary 1987)

Based on the different aspects mentioned above it can be concluded that all the treated frameworks seem to have deficiencies when used in description of development of health-promotional foodstuffs. In search of a new framework a relatively new industrial networks[6] based approach was found. Use of network structure and processes as a conceptual framework has became popular in studies of industrial markets (see e.g. Backhaus and Büschken 1997, Möller and Wilson 1995, 605). The relationship between the network approach and the traditional industrial market approach could be described as complementary and not substitutive.

The network based approach is promising as different aspects of the context of health-promotional foods are taken into consideration. Industrial networks are linked to the market context but without the often very demanding assumptions of the more traditional market approaches. It can be thought that in the network context also the development of a product and not only the exchange of a product are of significance. Networks also use a multi-actor perspective, which is not limited to chain-of-actors types of constellations.

The framework that is used to describe the food context could be called food networks. However, in this study there is more emphasis on the context – specific food context - of the network than on the network itself. It is thought that the use of a web as a central concept would better reflect this aspect. For these reasons the framework which is used to describe the context of health-promotional foodstuffs is generally called a foodweb.

1.2. Objectives and the scope of the research

It is assumed that health-promotional foods have brought with them problems and questions, concerning the development of food products, which go beyond those in traditional food product development. This has implications in the determination of the objectives and the scope of the research. There is a need to go deeper into problems than has been typical in the food development context and also to explore the subject from a more holistic perspective.

1.2.1. Research objectives

The objectives of the study are:

** to position health-promoting foods within foods in general*
** to describe the empirical development process of health-promoting foods using the foodweb as a conceptual framework*
** to increase understanding of the underlying problems in the development process, specifically of those which are new in the food development context.*
** to explore the properties of the foodweb in the context of health-promoting foods.*

[6] ”Networks” have meant exchange relations, in which a change in one relation affects other relations.

These objectives lead to a set of questions that need to be answered:

1. How do health-promoting foods relate to other foods?
In this study health-promoting foods and the context from which they emerge are a key starting point. There is a need for evaluation of foods to the extent that health-promoting foodstuffs can conceptually be positioned in relation to other foods

2. What are the properties of a foodweb as a holistic development framework?
The foodweb as a framework is based on the model of industrial networks. It is adjusted in order to make possible an analytical approach in which the emphasis is on development of food products. Development is not restricted to the traditional prior to the market phase but is assumed to continue as the products enter the markets. A foodweb is more than just a metaphor but less than a parametric or ideal model. The empirical fit of the framework is considered to be more important than the theoretical coherence within the framework itself.

3. What kind of special problems are countered as development of health-promotional foods takes place in empirical context? It is expected that the special nature of these products cause problems that are new in the food development context.

4. What kind of initial generalisations concerning the respective foodweb can be made based on empirical findings? There are not many studies concerning the development process of health-promoting foods. It is expected that empirical findings can lead to initial generalisations concerning the foodweb in general.

1.2.2. Scope of the study

Food phenomena are very complex and linked to different kinds of questions. This is even more so when it comes to a new context integrated by health-promotional foods. In this study a broad perspective is chosen when it comes to the background of foods. References are made to research done in many areas both in the social and natural sciences.

Industrial networks create a basis for the framework of foodwebs. Industrial networks here refer more specifically to the so-called Uppsala school of networks (Tikkanen 1997,14). The perspective in network studies is broader than in many other traditional subjects within the field of economics and management. This means that also the context of foods will be seen from a broad perspective where different economics, marketing, and management related subjects are being confronted.

The scope of the empirical study is limited to the Finnish context when it comes to the selection of primary sources. The limited resources available restrict the scope and the depth of the empirical study. The study is not part of any research programme; it represents a one-man-one-study approach.

1.3. Methodological questions and structure of the study

1.3.1. Qualitative research as a starting point

Scientific research can be divided into two main categories: qualitative and quantitative research. Qualitative research tradition originates from criticism raised by the social scientist towards the basic assumptions of the positivistic sciences (Creswell 1994, 4). Currently qualitative research consists of a very heterogeneous research base. Denzin and Lincoln (1994, 2) define qualitative research in the following way: "Qualitative research is multimethod in focus, involving an interpretative, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them."

Creswell (1994,5) has collected different paradigmatic assumptions of qualitative and quantitative research (Figure 2) which show the different basic natures of these research types. There are differences at the ontological, epistemological, axiological, rhetorical and methodological level.

	Question	Quantitative	Qualitative
Ontological Assumption	What is the nature of reality?	Reality is objective and singular, apart from researcher	Reality is subjective multiple as seen by participants in a study
Epistemological Assumption	What is the relationship of the researcher to that researched?	Researcher is independent from that being researched	Researcher interacts with that is being researched.
Axiolocical Assumption	What is the role of the values ?	Value-free and unbiased	Value-laden and biased
Rhetorical Assumption	What is the language of the research ?	Formal Based on set definitions Impersonal voice Use of accepted quantitative words	Informal Evolving decisions Personal voice Accepted qualitative words
Methodological Assumption	What is the process of the research ?	Deductive process Cause and effect Static design- categories isolated before study Context-free Generalisations leading to prediction, explanation, and understanding Accurate and reliable through validity and reliability	Inductive process Mutual simultaneous shaping of factors Emerging design - categories identified during research process Context bound Patterns, theories developed for understanding Accurate and reliable through verification

Figure 2. Paradigmatic assumptions of qualitative and quantitative research (Creswell 1994, 5)

In this study the key phenomenon under study, development of health-promotional foods, has an empirical background. The objective of the study is mainly to describe and to understand and not so much to explain and to predict. For these reasons it is quite natural that a qualitative research approach is adopted. This is, however, not to say that the research meets in all aspects and all levels the assumptions that are set for a qualitative approach.

The assumptions are very complicated in a deeper sense. It is very easy for example to state simply that the reality where foodwebs exist is subjective and multiple. Does this mean that there are no objectivity and singularity in that reality? A more realistic stance is to assume that some parts of the reality can be considered as objective and others subjective. An example of the former would be many events in the natural environment. In the long run it is probable that many parts of the reality that are now considered as objective, will turn out to be more subjective and vice versa. In this study it is realistic to assume that reality consist of both objective and subjective elements.

Theory has a different role in qualitative than in quantitative research. In the former theory is used to help understanding and not so much to explain or predict. In qualitative research there are no similar procedures for testing theories as for example in the positivistic tradition (see e.g. Popper 1965, 241-242). In qualitative research the relationship between the research process and the following theory are close to each other (see specifically grounded theory: Glaser and Strauss 1967, Strauss and Corbin 1990) whereas in quantitative research theory is typically a result of a study. The boundaries are, however, not very distinct. For example it can be thought that even in the case of qualitative theories there are types of falsification procedures although in more discreet forms than in the positivistic tradition. As this study is more of the qualitative type, this means that the theories in the study are primarily used to help understanding the phenomenon under research.

In qualitative research verification is a very important methodological procedure. Miles and Huberman (1994, 11) describe the spectrum of verification: “Verification may be as brief as a fleeting second thought crossing the analyst’s mind during writing, with a short excursion back to the field notes, or it may be thorough and elaborate, with lengthy argumentation and review among colleagues to develop ”intersubjective consensus”, or with extensive efforts to replicate a finding in another data set.”. As the assessment of the research in concerned Creswell (1994, 158) recommends that also in qualitative studies both validity and reliability considerations should be distinguished between. A specific evaluation of these themes, concerning empirical research, will take place in section 4.4.

1.3.2. Strategic choices in the study

The qualitative research approach was chosen because it responds better with the objectives of the study than a quantitative approach. Because of this many alternatives that are of strategic nature are already fixed. However it can be thought that even within the qualitative research type there are choices that are of a strategic nature.

In qualitative research it is not necessary to separate theoretical and empirical parts in a study because the theoretical and empirical are interlinked (Creswell 1994). However, in this study such a division is made. Theoretical themes are being treated mainly at the beginning of the study. From that perspective the study is not quite in the mainstream

under the qualitative approach. In principle this could be done in a reverse order. First going into the empirical phenomena, then relating that to theoretical subjects. Specifically this could be justified, as the whole idea of specific health-promoting foods is not very well established. There is considerable obscurity concerning the subject and there are various views about it.

It is assumed that the prior knowledge that the researcher has of the subject area justifies the chosen approach. Consequently more emphasis will be given to examining the development of products. It is recognised that in the chosen procedure, there is a danger that if those theory-based frameworks that are constructed are biased, the validity of the study will suffer. An a priori conceptual framework can also lead to a situation where the understanding of the phenomena becomes subordinate to the testing of a framework.

The evolving decisions made in the study make it qualitative in nature. It is also assumed that there are weaknesses in causal structures. A probable outcome is that there are independent elements that can initially be linked together with the relationships between them not being very clear. The subjective elements in the study mean that certain choices can be made on an inductive basis without thorough explicit explanation because the choice is so obvious from the perspective of the researcher. This of course brings with it the risk that important decisions are made too intuitively without taking into consideration the demands of the target group for the study. Specifically an area where the subjective approach is prevalent concerns the area of traditional food product development. References to this area are very much based on the experiences of the researcher in the respective area and not so much on any theoretically based approach concerning food specific development processes.

Within the qualitative approach there are many research traditions that use different kinds of research methodologies (see e.g. Denzin and Lincoln 1994). A case study was considered to be a viable option. The choice of a case study is, however, not a methodological choice. The case study approach can be used both in quantitative and qualitative studies (see. e.g. Stake 1994, 236). What is typical for a case study is that it makes possible the approach of the phenomena from different angles, use data from multiple sources and study selected issues in detail and depth (Patton 1990). These features support the purposes of this study. Therefore the case-study approach was chosen as the empirical phenomenon was studied. It was also discovered that industrial network approach favours qualitative methodologies and that case studies are commonly undertaken (Araujo and Easton 1996).

When it comes to case studies there are several ways a case can be defined. In this study a product-based approach is considered as the most suitable option. There are certain requirements concerning these product cases. It is expected that products are commercially successful and there is already some history behind the products. Then it will be possible to approach the subjects more holistically and to examine the specific development processes and to identify respective foodwebs.

1.3.3. Structure of the study

Chapter one is an introduction to the study. In chapter two a short exploration is made of the area of foods in order to position health-promotional foods within the domain of foods. The basic characteristics of foodwebs are introduced in chapter three. The

construction is based on the model of industrial networks, which is adjusted in order to make it more responsive to the phenomenon under study. In chapter four the questions relevant to a case study are considered. The choice of the cases is justified and factors concerned with the validity and reliability are discussed.

In chapter five the individual cases are described applying the frameworks developed in chapters two and three to guide the analysis. In chapter six a more general perspective on the phenomenon under study is taken and some initial generalisations concerning the foodweb and the development of the respective products are made. In the concluding chapter general conclusions are made, practical implications are presented, possibilities for the generalisations of the foodweb framework to other contexts are discussed, and some suggestions for further research are examined.

The structure of the study could also be divided into three parts based on the object of interest (Figure 3). First, there is the level of products that is specially centred around health-promotional foods. Secondly, there is the environment of these products. Thirdly, there is the relationship between the products and their environment that is of special significance to the development of the products.

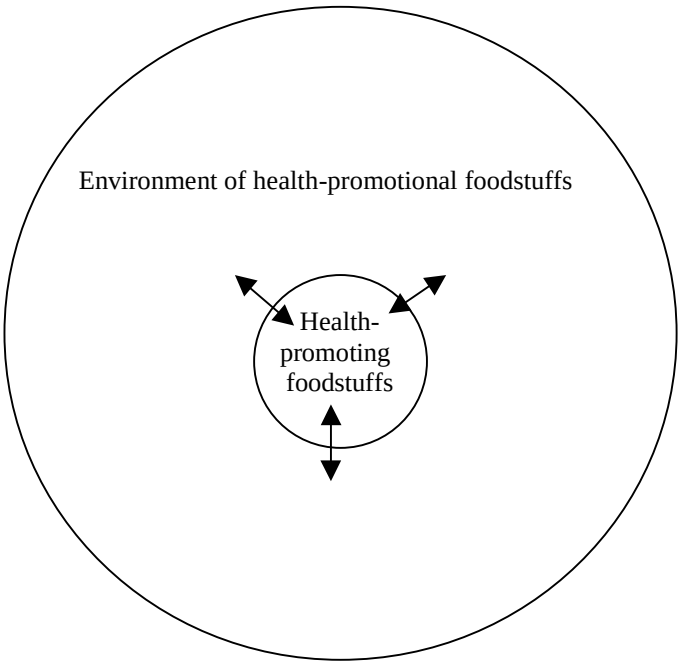

Figure 3. Objects of interest in the study

1.4. Central concepts in the study

The central concepts in the study are foodstuff, health-promoting foodstuffs, a foodweb, and the development of a product. The starting point of the study directs the contents given to the concepts. It is assumed that the concepts are linked to each other so that they together cover the phenomena under study. Concepts are more related to the phenomena under study than to how other researchers have possibly defined them. The numbers in parenthesis in headings indicate the chapter or section in which the concepts or related subjects are further examined.

Foodstuff (or a food product, foods)

A foodstuff is a product that is given a foodstuff status in a social context. It is not expected that a foodstuff can be defined based only on its material properties (e.g. nutritive value), but the status of a foodstuff is influenced by many social and individual factors. It is assumed that foodstuffs are produced industrially and they are commercially available.

Health-promoting foodstuffs (2.2.1, 2.2.2)

Health is limited mainly to bodily health and it can be characterised as the balanced state of the body. Health-promoting foodstuffs contain positive health relevant factors that are of a major significance for the identity of these foodstuffs. It is expected that these factors have a scientifically validated basis.

A distinction is made between health promoting qualities and the safety of foodstuff. Health-promotion relates to specific intended effects whereas safety concerns also its realisation. For many reasons there is typically only a probability of reachieving the intended effects.

Foodweb (3.2)

A foodweb can be defined as a network in which foodstuffs are being developed.
What is typical in a foodweb is that interaction in one part of a foodweb affects interaction in other parts of the foodweb. A mutual interdependency prevails in a foodweb

Development of a product (3.2.2, 6.2.)

A product in this study is not only limited to concrete exchangeable objects that is typical in the market context. A product exists already on an idea level and at the stages where there are a lot of uncertainties concerning its possible market value. Development of a product is a continuum and no final products are assumed.

Development is assumed to take place in a network type of a context where there are several more or less independent actors and many other factors that affect the development. It is assumed that the development of a product is partly based on purposeful activities and partly based on emerging opportunities.

1.5. Significance of the study and the audience

The main significance of the study is expected to be a new holistic view on the development of health-promotional foods. The actual development process is not very well taken into consideration in traditional market views. Typically products are seen either from a macro level (national, international), in which case the actual development process is not seen at all, or from a micro level (within organisation), in which case only part of the development process is taken into consideration. Foodweb can flexibly cover parts of both the traditional microenvironment and macroenvironment. A food chain approach has in principle a similar type of broad coverage. However, it very much emphasises the distribution related matters of physical products. It is therefore a more partial view on the development process than that based on a foodweb.

The study also contributes to food studies in general by constructing a new reference point for foods. An attempt is made to define dimensions and boundaries that are specifically relevant to health-promoting foods. It is also evident that the development point of view is broader than that used in a traditional in product development context. This is thought to bring new insights to the development of new food products.

The study also makes a contribution to network studies, specifically to industrial network studies. Even though the subject under study is industrial, the perspective of the study differs from previous network studies. The concept of an industrial network is typically the same as the concept of a network of industrial organisations, whereas in this study the starting point is different. The role of a product has more significance. This means that both the structure and the processes of a network will be seen from a different point of view. This can be expected to bring new insights concerning industrial networks.

The main audience of the study consists of researchers interested in the area traditionally treated under the theme of markets of health-promoting foodstuffs. It is also probable that there are elements in the study that will be of interest to researchers of new foods in general. Due to the specific point of view to industrial networks it can be assumed that the study also brings up factors that are of interest to those doing research in industrial networks applied to certain specific context.

2. Understanding health-promoting foods

2.1. Background of health-promoting foods

In the following the background of health-promoting foods will be examined. It needs to be pointed out that the starting point in this study is not health and health promotion but foods. On the other hand it can be anticipated that health-promoting foods have characteristics which make them different from traditional foods. To bring out the problematic related to health-promoting foods, a more broad approach than that typically used in a food context is needed. A new category of foods, called body-centred foods, is introduced and some key questions linked to them are described. The category is then examined based on the idea of functionality of foods. According to this foods are not an end product themselves but they contribute to certain bodily objectives. In this respect body-centred foods can be considered to be functional.

2.1.1. Body-centred foods

Body-centred foods consist of foods in which the material relation between the foods and a human body is specially emphasised. The focus on the body means that for example foods whose use is based mainly on such social aspects like rituals are excluded. Body-centred foods are examined from three points of view: natural, social and individual (Figure 4). It is assumed that thereby different characteristics of body-centred foods can be revealed.

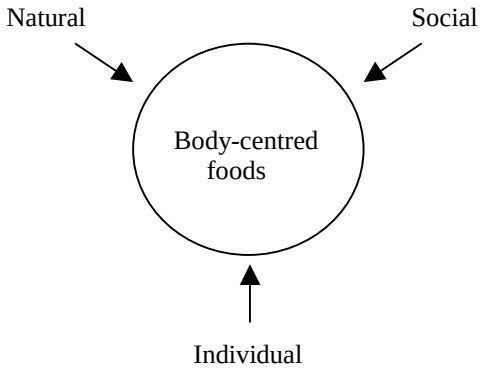

Figure 4. Body-centred foods seen from three points of view

Natural point of view

The natural point of view is linked to the biologic-physiological environment. Foods carry materials and sources of energy from the environment to a human body. Usually foods are taken orally. There is a continuous dependency on the environment because the ability of the body to store materials and energy is limited. To emphasise the many aspects of this dependency, foods that are ingested can be considered to make up a flow of foods. This covers different aspects than, for example, what is included to the concept of a diet, which usually refers to the real or targeted selection of specific foods ingested in a certain period of time.

A physical food flow can be divided into three phases in relation to the body (Figure 5). A relationship between a food and the body is formed in a phase called the pre-oral phase. In it foods and the body are not yet in direct physical contact. In the second phase, called the oral phase, foods enter the body stimulating sense organs located in the mouth and its proximity. The following phase, here called the post-oral phase, begins as foods pass to metabolic processes through the gastric system. Typically the first two phases are separated from the last one in a food context. In this study a more holistic view is chosen and the post-oral phase is emphasised.

Food flow leads to body reactions (Figure 5). Every food causes some reactions in the body. Here physically recognisable reactions are of main interest. Examples of such reactions are the process that takes place as foodstuff in an oral phase stimulate the receptors of sense organs or the process by which a substance in foods contribute to a metabolic process. Typically this takes place in reaction chains. For example, the above mentioned sense organs are linked via the nervous system to the human brains in which messages integrate in complicated neurophysiological processes (see e.g. Booth 1994,164-172). The body reaction is then perceived at the cognitive level. Metabolic processes in the body are all linked to different chains of reactions that lead for example to visible movements of the body.

Body reactions can by nature be positive or negative. An example of a positive reaction is a physiological change that enhances body health. An example of a negative reaction is an allergic reaction by the body. There are many different mechanisms that link foods to body reactions and reaction chains. Some body reactions are directly perceivable some are perceived based on indirect information that is acquired for example by different

measuring devices. In the case of body-centred foods body reactions are central when it comes to assessing the value of foods.

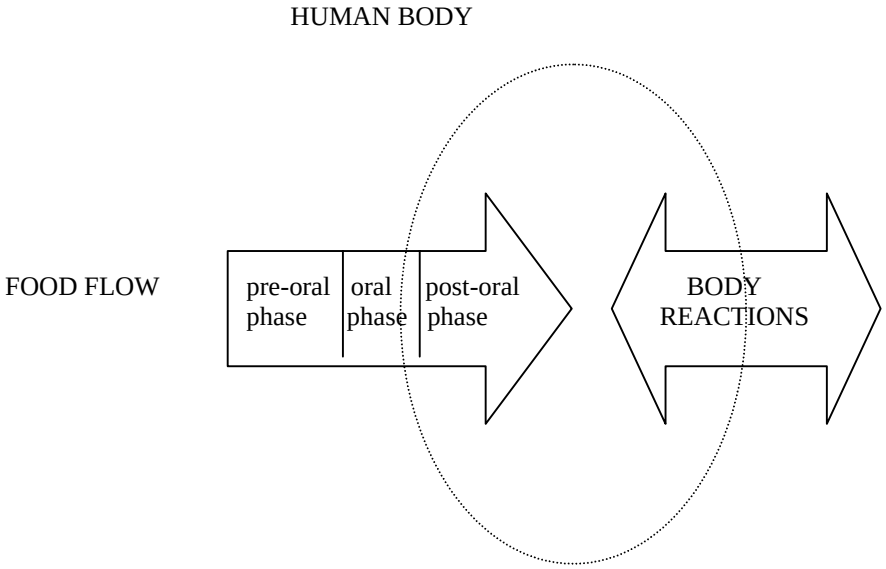

Figure 5. Food flow and body reaction

Body-centred foods are not only based on bodily needs but they also depend on raw materials that are available and the technological possibilities to produce foods. There is always a dependency on nature as food products are concerned. In an underdeveloped food system it is typical to rely on products that are spontaneously being produced by nature. Foods are more or less given by nature because know-how is limited and the technological possibilities to intervene in natural processes are restricted. In a developed food system controlled intervention in natural processes at many levels is a typical feature which gives more predictability to the system.

The social point of view

The body depends on its social environment. Changes in that environment have direct consequences to bodily needs. An example of that are changes that take place at work. For example it is well known that the need for energy content of foods has been continuously decreasing, as physical strength at work has become less important. At the same time the significance of mental performance is growing. There is a need to achieve a high level of mental performance at work. For potential new foods this means that they are expected to cause different body reactions than the old foods. Even energy is still needed but with different emphasis. In old foods the focus was on energy for muscles whereas in the new context it is more a matter of energy for the brains.

In the social context the differences between social classes have always been of a concern. According to Bourdieu (1984) traditional social classes exhibit differences in taste which can be seen as different preferences for foods. However, it is argued that even there are foods, which have a socially differentiating role, it is more probable that underneath the social classes lie many other factors. It is not very probable that, for example, in the case of health-promoting foods social class would be found to be the most important explanatory factor of the consumption. Such factors like nationality, age, sex, lifestyle, and psychological factors are probably as valid bases as traditional social class. It seems also that only seldom food related matters lead to convictions where foods strongly differentiate social groups (an example of such an outcome is vegetarianism).

Taste can be examined also in a more limited sense in relation to the oral phase. Taste consisting of such elements like flavour and texture of foodstuff. The taste of foods in the oral phase has always been a major determinant of their value. But the post-oral influence of foods is also important. It is very probable that for example the increasing preference for less fat containing foods is to large extent based on the fear of negative health consequences that excess intake of fat may have. This has happened even if the taste of new low-fat products initially were not preferred. Those products have then become preferred products for the majority of consumers. This means that there is link between the post-oral qualities of foods and oral qualities.

An important basic determinant in a social context concerns the value given to the body. It is from this value that also the value of foods derives. What makes the question difficult is that there is not any single body determinant. Even on a materialistic level the value of the body is far more than for example the value of its physical parts. In a society the value of the body can indirectly be assessed based for example on the amount of resources that are allocated to sustain the health of bodies. Body value can also be assessed from an instrumental point of view. The body can be used, for example, to give aesthetic pleasure to its owner or to improve one's performance in a task. It seems that taking into consideration different aspects the overall value of the body is increasing in modern societies.

It could be thought that the increased value of the body means that automatically the value of foods is also increasing as body and foods are so dependant on each other. However, this is not always the case. It is obvious that although in earlier societies most of the materials ingested could be called foods in a modern western society a diversification has taken place where foods form just one category of ingested products.

As an example of such a development we could think that there are consumers who are worried about the optimal intake of vitamins. They know that the concentrations of vitamins vary in foods and therefore they may prefer to take vitamins supplements in order to make sure they insert right amounts. If the intake of separate vitamins is the first priority and foods come as second, the consequence of this is that actually a consumer should eat foods containing no vitamins, to avoid obtaining an excess of vitamins. The more there are similar developments, the more probably the value of foods will decrease, as part of the previous value of foods is actually transferred to other products.

In a social context there is a question of responsibility. Who is responsible and to what extent for an individual's body. For example, is it an individual him/herself or society? We could assume that there are two extreme alternatives. One is a case where society is fully responsible of an individual's body. It would resemble a situation where society

actually owns the body and an individual has mainly a right to use his/her body. In order to preserve the societal asset an individual would have to obey strict rules of behaviour concerning his/her body. That could include only specific officially approved foods to be eaten under controlled conditions.

In another alternative society is based on extreme individual decision making. An individual is solely responsible for his/her own body. Whatever an individual desires concerning his/her body is always supported by society. On a food level this would mean extremely diversified foods. Foods could contain any ingredients at any levels. In reality there are no such extremes but in societies the responsibilities are typically shared. Consequently there is more or less freedom for different kinds of foods.

The individual point of view

First a division can be made between the human mind and body which together can be considered to form an individual[7]. The relationship between them could be described as that between a consumer and a customer. The mind is a customer who typically decides what is available for consumption. The body then utilises foods in a very physical sense (or rejects them if there is for example a severe negative body reaction). There is a mutual interdependence between the mind and the body. The relation, however, is not always in balance and there can be a constant tension between them.

The power of the mind is revealed in the fact that despite the body expressing symptoms of a need for food, a mind can decide that food will not be eaten. This can be taken to its extremes for example in a hunger strike. After a certain period of time the feeling of hunger disappears. If that state continues it leads to a situation where even if the mind would prefer to eat, it is not any more possible because the body has taken the lead. This results finally in the destruction of the body. Besides hunger strikes, which are conscious decision, there are at least partly unconscious psychological (and social) reasons that can lead to similar types of situations (e.g. bulimia, anorexia). These examples show that there are limits to conscious decision making and that there are unconscious reasons that direct the intake of foods.

If an individual can even destroy his/her body by a conscious decision it is easy to understand that decisions can be made where the health of the body is not the first priority. Even in less dramatic conditions there can be a willingness to sacrifice the health of the body. The reason can be for example that pleasure is valued over health or that there is a serious attempt to perform in a task (e.g. within sport) even knowing that there is a risk to body health. Foods are not necessarily an outside factor. They can be more or less important instruments in an attempt to attain certain goals. The more committed an individual is the more probable it is that all the factors, including foods, are taken into consideration.

Even if the promoting of health is the dominating value for an individual it is not self-evident how this goal can be achieved. What makes the situation difficult from an individual point of view is that there are limitations in direct communication between the mind and the body. Even if an individual prefers health-promoting foods, the information system within the body has a very limited capability to provide this directly. Positive

[7] In a sociological context they are typically united (see e.g. Falk 1994)

health active properties cannot usually be seen or tasted. Indirect information is therefore needed.

Every individual can be considered unique when it comes to both body and mind. This means that from an individual point of view the actual scope of products valid as foodstuffs can be very limited. We could think of an individual who rejects most of the common foods. There can be negative factors emerging at any phase – pre-oral, oral or post-oral -for a food flow, which alone or together make us reject foods. In the middle of an apparent abundance such an individual confronts a scarcity of foods. The more all food related needs are taken into consideration, the more probable is the situation that can be expressed by modifying the Malthusian thought: the requirements for foods grow on a geometric scale whereas the possibilities to meet them grow only on an arithmetic scale.

2.1.2. Functionality and body-centred foods

In the previous chapter the concept of body-centred foods was introduced. They were defined as foods in which the relation to a human body was of special importance. This relation is broader than the traditional nutrition based relation. Body reaction was used to describe the outcome of the influence of foods. It was also seen that the body is instrumental towards certain goals. When foodstuffs specifically support the attainment of these goals they can be called functional foods.

The following categorisation of functional areas has been adapted from Winkler (1998, 186-191), who considered different kinds of foods (Disease-Specific Foods, Risk Group Specific Foods, Foods to Reduce the Effects of Ageing, Performance Foods- Physical, Performance Foods- Mental, Mood Foods) and not directly functional areas. In this section it is not so much the foods itself than the various areas that are of interest. The following categories are examined: nutrition, health, performance, pleasure, and esthetic. It is not argued that this is the most valid categorisation including all the areas and being exclusive within categories. The subject is approached in a materialistic manner so that the characteristics of the physical substances linked to the respective areas are emphasised.

Nutrition (nutrition functional)

Nutrition is of specific significance in a food context because usually health related subjects of foods are treated within the domain of nutrition. Foods and nutrition have traditionally been closely linked to each other. This in turn means that questions concerning foods are often of direct significance when it comes to nutrition. In the following some basic questions are examined at a general level without trying to go deeper into nutrition as a science or an actual field of inquiry.

A question can be asked what is the relationship between nutrients and foods? To what extent are they separable and to what extent interdependent? If the former case is true, foods are mainly carriers of nutrients. If there is interdependency, the question can be asked to what extent a food context matters? Probably not all foods are similar. One context is better than another context from a health point of view. In such cases nutrients can not be viewed only as substances in the reduced (e.g. chemical) form. They should be viewed as a combination of a specific substance in a certain context. In order to produce

such a nutrient it means that something needs to be taken away from a specific food or something has to be added to a certain reduced natural (or synthetic) substance. If this is true, then it can be asked to what extent the current way in which nutrients are described takes these factors into consideration. Should not for example a vitamin then be a combination of a chemical substance in a certain context?

Within nutrition a change has taken place from nutrient levels needed to prevent deficiency diseases to levels needed to reduce the risk for chronic disease and achieve optimal health and well being (Berner et all 1999, 91). This usually refers to the development within the traditional well-established nutrients. There are, however, many questions concerning new possible nutrients: What are the criteria for a nutrient? Is it more its essentiality in specific bodily metabolism than its contribution to bodily health that matters? Do nutrients have to be exclusive in that no other substance can have similar effects? How will the status for a new nutrient be granted? Because of the high esteem of nutrients in a health context it can be anticipated that the borderline between nutrients and other substances that have a positive health-promoting effect, will attract more interest in the future.

There is one important question when it comes to the relationship between foods and nutrients. Is it necessary that new nutrients can only be found in traditional foods? If total scientific evidence shows that a substance of non-food origin has a nutrient like contribution, would it be accepted as a nutrient? Can we assume that all the nutrient potential substances are already in foods? It would seem rather unlikely considering the basis that is behind the original selection of foods. The emergence of foods has traditionally been influenced very much by supply related questions. Bodily needs are only one aspect that is taken into consideration.

Health (health-functional)

Health and nutrition are not exclusive categories. The aim to improve the health of the body is also the key aim in nutrition. Actually nutrition should be considered as part of the health and nutrition functionality should be included in health-functionality. This separate treatment is however justified because nutrition has such a strong a position in the food context.

The typical difference between health and nutrition concepts is that nutrition refers mainly to the objective biologic-physiological basis whereas health typically includes also psychological elements and an individual basis for assessment of health status (see e.g. Blaxter 1990, 4-12, Erikssson 1976). Even within the more objective body sphere the concept of health covers a broader field than the concept of nutrition. An individual's health is impacted by many diverse factor such as genetics, mental state, immune system, activity levels, environment and diet (Berner et al. 1999, 93)

Following the same materialistic approach as in case of nutrition we could assume that there is a special health product category in which the core of the products would consist of healthients. Healthients would consist of all those material substances that have been shown to have a positive effect on health. When scientific evidence is required the scientific basis has not to be only natural sciences but also for example psychology because health has a subjective element in it.

The actual content of a foodstuff could be described as consisting of four different kinds of factors (Figure 6). Factors having positive health effect are part of the above mentioned healthients. Foods typically have also factors that have a negative health effect. Typically there is tendency to remove, eliminate or reduce the amount of those factors (e.g. salt). There are also hundreds of factors (factors as substances) in foods, whose physiological effects are not very well known (Tansey and Worsley 1995, 52).

*Factors having positive health effect
*Factors having negative health effect
*Factors, which are neutral to health
*Factors, whose health effect is not known

Figure 6. The content of a foodstuff in relation to health

Potentially it could be thought that if the factors and their contribution to health are known, a health value of a foodstuff could be determined. A food flow within a certain time period would consist of different kinds of foods and their related health factors. It would be the aggregate of those factors that would be of significance. A health-balance could indicate the total effect on health when the positive and negative factors were taken into consideration. In practice there are many difficulties: all the factors are not known, they are interrelated and both the food and the body contexts are also of significance.

There are other differences between nutrients and healthients. Nutrients are typically elementary raw materials used for metabolic processes in the body. They support the self-sufficiency of the body. Healthients can also be secondary products that are produced by the human body but not for example in optimal amounts from the health point of view. Within healthients there is a specific category of products - medicines. They are products that are justified based on their effect on bodily processes; their origin or natural existence in the body is only of secondary concern.

It can be asked to what extent foods differ from medicines. Here the substance itself is not a valid starting point. The difference can be assumed to originate from different starting points when it comes to a bodily state. In the case of foods it is typical to assume that the body exists in a self controlled state that is close to a balance (homeostasis). The purpose of foods is to support this state by providing raw materials for continuously repetitive processes. In the case of medicines the starting point is usually a significant deviation from this balance. Typically the purpose is to restore the balance using more or less strong outside controls.

This is a strongly simplified differentiation. There can hardly be an exact line between these areas. However, it brings up some new questions. Some negative factors in foods can actually lead the body away from balance. In this sense foods can be considered even as opposites to medicines. On the other hand there can be factors in foods that support the recovery of this balance. Or recovery can be linked to different combinations of foods and medicines.

It can be assumed that there is a grey area where the body is not in full balance but not significantly out of the balance. It can also be assumed that the scope of this grey area increases the more we know about the body. Now it can be asked who takes control of this grey area? What usually happens is that as soon as a specific bodily condition is

given a status (e.g. a disease status) in the medical context, the role of medical system increases and the role of traditional food system decreases. There are not usually ways that food system could define its domain when it comes to these new health questions.

Actually the medical system is already dominating the food area, if nutrition is considered as just one area of medicine (see e.g. Rayner 1998, 175). Accordingly, nutrients would then be a specific product category within medicine. This does not mean that foods would be seen as being the same as medicines because within medicine there are also other product categories than medicines. In many respects health-promoting foods could then be comparable with vaccines based on their aims. It seems evident that even though foods have been separated from medicines on a product level there are still strong uniting links.

In health products the characteristics of foods and medicines are typically mixed. As an example we could think of a situation where there is a bodily unbalanced state that is permanent (e.g. due to genetic reasons). As a result of this there are specific substances that needs to be taken daily to support the overall balance of the body. This is a food type of a property even though such products would typically not be included in foods. To what extent foods can be extended to the area of medicines or medicines to the area of foods is a question that has no simple answer and there are probably no definite boundaries. Despite this an attempt is made to characterise foods, health products and medicines (see Figure 7). In the figure some features that typically differentiate the product categories are presented. It is however obvious is that there is a lot of overlapping between these product areas.

	Foods	Health products (e.g. toothpaste)	Medicines
Bodily purpose	continuity	prevention	restitution
Focus	unfocused	generic focus	specific focus
Effect	mild	moderate	strong
Value assessment	sensoric(hedonistic)	information based	advantages/disadvantages
Authorisation	average consumer	informed consumer	professional supervision
Product form	traditional	consumable	reduced

Figure 7. Typical characteristics of foods, health products and medicines compared

Performance (performance functional)

All foods have more or less strong effect on performance. If foods are being used to improve either physiological or/and mental performance the setting is however different from the ordinary food use. On a material level it typically means that there are specific substances in foods which cause the performance improvement or/and that the food flow is designed in order to improve performance. An example of the former is caffeine found in coffee. Its stimulating effect can be considered as performance improving. An example of the latter is the food flow of an athlete preparing for a competition. Even if the design of a food flow takes place only within traditional nutrients and foods its effect can be significant.

The context where performance improvement is taking place is of great significance. It is a very different situation if the goal is to improve long term mental performance at work than if the aim is to gain a momentary performance improvement at the highest level of sports. Performance improvement can mean that a performer is ready to accept a conscious risk for body injury that is higher than in normal conditions. This could also mean an increased willingness to take risks where foods are concerned if performance is thereby expected to improve.

Pleasure (pleasure functional)

Pleasure can here be defined as a positive mental sensation. It is an important theme in the food context. Pleasure based on the sensory characteristics and the subsequent hedonistic values to a large extent determine the value of most traditional foods. The difficulty here is that pleasure due to its individual nature is difficult to observe and validate. Typically sources of pleasure are active in pre-oral and oral phases. When pleasure is specially emphasised as a goal also the post-oral influence of foods becomes relevant.

Products that cause pleasure can generally be called pleasurables (see Falk 1990,36). Pleasurables have links to foods. Spices are an example of products that are used mainly in foods because of the body reaction they cause that ultimately leads to pleasure. There are other pleasurables (e.g. alcohol) that are only loosely thought of as foods. In the case of pleasurables we must make the same kind of considerations as we did for the relationship between medicines and foods. There is a limit after which a product containing a substance typical in pleasurable is no longer a food. Alcohol being a typical example of such a relationship. Products with a very high alcohol content are not typically considered as foods. This is also the case with psychochemical substances in general. Typically high concentrations of such substances are not tolerated in foods.

It is very probable that the role of the pleasure function is increasing. According to Falk (1992, 36) in the modern period typical representations of the orality are the marginalisation of the common meal and appearance of different nonritual, individual meal habits that typically aim for the sensation of pleasure by the use of oral stimulants. Also, in the recent sociological literature it has been typical to link foods to the general phenomena of consumption (e.g. Warde 1997). This indicates that in foods the necessity aspect, although not disappearing, will be more and more hidden behind other aspects, such as pleasure aspects.

Esthetics (esthetics functional)

There is also an area where an increase of the esthetic value of the body is a goal. The respective activity is here called body design. This does not refer to procedures, e.g. weight reductions that are done for medical reasons. Body design refers to activities where the esthetic values direct the changes made to the body. As a consequence of this foods may for example contain non-nutritive substances. They can be substances that have no energy value from the point of view of the body.

An analogy could be taken from plastic surgery where certain materials that are not normally part of the body, are inserted into it to permanently increase a body's esthetic value. In the food context this would mean that substances not traditionally used in foods, are repetitively taken into gastric system to attain certain body design purposes. The underlying strategy here is that in order to reach a certain goal changes are made to foods and not so much to food habits.

Conclusion

The purpose of the treatment above was to describe the dimensions of functionality, which are typical for body-centred foods. The health-functionality dimension that lies behind the health-promoting foods is only one part of that. There are other areas in which the same kinds of questions appear concerning the role and limits of foods. It should be noticed that even health-promotion is not self-evident. Like in other functional areas its goals can be can be set to different levels. If the purpose is to avoid a shortage of basic nutrients in the short term, the respective foods are very different from those that are used when the purpose is to meet long-term individual health-promoting needs.

Even though it is possible to assume that there could be a food consisting of a single function, a more realistic stance is that foods are usually multifunctional. The dominance of certain functions may however lead to a situation where a food is labelled by a single function e.g. a health-functional food.

2.2. Health-functional foods in an empirical context

2.2.1. Emergence of the product category

In the previous chapter the properties of body centred foods were examined. Several areas of functionality were found. From now on the focus is on health-functional foods as they have emerged as an empirical product category. For reasons of brevity in what follows the concept functional food is used almost as a synonym for the health-functional foods unless otherwise specified.

Associating health and foods is not a new invention. A product category called health foods has been known for a long time. The difference between the modern functional foods and the health foods approach is that there was not such a scientific basis for health foods as there is now for functional foods (Labuza 1994, xii). The assumptions concerning health-promoting effects of health foods were usually based on traditions and empirical knowledge. Health foods used to be a special segment and not in the mainstream of industrial foods.

However, it would be wrong to claim that other foods than health foods have been free from beliefs concerning their effects on health. There are many common beliefs concerning traditional foods that have not been validated by modern scientific methods. There is also room for such beliefs. Even experts in the field (see e.g. Tansey and Worsley 1995, 52) recognise that traditional foods still contain many unknown properties. As long as this is the case there are at the same time both scientifically based knowledge and traditional beliefs concerning foods.

What has also affected the emergence of health-functional foods is that borderline between medicine, biology and foods has become an area of major new interest. There are many reasons behind this development (see e.g. Hasler 1996). The reasons that have been mentioned are, for example, an increase of scientific knowledge concerning relationships between foods and illnesses, a raised interest in preventive care due to the growth in health care costs, consumers better awareness of the role of foods in health, and need of industrial firms to find new profitable product areas.

2.2.2. Characteristics of health-functional foods

There are no official definitions of functional foods. Definitions that have been proposed are based on the development that has taken place in the field and they differ to some extent due to differences in backgrounds of the people who are making them. In the following some examples of these definitions are quoted:

" a functional food can be defined as any food that has a positive impact on an individual's health, physical performance or state of mind *in addition to its nutritive value* " (Goldberg 1994,xvi; referring to J.Rabe)

" A food can be regarded as 'functional' if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease. Functional foods must remain foods and they must demonstrate their effect in amounts that can be normally consumed in the diet…." (working definition, Scientific Concepts of Functional Foods in Europe, Consensus Document 1999,6)

" a food category in which the products are either a) modified or b) fortified with substances that have a preventive or therapeutic effect beyond their original nutritional value." (Jonas and Beckmann 1998, 2)

What is common to all these definitions is that functional foods are considered as extensions to traditional foods. Not only the positive nutrient content of foods is taken into consideration, but that there are also other positive factors in foods. However, as it was seen when the health-functionality was evaluated, traditional foods contain typically positive and negative factors. Reference only to the positive factors gives an impression that only new positive factors are added to a neutral basis, whereas in reality many positive characteristics are added in order to overcome the negative factors in current foods.

Japan is considered to be a pioneer when it comes to functional foods. Japanese foods are seen to have three functions (Ichikawa 1994, 453). The primary function is the food's nutritive value. The secondary function is the food's sensory appeal, or organoleptic properties. The tertiary function refers to the food's physiological aspects such as

neutralising harmful substrates, regulation of body functions and physical conditions, preventing diseases, and promoting recovery and general good health. It is this third function that is considered to be typical for functional foods.

As this functionality of foods is compared to that used in this study, there is an obvious difference in perspective. Whereas the above foods are taken as given and it is the content of the foods that is of interest, in this study foods are seen in a broader context. It is assumed that there is a relationship between the body and certain goals. The body as such is not a goal. For example, a body can be used to improve performance in a task, which then sets specific demands for foods. In a similar fashion health is not a naturally occurring condition that simply exists but there has to be an aim for health. Foods then become functional from that point of view.

Functional foods are not the only concept that is being used in this context. There are also other concepts that refer to the same product area, for example nutraceuticals, designer foods, pharmafoods, medical foods. Nutraceuticals is a commonly used concept, especially in Northern America: " Foods or bioactive ingredients in foods that protect or promote health whether they are delivered in raw agricultural commodities, processed foods, dietary supplements, extracts, beverages, or other products" (Childs 1999,74). It is evident that nutraceuticals is a broader category and not restricted only to foods in the traditional sense. Nutraceutical products can range from isolated nutrients, dietary supplements and diets to genetically engineered designer foods, herbal products, and processed foods (Murthy.1997, 76).

Functional foods or the above mentioned respective categories do not usually have specific legal status in food legislation. Medical foods are an exception. Medical foods are a special category within US legislation: "A medical food is a food which is formulated to be consumed or administered enterally under the supervision of a physician and which is intended for the specific dietary management of a disease or condition for which distinctive nutritional requirements, based on recognised scientific principles are established by medical evaluation " [8]. In the US context the difference between the medical foods and foods for special dietary use is that medical foods must meet all the nutritional requirements arising from a particular disease or a medical condition (Murthy 1997,87). Thus a product formulated to meet only part of the specific demands in a medical condition would be a food for a particular dietary use. Medical foods are actually close to being called prescription foods.

The official categories into which functional foods fall often concern the needs of the not-so-healthy individuals. In Finnish legislation there is, besides traditional foods, a category of special dietary products (special foods) that consists of foods that either because of their composition or production method, differ significantly from ordinary foods. These foods are aimed at individuals having metabolic or malabsorption disorders or which due to their special physiological state benefit from a controlled intake of ingredients that these specific food products contain [9]

Within the legislation of European Union there are nine separate categories under Foods for Particular Nutritional Uses [10] which though are not all actively used. These product

[8] Section 5b of the Orphan Drug Act (21 U.S.C.360ee.
[9] Ministry of Trade and Industry decision on special foods 937/95
[10] 89/398/EEC

categories consist of different purposes for which foods are aimed and of the consumer groups to whom these products are targeted. There are for example categories of baby foods, sport nutrition and foods for diabetics. Basically this reflects the continuum that exists behind the idea of functionality. There are no ideal foods that would suit all but there are special needs that are not only linked to a state of unhealthiness. It is not very common for example to classify a child unhealthy if he/she uses specially optimised baby foods. In the USA a relevant category from the functional foods perspective besides medical foods are dietary supplements. They include also those products that are not usually classified as nutrients (including phytochemicals, hormones).

When the empirical situation is compared with the categorisation in the previous section, it seems that usually functional foods are considered within a broader area than simply health-functional foods but usually not in such a broad area as that is a covered under in functional area of this study. Typically, instead of a pleasure function a concept of mood foods is used which seems to unite performance and pleasure aspects. The esthetics type of function is not usually mentioned in the context of functional foods.

There is a question concerning limits to the health-functional foods. Do only the changes that are being made to foodstuffs in order to promote health make them functional foods? Implicitly it is usually thought that unless very obvious changes are made to a foodstuff or something untraditional is being added, it is not a functional food. However, if the above definitions are taken as a starting point it is not required that significant physical changes are made to foods. Above all it is a matter of information concerning the health-promoting effects they have. Based on scientific research a traditional food could also become a health-functional food.

2.2.3. Validation of health-functional foods

Validation of functional foods consists of many phases and there are different parties that are involved. In the following the subject is examined from four perspectives: research, manufacturing, public regulation and consumption.

When it comes to validation of health effects the scientific research methods are considered of key importance. Sometimes there is an underlying tone that scientific validation and clinical tests were previously unknown in the food context. This is, however, not quite right. Nutrition and role of nutrients has always based on the use of scientific methods. What has especially changed is that this does not only concern traditional nutrients. Earlier positive relationship between foods and health were to a large extent same as nutrient related considerations, now the perspective is broadening to cover other factors as well.

If there is an immediate body reaction towards a specific goal (e.g. performance or pleasure) the validation of foods is relatively straightforward. In the case of health-functional foods, especially when it comes to the preventive properties of foods, the validation is more complicated. Often it means that the goal is to prevent certain body reactions taking place in the future (e.g. a body reaction in a form of an outbreak of a disease). In that case specific markers (e.g. cholesterol and its level) are needed that can be used to anticipate future body responses. It is then the effect of foods to these markers that is of importance when the products are being validated. A proposal has been made concerning the scientific concepts behind functional foods in which also the theme of markers has

been elaborated (Scientific concepts …1999). These markers are assumed to be of crucial significance when the future development of functional foods is concerned.

From the manufacturers point of view it is the profitability of the product that validates it. In that sense health-functional foods do not differ from other food products. What is now different is that a manufacturer needs to consider questions that were previously mainly the domain of the public sector. The old situation was that in most cases the results of research concerning the relationship between foods and health were more or less given from the point of view of a food manufacturer. Now it is necessary also for a manufacture to decide how much to be involved in this area. What used to be an area where only certain minimum product requirements had to be fulfilled is becoming of strategic significance for many food manufacturers.

From the public regulation perspective validation means that new health-functional foods should improve public health. The minimum requirement is that the new products should be tested in order to assure that they do not bring with them new negative health factors. That is not a new requirement in the food context. There has been such demands even before concerning new ingredients and major food modifications. What these new foods may bring with them is increased demands concerning the health aspects. It could be thought of as a separate question not concerning old foods. However, there is a link between old and new products. It is probable that the more that is demanded of new foods the more negative characteristics will be found also in traditional foods. This in turn puts more pressure to changes in old foods. In the long run it is not a very sustainable situation if there are different requirements concerning products in the same legal category.

The more there are special health optimised foods the more different will also be the basis that will affect public health. Market dependency will increase. The dependency from market products then replaces the dependency from generic food products. Changes in the market share of specific products or change in the content of a dominant product on markets may have more significance from health point of view than changes in traditional food habits.

When it comes to functional foods there are specific questions linked to consumption. Information that is based on sensoric characteristics was considered typical for traditional foods. In the case of health-functional foods indirect information has probably a more important role to play. Decisions are made on the cognitive level. This means that questions such as what is a consumer's general attitude on information concerning foods will become crucial. It can especially be asked what is the attitude of a consumer towards scientific validation. If scientific information is not given specific value in general it is not very probable that it would be of value in this context.

When an individual consumer validates products the subjective nature of health comes into picture. A key question concerns the extent to which health properties are valued in foods? As it was previously noticed an individual is normally very powerful when it comes to food choices. If he/she can even decide not to eat at all, it is much easier not to eat properly in a health supporting sense. The situation is more complicated as individuals are often not very aware what is the starting point: how healthy are the foods they actually eating.

What is important to remember is that an individual even if he is eating alone, is not doing so when it comes to food choices. Social influence is important. What are the attitudes of reference groups or other influential groups like health professionals toward these new foods, is of major significance. In a social context also other questions arise. For example to what extent should special foods for special needs be available in social occasions? And how do general attitudes develop? Will it be possible in the future that dinner guests consider it quite normal that the healthiness of their dinner is based on health-functional foods?

3. Foodwebs – a framework for studying the product development

In this part of the study there is first a brief introduction to the general background of industrial networks. After that the main structure and processes of the industrial networks, or more specifically of the so-called Uppsala School of networks (Tikkanen 1997,14), will be presented. In the second section the focus is on foodwebs. The modifications, which must be made to meet the purpose of this study, are examined and the initial basic assumptions concerning foodwebs are presented.

3.1. Industrial Networks

3.1.1. The background of the industrial networks

Network analysis has been a common approach in the social sciences. A network in a social context is typically defined as a specific type of relation linking a defined set of persons, objects or events (see Mitchell 1969). Different types of relations identify different networks. As the actor perspective is emphasised there are many kinds of social relations between them. Knoke and Kuklinski (1991,177) list some examples of relations: transaction, communication, boundary penetration, instrumental, sentiment, authority/power, kinship and descent relations.

Network analysis has gained popularity also in industry and business related studies (some examples: interorganisational studies, see Oliver and Ebers 1998, Ebers 1997, Osborn and Hagedoorn 1997, Araujo and Easton 1996; strategic networks, see Jarillo 1988; marketing networks see Anchrol 1997; Möller and Wilson 1995; small business networks, see Johannisson and Mønsted 1998, and internationalisation, see Johanson and Mattson 1988). The network approach in industry and business studies is primarily institutional even though there are also more formal approaches to the subject (e.g. Easton et al. 1997, Jones et. all. 1997). The perspective is usually at the business strategy level (see e.g. Håkansson and Snehota 1989). Relationships within networks are emphasised in many approaches. The perspective on networks is however not only restricted to relationships. According to Easton (1992, 8-27) networks can be studied based on relationships, structures, positions and processes.

The background of the industrial network approach, the Uppsala School of networks approach, can be linked to the studies during the 70s emphasising industrial marketing. The Industrial Marketing and Purchasing Group (IMP) in which research centres in Sweden, Great Britain, Germany and Italy co-operated, was organised out of these efforts. The reason for the new approach was based on the finding that industrial marketing differed significantly from the consumer marketing (Mattsson 1997, 451). Network research has however a broader functional perspective and background than simply marketing. Research is linked to macro-organisational studies, economic sociology, and theories of technological change and economic history (ibid. 452).

According to Håkansson and Johanson (1992, 28) the main aim of the model of industrial networks is to make possible an integrated analysis of stability and development in industry. A second aim of the model is to provide a basis for studies of the roles of actors and sets of actors in industrial development processes. According to Möller and Wilson (1995, 605) the intellectual aims of the networks approach are primarily descriptive. It tries to understand systems of relationships from the positional- focal firm's perspective, and the network perspective angle.

It can be asked what differentiates industrial networks from social networks in general? The difference between social and industrial networks according to Håkansson and Johanson (1993, 35) is that social networks are dominated by actors and their social exchange relations. In industrial networks activities and resources are of equal importance. The difference is not necessary very dramatic. If the above definition of social networks consisting of persons, objects and events are taken as starting points and adapted to an organisation context, the difference is not in principle very significant.

If industrial networks are to be differentiated from social networks in general there has to be other reasons. Is it industry? What then is industry? In the business-to-business context industry has been defined based on the actor basis: " industry being an aggregated system of participating organisations in a time-and space bound techno-social system"(Möller and Wilson 1995, 588). However, industrial networks based on organisations is not the only alternative. Traditionally industry has been defined based on products [11]. It could also be the basis for networks. However, the industrial network has typically no direct links to products.

Could industrial networks be separated from other social networks based on specific relationships? Could exchange relationship form a proper basis? It is common to link the industrial network basis to the Cook and Emerson (1978.725) definition of networks as "sets of two or more connected exchange relations". Theories of social exchange are primarily interested in explaining the emergence of various forms of social structures, including networks and corporate groups (Cook and Emerson 1984). Cook and Emerson's (1978, 725) definition points to social network on a general level and not specifically to that on an industrial level.

What would then differentiate industrial exchanges from any social exchanges or from pure market (or economic) exchanges? The distinction between the context of industrial network and economic context has received some attention (see e.g. Easton and Araujo 1992.). There have also been attempts to find common denominators on a relational

[11] Industry consisting of homogeneous products or products that are in close susbtitute positions (see e.g. Tirole 1989,13 and Bain.1966,6.).

basis. Olkkonen (1998) has developed a concept of relational exchange to emphasise the long-term features of exchanges within networks.

It has also been suggested that networks could be considered as such a common governance structure in a similar way as the market and hierarchy forms have traditionally been (see e.g. Håkansson and Johansson 1993; Powell 1990, Thorelli 1986, 37-51.). Axelsson (1992, 237-251,) was critical in this respect when evaluating the basis of industrial networks. On the whole, there seems to be weaknesses in the theoretical basis of industrial networks. However, these questions have not prevented the model of industrial networks becoming widely used. Citation based analysis of the impact of IMP literature on scholarly research showed that particularly since 1994 the approach[12] has been gaining wider acceptance (Horan et. all. 1998).

3.1.2. Structure and processes of industrial networks

In the beginning of the 1980's the IMP approach was still very much based on dyadic relationships. The emphasis on analysis was on the interaction of firms that buy and sell (Håkansson 1982,15). The network model of the late 1980´s (Håkansson 1987, 17) already contained the elements that have since been attached to the industrial network model (Figure 8). By that time the network model was specially linked to technological development.

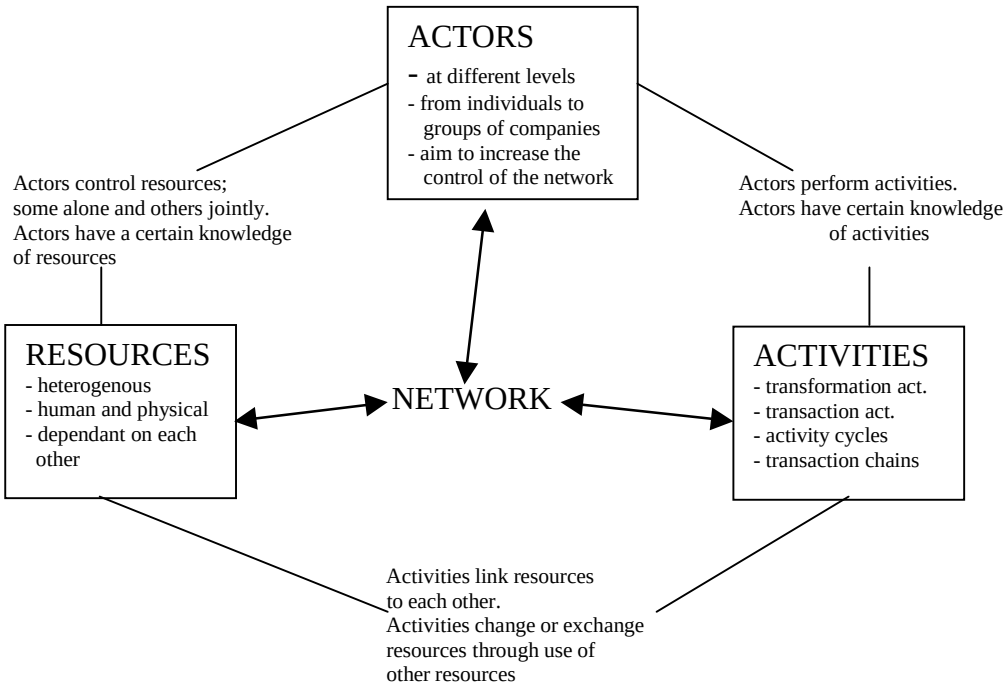

Figure 8. Network Model (Håkansson 1987,17)

Actors can be individuals, a group of persons, and a part of a company or group of companies. Each actor can be described in three dimensions: which activities the actor performs or controls, which resources the actor controls, the knowledge the actor has about activities, resources and other actors in the network The actors' main aim is supposed to

[12]It has to be pointed out that IMP does not only consist of industrial network approach.

be to increase their control in the network using their experience and knowledge of the network as well as their relationships with others (Håkansson 1987,14). Later on the development of relationships and goal orientation (increase of control) was raised beside the three main dimensions to characterise the actors (Håkansson and Johanson 1992, 28).

Activities are performed by the actors, which means that resources are combined, developed, exchanged or created by using other resources. There are two main categories of transaction activities: transformation and transaction activities. Transformation activities are always carried out within the control of one actor, and are characterised by one resource being improved by the use of other resources. Transaction activities link transformation activities, forming chains of activities, and creating relationships with other actors. Activities are linked to each other in various ways and they constitute parts of more or less repetitive activity cycles, where a number of interdependent activities are repeated. (Håkansson 1987,14).

Resources consist of physical assets (machinery, material, etc.), financial assets, and human assets (labour, knowledge and relationships). Transformation and transaction resources are mutually dependent. The use and the value of a specific transformation resource are always dependent on how it is combined with transaction resources and vice versa. Knowledge and experience of resources are important. New insights in the handling of resources can change or break old activity cycles and therefore contain the seeds of development and change in the network. Resources can be characterised by the actors controlling the resource, by the utilisation of the resources in activities and by the versatility of the resources. (Håkansson and Johanson 1992, 33)

The elements within each of the three basic classes of variables form within them a network structure. They are interwoven in a total network. There are specific forces that bind the three networks together (Håkansson and Johanson 1992, 34):

1. Functional interdepence: actors, activities and resources together form a system where heterogenous demands are satisfied with heterogeneous resources. They are functionally related to each other.
2. Power structure: on the basis of control of activities and resources there are important power relations between the actors. The performance of the activities is to some extent organised on the basis of those power relations.
3. Knowledge structure: the design of the activities as well as the use of the resources are bound together by the knowledge of the previous and earlier actors. And the knowledge of those actors is related to one to another
4. Intertemporal dependence: the network is a product of its history in terms of all memories, investments in relationships, knowledge, routine, etc. . Changes of the network must be accepted by at least large parts of it. Therefore all changes will be marginal and closely related to the past.

The intertemporal dependence suggests that stability and development within the network are closely related. Development in certain areas needs stability in others, and vice versa. The actors can act and therefore the model is voluntaristic. The relations between actors, activities, and resources though circumscribe the action possibilities. In brief the network model suggests mechanisms whereby stability and change in industrial systems not only co-exist but also are actually dependent on each other. The change of the network can also be considered as an evolutionary process Håkansson (1992, 129-143).

What have also been emphasised are the relationships within three basic elements (Håkansson and Snehota 1995). There are actor bonds, activity links and resource ties that bind the elements together. This was extended to a view where it is actually a question of a network on networks situations as the three elements are also considered as networks. In respective sub-networks it was expected that activity patterns, webs of actors and resource constellations could be identified that correspond to certain specific industrial network.

The industrial network paradigm has inspired a large number of studies in which the above-described model has been in a more or less dominant position[13]. Whereas in the beginning technological development and related subjects where emphasised, later on the relationship theme in business relationships in general has become more dominant (see Håkansson and Snehota 1995).

There have also been proposals to modify the basic network structure. Johanson and Mattson (1992, 206) suggested that the network governance and production should be separated from each other. This can be seen as an analogical development to that which has taken place in the institutional economics where the paradigm of a firm as a production unit has been replaced by the paradigm where the governance and production functions are separated. If this is commonly accepted there will also probably be more of a focus on network agreements.

3.2. From industrial networks to a foodweb

3.2.1. Change to food product perspective

It can be asked what is the role of the product in industrial networks. The origin of a network is linked very much to the studies of technological development. Studies have also been made concerning the development of products in industrial networks (Håkansson 1987, 84). In those studies development of a product has been a central goal that the network is striving for. In general the role of products has however not been very significant. This is demonstrated by the fact that products are not part of the explicit network structure.

In the market context products are key intermediates between the actors in the markets but in network context this is not the case. Market products are objects, which form the basis of value formation. In the network context it can be thought that it is the relationships itself, which are being valued and not the products that are results from these relationships. When food area is approached the lack of products in an explicit sense becomes a weakness. In industrial network analysis the starting point is usually certain specific actors, which form the network. The product area is of less central significance. In case of foods the opposite is true. Product area (foods) is of primary significance and actors are dependent on this. This means that there is a need to shift the emphasis to stress the role of a product because products are so important from the identity point of view of foods.

[13] see e.g. IMP Annual Conference Proceedings 1999.

Product emphasis can also be considered to bring more purpose to the existence of networks. It can be questioned whether networks would exist at all if they do not aim to create products. A network without a purpose would be just any social network. Even the forces that Håkansson and Johanson (1992, 34) mention are not related to any purpose. This is not to say that networks always aim for specific products, which could be called managed products. This is the perspective of traditional product development (typical in marketing, see e.g. Urban et. al. 1987). The product-network relation is typically less managed. Within networks opportunities emerge that can lead to different kinds of developments concerning products.

The product basis brings networks also closer to the traditional industrial approach where products are the basis of differentiating industries. Within the industrial network approach this would mean a change of emphasis from governance on an actor basis to governance on a product basis. In the case of industrial networks it would be the products that differentiate networks. A different question is the actual actor-product relation. Network products could be compared with other types of products (Figure 9). In the traditional approach the relationship between a firm and a customer is emphasised. The service approach brought out the importance of interaction between a firm and a customer. In the network approach the actor basis is especially broadened. Network products would differ from others in that there are actually more than two actors that more or less simultaneously create a product (Figure 9c).

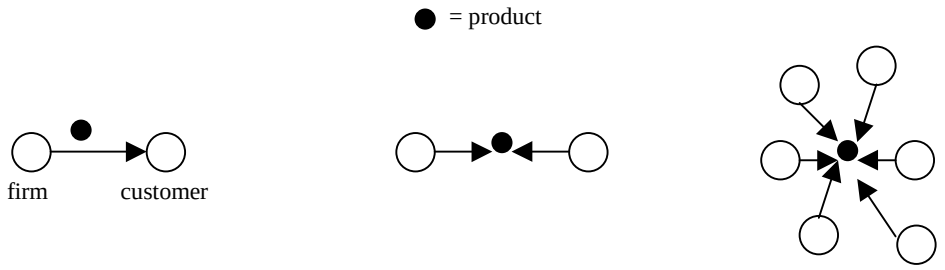

Figure 9. A product within different actor-product relationships

The food context could be described as an industrial context, especially if industry is defined based on substitute products. It is, however, unclear what is the basis of substitutability. In order to differentiate between market products and industrial products it would be tempting to define industrial products as supplier products, if market products in turn are producer-consumer or supplier-customer products. It is though too simplistic because consumers and customers also influence industrial products. In the industrial network context the actor basis is even broader and the influence of different actors on products can vary.

Industry has also another typical feature. Even though industry by above-mentioned definitions does not necessary have requirements for high product volumes it is common to consider industries and massmarkets as a similar types of phenomena. However, in theory it is also valid to consider industries that consist of a few product types with very low product volumes. The use of the concept of an “industry” can be even misleading. For example on a general level it is common to use the umbrella concept of the food industry

even though there are many food products which are not truly substitutes in the real market context.

That leads to the question of the difference between technological similarity and substitutability. In the case of health-promoting foodstuffs the difference becomes evident. A health-promoting yoghurt although in many respects similar to other yoghurts is not necessarily a substitute for traditional yoghurt products. It could be as well be part of a specific health industry than the dairy industry in which it is traditionally located.

3.2.2. Properties of a foodweb

Basic assumptions

Some basic assumptions are made concerning the behaviour of the actors in a foodweb. They are thought to be rational actors. Rationality is however not given technological boundaries (like limitations in brain capacity) but it is thought to be institutionally dependent. It is assumed that actors in foodwebs are bounded by institutional[14] rationality. This means that their preferences and decisions are very much based on customs and habits.

Interaction is thought to be a key elementary process within a foodweb. As it is assumed that a foodweb is an open system, the interaction process also links a foodweb to its environment. Interaction has a relation with exchange phenomena. An exchange is like a derivative of an interaction process. Interaction therefore refers to the continuity of a process whereas an exchange is more like a cross-section in time. Even if it can be thought that ideally all the interactions in a foodweb are known, a more realistic approach is, that in any specific context only some of them are known. In order to emphasise this fact the concept of revealed interactions is adopted. This refers to the fact that for an outsider or even for an insider in a foodweb the entire interaction that takes place is not visible but remains at least partly unknown.

Foodwebs can only in special conditions be considered as managed or controlled. At certain phases or under certain conditions a single actor or small coalition can be so dominant that they actually seem to control the foodweb. It is assumed that the open nature of foodwebs usually makes this is a temporary situation.

Structure of a foodweb

The structure of the foodweb is based on the Nordic model of industrial networks (see chapter 3.1.1). The model is specially modified to take into consideration product perspective. For that reason product development is given an explicit role in the structure of the foodweb (Figure 10). Product development is not only considered as a single activity in the web but as a key integrating mechanism.

[14] The content given to concept of institution is not uniform (see e.g. Mäki 1993, 13). ”Institution” usually refers to social rules and regularities that are based on common beliefs.

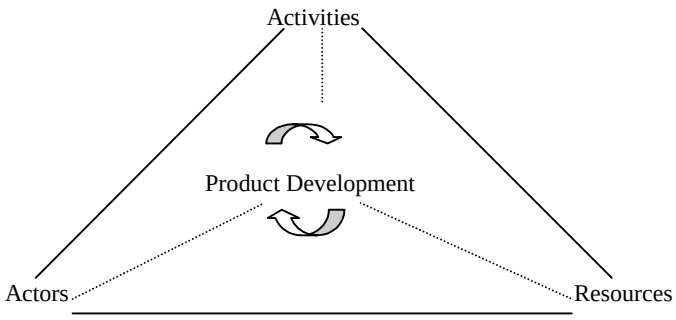

Figure 10. The structure of a foodweb

Activities

Activities are those elementary operations of a foodweb that usually take place repeatedly and more or less regularly. They are relevance for the development of products in a foodweb. In industrial networks transformation and transaction activities were considered as actors performed the elementary activities which linked resources. Activities can form different types of configurations. In foodwebs market like activities are the starting point for describing the activities. It is assumed that in minimum case there are there are two types of activities in a foodweb: production and consumption activities. Production refers to industrial scale transformation activities that result in tangible and intangible products. Consumption refers to the use of products that is ultimately dominated by the interests of individuals.

Actors

Actors define the operative units that are of importance in a foodweb. Such actors are of special influence when it comes to the development of products. They are not necessary the same as formal organisations because usually organisations contain many parts that are not of direct significance for specific products. On the other hand within certain organisation different parts of the organisation can together form an actor that is of relevance in the product development context. The separation of actors and activities is assumed to take place in foodwebs. It is for example possible that within a single actor both production and consumption type of activities take place. It is also possible that e.g. production activity is divided between several actors. A one-activity-one- actor situation is considered to be an exception.

Industrial networks were thought to consist mainly of industrial actors. Individuals can also be actors but it is usually assumed that they act on behalf of industrial organisations. If they were assumed to be motivated based on their own advantage, they would be acting like consumers. The starting point on foodwebs is that actors are united with product related interests. Behind this product interest there can then be very different kinds of motives.

It can also be argued that there are situations where the gap between actors on industrial networks and foodwebs is not any more very clear. A global industry with tens of thousands of customers with localised markets can not act at a similar personal relationship level as a network where there are dozens of actors. It can also be claimed that today

many consumers are in their attitudes very much like professional buyers as they make food purchases, for example, for their families.

Resources

The third element that can be assumed to be necessary for product development is resources. A foodweb without any links to resources would hardly be recognisable as a foodweb. Resources on foodwebs are initially assumed to consist of two types of resources: natural endowments and technology. In industrial networks different types of resources are assumed to exist, but here the starting point is simpler. It resembles that of the market approach in which typically technology is considered a key resource factor. From traditional food context stems from the assumption that natural endowments are of significance as a resource base.

Development of products in a foodweb

Product development is here considered in a different sense than in network context in general (see e.g. Håkansson1987, 84). It is a continuing process that is linked to the very existence of networks. The creation of products is also different from product development in a single organisation context. The actor, activity and resource basis contains more possible development trajectories than are typical in single organisation context. Generally, it can be assumed that there are many more uncertainties due to the uncontrolled nature of networks.

Development in single organisation context could easily be labelled a supply based development. Even in supply based development demand is always present in some form. A product could be assumed to consist minimally of supply and demand ideas. What is typical in the supply approach is that the demand idea will get less attention than the supply side idea. Even though both sides start from an idea level most development efforts are on the development of supply side concepts. In a foodweb context the situation is more complex because there are usually several concepts that all direct the development process to greater or lesser extent.

Product development can be considered as a tertiary level in foodwebs. Interaction being the most elementary process. Actors, activities and resources combined with the interaction between them form the secondary level (Figure 11).

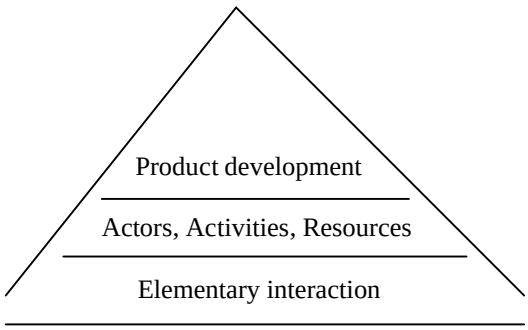

Figure 11. Process levels in foodwebs

Change in foodwebs

In the Nordic industrial network an assumption is made that the networks are stable. No such initial assumptions are made concerning foodwebs. A foodweb can be retained or either a long or short period of time. What is here of importance is the role of a product. To what extent it is dependent on a specific foodweb? It is very likely that there will be changes in a foodweb as the development process continues.

If actor perspective is being emphasised it can be assumed that normally there are two general dimensions in the changes in a foodweb. One of these is an expansion that means that the number of actors that interact with the foodweb increases. This may mean only quantitative changes in which case the new actors that join a foodweb are a relatively homogenous group or it may mean also qualitative changes as the new actors differ from each other. An opposite dimension to expansion is contraction that can also be of a quantitative or/and qualitative nature.

When besides actors also resources and activities are being considered the change of the foodweb can have two dimensions. One is integration that means an increase in the integrity of a foodweb. It can mean more personalised interaction, more activities that depend on one another, and a resource basis that is less distinguishable. An opposite direction to this would be dispersion of the foodweb.

The dynamics of change in a foodweb can be divided into two broad classes. There can be incremental changes. This means that a change in any foodweb elements or its environments causes changes that takes place gradually even if the final outcome is very different from that at the starting point. Another type of a change is radical change where a foodweb alters remarkably in a short period of time.

Foodwebs can also be considered from the learning point of view. An actor point of view is emphasised when the learning process of the foodwebs is examined. It can be assumed that foodwebs are constantly learning and this will affect the ways it operates. A foodweb can be called a learning foodweb, if significant changes take place in the ways it operates based on experiences from the past.

4. Empirical part of the study

4.1. Case study method

According to Stake (1994, 237) case studies can be classified based on the purpose of the research. There are three general types of cases: intrinsic *case study,* here a study is undertaken because one wants a better understanding of the particular case; *instrumental case,* a particular case is examined to provide insight into an issue or refinement of a theory; *collective case study,* it is not a study of a collective but an instrumental study extended to several cases.

Another approach is to classify case studies based on the number of cases in the study. Yin (1989) differentiates between single and multiple case studies. If multiple cases are being examined there are various possibilities. Yin (1989) differentiates between holistic and embedded types of approaches when multiple case approach is chosen. In holistic type one unit of analysis per case is chosen whereas an embedded type consists of several units of analysis per case.

In this study the phenomenon under study was the development of health-functional foods. It was therefore not a matter of development of any specific health-functional foodstuff, which ruled out the intrinsic case study approach. Then there was the possibility to select a single case that would have been considered as an instrumental case to provide insight into the development phenomena. What favoured the single case method was the limited resources available. With limited resources a single case study would have made it possible to go deeper into the details of that specific case. However, it could have meant that certain important features of the phenomenon would have been by-passed if they were not of significance in that special case. On the other hand with limited research resources available in a multiple case approach there is always the risk that the cases will be approached too superficially and the underlying phenomenon will not be understood.

In this study the collective case study approach was chosen. The phenomenon that was of interest was the development of health-functional foods and the cases were examined in order to provide insight into it. The choice was based on the fact that the phenomenon had not previously been much studied. It was thought that despite the risk that in multiple cases it would not be possible to go deeper in details, it would give a more holistic picture of the phenomenon.

In multiple case analysis it is also possible to make cross-case analysis in addition to the basic within-case analysis. As the phenomenon under study was examined using qualitative approach, it was not necessary in advance to decide to what extent there would be cross-case evaluations, but such decisions would evolve as the study was carried out. Cross- case analysis was not an aim itself, but it was thought that it could give new insights.

4.2. Selection of the cases and broadening the information basis

When selecting the cases it was hoped that they would reveal different aspects of the phenomenon. The universality of these aspects were of less interest. Certain selection criteria were set. What united all the cases was that they all should involve health-functional food products. Other selection criteria were that they had to be commercially successful and that they had to have already had some history behind them.

When we looked at the availability of such cases we found out that there were not very many such products on Finnish markets in 1997. The uncertainty concerning the true extent of this product area made the choice of cases even more difficult. There were opinions according to which all foods are health-functional. There were also opinions according to which only products with substantial modifications should be included to this category. The examination concerning the background of this product group, which led to some characterisations of health-functional foods, was of significant help at this stage.

From the study point of the view it seemed that actually it would be advantageous if there were some cases that lie on the borderline between being health-functional and non health-functional. This would make it possible to examine the problem further and to gain new insights in addition to those already gained. Based on the above considerations the following product cases were initially chosen (identified by the respective trademark if the products had them):

Benecol, was a recent product of the Raisio Group, which many experts in the field considered as the most typical example of the modern health-promotional foods when this group of foods are evaluated on the food-medicine dimension.

Hyla, was a product of the Valio Group. There opinions were divided as to whether it was really a health-functional product. The question of health-functionality would be an issue. It was also interesting because it was an older generation product by the same company as was producing LGG based Gefilus. It would mean that some aspects involving differences in time could be dealt with.

LGG, produced also by Valio, was also considered as a typical example of what was meant by a modern health-functional food. The Benecol and LGG cases seemed to create a pair that had both common and differentiating elements and they would therefore be especially interesting in-between-case analysis.

Xylitol (also a generic name of a substance), was a product by Cultor. Xylitol is often considered in the Finnish context as the first health-promotional food already before this category had been widely recognised. This case was expected to bring also some perspective to the development of foodwebs in general.

Yosa, was a product from Bioferme. Initially some experts raised concerns whether it was a true health-functional food. It differed from the other products because it was a product made by a small company. It was expected that the foodweb would therefore be different from the others.

After the products were chosen, contacts were made to respective firms that produced and owned the trademarks of the products in order to establish whether they were positive towards giving information for the purposes of this study. Their attitudes were positive in all case and the study process could continue as planned.

At this stage of the research there were already indications that some factors (e.g. the actor basis and differences in public regulation), even though they are of significance from the development point of view, might not become a significant issue in the Finnish context. This meant that as a general hypothesis concerning the foodwebs was going to be made, some important aspects would not be represented. Therefore it was decided that after the case study in the Finnish context was undertaken, additional information concerning development in the international context would be required. This meant that the study actually was going to be more comprehensive than the initially planned specific product based case study.

4.3. Data collection and analysis

Data collection

Data collection started with a preliminary familiarisation with the cases. Prior relationships that the researcher had with professionals in the empirical field of study made it possible to make inquiries and short interviews first on an informal basis. The idea of a foodweb contains an assumption that there are usually different types of actors in a foodweb, so it was necessary to incorporate different viewpoints in the study.

One difficulty concerned the fact that some cases had a history reaching back to the 1970´s. A typical situation was that in the respective organisations changes had taken place and some of those persons involved in the development in the first place, could no longer be reached for different reasons. It was also found out in the early stage that selection of informants could not only be based on their position in the organisational hierarchy. It seemed that in the cases for example the role of the top management seemed to differ. In some cases they were more involved than in others.

As far as the development process is concerned one problem is how far back should the processes be traced. In practice it is possible to follow different development paths to different extents. In this study a key starting point was the time when the first idea for the product was expressed.

A major problem concerning the data collection was that there were few sources in written form other than product specifications or other technical data. There were even less written data available concerning the development of the product. Given the resources it would not have even been possible to go through all the internal memos of all the actors involved even if they had been available. Therefore it was necessary to rely mainly on information received from those people actually involved in the development processes.

In the first phase experts were interviewed who were not linked to any specific cases but who were at least in principle part of all the food webs. One of the experts represented major retail chain in Finland (Kesko Oy), two others were representatives of public authorities (The Ministry of Trade and Industry and Finnish Food Authority) and one represented consumers (The Finnish Consumer Association). In the second phase informants were chosen who had been closely involved in the product development process.

The following structure of informants/case was the result (more details concerning interviewees are given in appendix 1):

Benecol:	two interviews
LGG:	three interviews within a company
Hyla:	two interviews within company
Xylitol:	three interviews
Yosa:	two interviews

Each interviewee were sent in advance a list of topics that were going to be discussed (see also appendix 2). As the interviews were made, a foodweb based framework was not presented to the interviewees and no references were made to the general

functionality of foods. The interviewing took place using the traditional conceptualisations that the respondents were familiar with. Most of the interviews were carried out in autumn 1997.

Interviews were not made in any specific order. The reason for this was that it was assumed that because it was a matter of heterogeneous cases there was no special reason to start from one specific case. It was assumed that a learning process would take place and affect the following interviews whatever the order may have been. This would make the approach in practice close to the replicative order (see e.g. Miles and Huberman 1994) in which the understanding of previous cases is the basis for studying other cases.

All the interviews were recorded and notes were taken during the interviews in order to help to organise the data. After the interviews transcriptions of the tapes were made. A case narrative was written for each of the cases based on the material available. The narratives were then sent to the interviewees who were asked to comment on possible incorrectness and misunderstandings. Changes were made based on these comments.

After the Finnish cases have been analysed another gathering of information took place. It was not any more restricted to information concerning the case products. The aim was to find out themes and problem areas that did not come up at all in cases or which were not of significance in a Finnish context. Some experts in the field were contacted concerning possible information sources. Such sources consisted of secondary sources such as books, journal articles, market reports, and information published on the Internet. Time horizon in the cases was from the beginning of the development to the end of year 1997, the time period for data gathered for the purpose of considering health-promotional foods on a more general level extended to the end of 1999.

Data analysis

The case narratives formed the basis for further analysis of cases. The case narratives could be characterised as stories of the product development based on consensus among respondents. The role of the researcher for this part of the research was as much as possible that of an information collector and editor.

According to Miles and Huberman (1994) data analysis consists of the following phases: 1) intertwining of data collection and analysis 2) formulating of classes of phenomena 3) identifying of themes, and 4) provisional testing of hypothesis. Intertwining of data collection means that data collection is not separate from analysis. This meant that data that was obtained from cases could not be treated as pure objective data, which would then later on be simply analysed.

As data was collected, analysis took place that increased knowledge concerning the phenomenon , which in turn affected further data collection. When it comes to formulating classes of phenomena and identifying themes, in this study the starting point was not typical for a qualitative study, because based on the previous framework constructing done at the beginning of the study, there were already some initial classifications made. The purpose was, however, not to test these frameworks, but they were expected to guide the analysis and improve the identification of the development relevant themes. In the study the aim was to produce initial generalisations and not clear-cut hypothesis.

When it comes to analysis phase no formal codification procedures were followed and no computerised data analysis methods were used. Taking into consideration the purpose of this study such procedures were not considered critical. Especially if the emphasis in the study had been more in the cross-case comparisons, the situation would have been different and probably the analysis would have benefited from the use of such analytical tools.

The analysis procedure could be called “process thinking” as for example the narratives and the initial framework were repeatedly gone through on a mental level in order to gain insights concerning the relationships. This meant a strong reliance on an inductive process.

4.4. Questions of validity and reliability

Qualitative researchers have no consensus on addressing such traditional topics as validity and reliability. Although researchers felt first compelled to relate to traditional notions of validity and reliability, later they developed their own language to distance themselves from the positivist paradigms (Creswell 1994, 157). Despite this development the issues of validity and reliability are still of key concern also in qualitative research.

Validity

Creswell (1994,158) brings out two themes concerning validity: 1) Describe how the study will address the issue of *internal validity*, the accuracy of information and whether it matches reality. 2) Discuss the limited generalisability of findings from the study – the *external validity*. There are also other ways classifying validity. Yin (1989) divides validity into three categories: *construct validity*, internal validity and external validity (see Yin 1989). Construct validity refers to the operationalisations of the concepts being studied whereas internal validity then relates more to the internal causal relationships within the case. Especially the internal validity in the latter approach reflects the influence of the positivist and quantitative traditions.

It can be asked about the validity of the empirical study. What was the significance of the case selection? It is obvious that selection of cases will affect validity. In this study it was considered that there were not very many alternatives when it comes to the selection of cases. If there would have been more cases available probably it would have been possible to use different criteria in case selection, thus matching the study better with the overall phenomenon. However, it is probable that the cases represented quite well the phenomenon in a Finnish context at a certain period.

When it comes to within case research processes, the main procedures to improve internal validity was careful selection of the interviewees, the choice of more than one informant per case and compilation of case narratives, which the interviewees then reviewed. As it is a matter of a qualitative research the personal role and behaviour of a researcher is also important. What probably helped in the orientation was the background that the researcher has in the field. There were also no value conflicts because the researcher has a general positive attitude towards the phenomenon under study. To lower the barrier between the researcher and interviewees the atmosphere during the interviews was kept as informal as possible and in the language that was used theoretical concepts not well known were avoided.

In the study the external validity was specially emphasised as the generalisability of findings is often considered to be the main weaknesses of case studies. Generalisation then usually refers to the statistical generalisation. In case studies generalisation more often refers to the analytical generalisation (Yin 1989). In an attempt to improve the external validity of the empirical part of the study, the decision to expand the information basis beyond the specific cases has to be mentioned.

Reliability

Reliability is linked to the replicativeness of a study (Creswell 1994, 159). Sometimes it is said that good reliability means that other researchers following exactly the same procedures as the one who has undertaken the study will arrive at the same findings and conclusions. In qualitative study such a demand causes problems. The question of the difference between the transparency and replicability of a study becomes of importance.

It is one question whether a research is so well documented that an outsider can follow the process of a research and the decisions that are made in it and another question to what extent a study is truly replicable. The more the inductive process, evolving decisions and the personal role of the researcher are emphasised, the more the replication would actually require that the person reproducing the study would have to have same mental set-up as the original researcher.

Yin (1989) suggested that a detailed protocol of data collection should be reported so that the procedure of a qualitative case study might be replicated in another setting. In fact the grounded theory of Straus and Gorbin(1990) relies very much on such specific procedures to be taken. When the purpose of this research was taken into consideration it was, however, decided that a detailed protocol of data collection that goes beyond the usual notes like facts concerning interviews, was not of crucial significance.

In a study where data collection is based on interviews, there are special reliability concerns. Interviewees are not impersonal sources of information. There are differences in how they remember and interpret occasions in the past. In case of special types of data, like dates, there can be expected to be always problems of reliability. There are also other concerns. Many factors are not under the control of a researcher or a researcher may not even be aware of them, even though they can be crucial from the reliability point of view. For example an interviewee may have an especially busy schedule on the day of the interview and therefore can not concentrate on the interview. This may result in some important topics not coming up during an interview. A similar interview at some other time could give different results.

Triangulation means procedures that reduce the likelihood of misinterpretation (Stake 1994, 241). This is also of significance as far as reliability is concerned. The selection of more than one interviewee per case can especially be thought to improve reliability. If the views seemed to differ it was always possibly to clarify them. Also the compilation of the case narratives improved reliability. Once the development process was presented in written form and examined by interviewees, the reliability of the study probably improved.

5. Health-functional foodstuffs – five cases

In this chapter the purpose is to describe the development process and respective foodwebs in order to increase understanding of the empirical problem and question that are confronted as health-functional foods are developed. In order to obtain a more holistic picture especially those aspects are emphasised that are special in every case. Cases are presented in the order in which products were launched to markets.

5.1. The case of Xylitol

5.1.1. Background of the health-functionality

As a chemical substance xylitol has been known for over a hundred years. The first applications in foods are from the 1950s. In the former Soviet Union and also in China it has been used as a sweetener for diabetic patients. For medical purposes xylitol is used in Japan and especially in West Germany, where it was given intravenously for patients even before the dental applications in Finland began.

The high consumption of sugar (saccharose) was considered to be a major health problem during the 1970s. Background of this was the well-known role of sugar as a promoter of caries. In order to prevent caries it was recommended that the use of sugar should be minimised. Consumption of sweets and chewing gums was considered especially harmful. These developments gave opportunities for sweeteners that did not cause the same kind of harmful health effects as saccharose. The health related background of the product is therefore based on a search for means to prevent dental caries.

5.1.2. Periods in the development of the xylitol products

In this section product development and events that had a major impact on that are on a forefront. Five different periods were recognised in the development of xylitol products. They are: 1. Complementing triad 2. Push by experts 3. Loss of safety image 4. Consumer commitment 5. Global orientation

5.1.2.1. Complementing triad

This was a period during which the initial foodweb emerged and a basis was laid for consumer products. The previous medical applications meant that toxicological studies had already been made on 1950s. In 1963 xylitol was approved in the USA as a sweetener in special diets. At that stage there were no large-scale commercial applications. The background of xylitol however made it possible not to start from the very beginning as it would have been with a previously unknown substance.

Cultor Ltd (by that time Finnsugar Co) had developed technology that was suited for the production of special sweeteners such as sorbitol and fructose, which were already established products on markets. New products were also looked for that could be produced using the same technology basis. This directed interest to xylitol. As production of xylitol seemed possible a search was made to find possible applications for xylitol products. The Institute of Dentistry at the University of Turku was contacted at the end of the 1960s.

At the Institute of Dentistry there was already an interest in prevention of caries. Preliminary tests were then made. The initial good results gave Cultor an incentive to support a two year long clinical research project, Turku Sugar studies, in which xylitol was compared with saccharose in a normal diet. The results were even more positive than the researchers had expected. Total substitution of saccharose was not needed to achieve the positive effects and a remineralisation effect was noticed. What was now needed was a producer of xylitol containing products to continue tests using consumer products.

The confectionery factory Leaf Hellas Co (by that time Hellas Oy) was at that time part of the Huhtamäki concern also located in Turku. The health policy aimed to reduce the consumption of sugar was intensified and culminated to a campaign against sugar in 1975-76. The sales of sugar containing chewing gums and sweets were declining. Products containing sorbitol had already entered Finnish markets and Hellas was lagging behind in this development. It was actively looking for products where alternative sweeteners to saccharose were used. The company had already examined the possibility to use fluorine in sweets before xylitol appeared.

Lozenges and chewing gums were especially suitable products for xylitol products because in both cases there is a mouth-lag. That means that products are not swallowed immediately, but they stay in mouth for a period of time. This was a necessity for xylitol to be effective. No sacrifices were made in the organoleptical properties of products. Some considered xylitol being organoleptically even better than saccharose because of its cooling effect, when it dissolves in the mouth.

After the Turku sugar studies a short follow-up research was done using chewing gum as a test product. That research gave similar results as the original study. The positive results meant that development could be continued on several fronts. At Hellas the development of xylitol products was started by Mr Sakari Taskinen who was hired to become product development manager and who then later on provided continuity to the development of xylitol products. After several years of research Cultor patented the industrial production method for xylitol in 1974. Hellas Leaf did not at that time consider it necessary to patent its development achievements.

Cultor contacted public authorities in order to get permission for xylitol in foods. First, the medical authorities and then the food authorities were contacted. Permission was granted first for chewing gums, lozenges and later a special permission was obtained for chocolate products.

5.1.2.2. Push by experts

Leaf Hellas launched Xylitol chewing gum –Xylitol Jenkki - both in Finland and in the USA year 1975, after the results of the Turku Sugar studies were published. During the first spring Leiras Oy[15] distributed the products through pharmacies. Later on in the same year Leaf Hellas entered the retail markets. In Finland the sales of xylitol products started to increase slowly. In the USA the product was not commercially successful. The company had not the resources and willingness to invest in a large scale to support the marketing of the product in the USA.

[15] a pharmaceutical company part of the Huhtamäki concern

Xylitol was more expensive than sugar. Accordingly xylitol based products were more expensive than sugar based products. To compensate this difference in most products besides xylitol other sweeteners such as maltitol and sorbitol were used. Consumers, however, accepted the higher price of xylitol products. In 1975 several new lozenge and chocolate products were introduced. The chocolate products were made based on the wishes received from the consumers and not so much on the wishes of the development personnel within the company. The dental health advantages of xylitol in chocolate are not as obvious as in other products. At the same time also other producers in Finland started to launch products that were sweetened using xylitol.

Already at the beginning the informing of specialists of the research results was an important part of the development. Specifically dentists and dental nurseries were informed of the research results and of the significance of xylitol. It was noticed at the beginning that in medicine other branches than dentistry understood the advantages provided by xylitol more readily. In the dental profession the older generation of doctors had not studied much chemistry, biochemistry and microbiology. This had an impact in the beginning. In Finland there is, however, a good system of medical further education, which spread the information of the advantages of xylitol to specialists.

Cultor was already in the early stages of development aiming for international markets as a producer of xylitol. At the same time as Cultor had developed and patented the production process for xylitol, the Swiss based company Roche Group (at that time Hoffman-la-Roche Ltd.) was investigating xylitol processes in its laboratories. Because of the patent protection gained by Cultor, they could not continue work to industrial scale. Therefore they contacted Cultor which was then looking for a partner that would be experienced in international marketing of such special products, and who could also manage the procedures that were needed to get permission for food use in different countries.

In 1976 the companies founded a joint-venture company the stocks of which were owned on a 50/50 basis. The mission of the company, called Xyrofin Ag, was to market internationally the special sweeteners produced by Cultor. Roche hired most of the sales and marketing personnel whereas Cultor was responsible for product support and technology development. The company was located in Zug, a small town in Switzerland. At the same time also a big chewing gum producer in the USA – Wrigley Co - had become interested in xylitol and as early as 1977 had bought considerable amounts of xylitol.

5.1.2.3. Loss of safety image

There was an intention to obtain a GRAS (Generally Recognised As Safe) status for xylitol in the USA, because it would not have been possible to enter general food markets in the USA without it. The permission obtained in 1963 for specific use was not sufficient in this respect. On the request of the US authorities, Xyrofin had research done at Huntingdon Laboratories in UK concerning the long-term toxicological effects of xylitol. The aim of the tests was to confirm the safety of xylitol. The test animals were rats, mice and dogs. In the beginning the test results were as expected but at the end of the research there were signs that xylitol causes cancer. These results were spread rapidly by the media.

Afterwards these tests have been very much criticised. The test animals were given extremely high amounts of sweeteners. The respective amounts would have meant that a

person weighing 70 kg should eat 0.6-1.3 kg of sweeteners in a day. The high doses meant that the normal metabolism of the animals changed. The high amount of saccharose and sorbitol that were used in the tests caused similar cancer promoting effects. Later on it has been observed that in corresponding tests also lactose has similar effects. Of major importance are also the differences in metabolism that exist between humans and that in the test used animals. The metabolism of rats, mice and dogs differ significantly from that of humans and they cannot, for example, use carbohydrates in a similar fashion as humans. A pig as a test animal would have been closest to a human physiology in many respects.

The results caused the research project in the USA being stopped. Wrigley also withdrew from the project. The results did not have major consequences in professional circles especially outside the USA and they did not cause changes to the official permissions already obtained. In year 1983, the joint committee of the WHO and the FAO (JECFA) concluded that a reasonable use of xylitol does not cause any health problems for humans. There is no ADI value (maximum Acceptable Daily Intake) for any sugar alcohol including xylitol. Especially in the USA authorities were unwilling to confirm the safety of xylitol. Not until 1986 the US authorities gave xylitol a GRAS position (Generally Recognised As Safe in food use).

The interest of Roche Group in xylitol was also diminishing. This in turn meant that the operational preconditions for Xyrofin were weakening. This combined with difficulties in the fructose markets resulted that Cultor raised its share of ownership in Xyrofin first to 70% and later on to 100% in order to get a better control of the business area. Key marketing and service activities were relocated to Redhill in UK that became a centre for Xyrofin operations.

5.1.2.4. Consumer commitment

In Finland the sales of xylitol sweets and chewing gums increased steadily even after the results from the Huntingdon research had been publicised by the media. A turning point was reached after the so-called Ylivieska studies. There were two research periods in that study. The first period was between 1982-85 and the second period between 1987-89. When the first results of the Ylivieska studies became public sales of the xylitol products started to increase significantly. The sales of xylitol products that Leaf Hellas was marketing increased by 30% in each consecutive year. In 1989 a chewing gum brand Xylitol-Jenkki was the most sold candy in Finland. At the end of the research period xylitol containing products dominated especially the chewing gum markets in Finland (Figure 12)

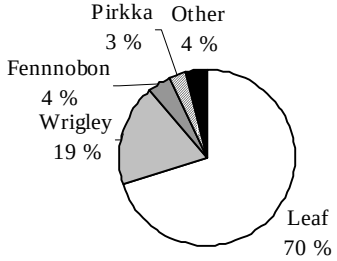

Figure 12. Market shares of xylitol chewing gums in Finland 1997 (Source: AC Nielsen Scantract; incl. grocery shops)

Xylitol containing chewing gums became an important part of oral hygiene not only of individuals. For example in many nursery schools, xylitol containing chewing gums were replacing the traditional use of toothbrushes, because of the difficulty of controlling the hygienic use of the latter. Xylitol was considered to be a convenient alternative.

Consumers have not been active only as buyers of the product. In Finland there was a special tax on products high in sweeteners. A school class (the 4th class in a primary school in Vatiala) made a proposal to exclude the xylitol containing products from this taxation. In 1994 they were successful after a three year campaign. The tax was no more levied on xylitol containing sweets.

5.1.2.5. Global orientation

Global orientation in the research started early on. During the 1970s xylitol was used in cariological research in the former Soviet Union. The WHO also became interested in xylitol research at an early stage and research was done in Thailand and Polynesia. At the beginning of 1980s just before the Ylivieska studies there was research concerning xylitol in Hungary and Canada. While the Ylivieska studies were under way, plans were made concerning long term clinical studies in which saccharose, sorbitol and xylitol were compared. This led to the Michigan program during 1988-95. Part of this was a major research project that took place in Belize in Central-America. In Belize there were over 1000 children that took part in research where different sweeteners were compared. The study concluded that xylitol is useful in programs aiming for the prevention of caries.

The budget of Belize project was over FIM 10 million. For Leaf Hellas, who was a major supporter in that study, it was the biggest single investment in xylitol research. It was estimated that the clinical tests of xylitol have altogether cost tens of millions of marks.

There were also other reasons why the research was becoming international. The use of xylitol in Finland had become so common that it was more and more difficult to find test subjects who had not used xylitol. This made comparisons with other sweeteners difficult. Also the ethical rules concerning research were tightening. It was not permitted to ask test subjects to use saccharose in comparative tests because saccharose was known to have a caries promoting effect.

In Finland the growth in use of xylitol, especially in chewing gums, slowed down during the 1990s because xylitol was already so extensively used. Therefore international markets became more and more important both for Leaf Hellas as well as for Cultor. Within the Huhtamäki concern a major change took place when the confectionery business was chosen to become one of the concern’s strategic business areas. Several confectionery companies especially in the USA were bought and a new unit Leaf Group was established in 1983. The former Hellas then became part of the new unit and was renamed Leaf Hellas. Xylitol products did not have any specific role in these changes even though it brought new opportunities for the products.

There were differences between European countries especially in consumption of xylitol based chewing gums. In Sweden, Norway, Holland, Switzerland, and Italy more xylitol based chewing gums were consumed whereas for example in the UK the overall per capita consumption of chewing gums was lower. The use of specialists in marketing of xylitol products to increase the credibility of the products has been of crucial importance

in all the countries. There are official endorsements by dental associations besides Finland also in Sweden, Norway, Iceland, Estonia, Belgium, Holland, Canada and Ireland.

For Cultor xylitol has been one of the most important products, the growth of which was over 15% during many years in 90's. The worldwide market share of Xyrofin was over 70%. The capacity for the production of xylitol was always slightly lower than the actual demand even though Xyrofin has continuously increased the capacity. Cultor invested over 500 million marks in xylitol between 1992-97. The return on the investment was higher than in other investments within Cultor. In 1996-97 Xyrofin build a xylose factory in connection with the viscose production of an Austrian wood processing company Lenzing AG. Beech is almost as good a source of xylose as birch that had previously been exclusively used. Crystalline xylose was still shipped to Kotka factory to be refined into xylitol.

At the end of 1997 xylitol was approved for use in foods in over 40 countries. After Japan permitted xylitol in spring 1997 xylitol is being approved to differing extents on all the major markets. Also US foods firms, including Wrigley, have taken xylitol-containing products into their product assortment. Besides sweets and chewing gums there are also other applications for xylitol in many other product groups like in oral hygienic products and medicines.

When international markets are considered besides the basic approval of xylitol products also other regulatory questions are important. Concerning the use of results of research in marketing, the attitudes of the Finnish authorities has been very pragmatic. Health claims in the food context were principally not allowed. However, the authorities did not intervene until a later stage when there were claims made concerning other than the dental health effects of xylitol. Internationally there were differences in that what kind of claims could be used. For example in the USA there was a claim approved for all polyols: does not promote tooth decay.

As Finland has entered the EU it is no longer possible to give xylitol containing products a tax advantage over such products where other sweeteners are used. Behind this there is the EU policy that aims at the enhancement of competition. It was not denied that xylitol had caries preventing effects. However, it was assessed that the advantage of xylitol was not so much that it would justify a tax difference based on national health considerations.

5.1.3 Identification of the respective foodweb

In the following emphasis is on the identification of the structure and dynamism of the foodweb that lies behind the product development process. This is expected to give more background to the development process that was described above and that was seen more from a product point of view.

5.1.3.1. Actors

In the following the main actors are briefly described. The basis here is the official type or form of an actor. Parts of the organisations or individuals are being mentioned as actors to the extent that their roles came up as the cases were studied.

Cultor Ltd (at the beginning of the period Finnish Sugar Co, annual sales in 1997 US$ 1.8 billion) had been a dominant producer of sugar and sugar based raw materials on Finnish markets. Especially under the leadership of *general director Gustav Herzen* it had gradually diversified also to other business areas like feeds, biochemicals and food ingredients. The former director of the research centre *professor Melaja* was in a key role as technology was developed. *Roche Group* (at the beginning Hoffman-la-Roche Inc, turnover 1997 US$ 11 billion) a Swiss based pharmaceutical and diagnostics company was an actor especially in the beginning as it founded a joint venture company *Xyrofin Ltd* with Cultor.

Leaf Group (at the beginning of the period Hellas Co, annual sales in 1997 US$ 400 million) was formed in 1983 as the Huhtamäki concern acquired confectionery producers mainly in the USA. Hellas was then merged into a new company and named Leaf Hellas Co. Within Leaf Hellas *research director Sakari Taskinen* and *marketing manager Erkki Leskinen* provided continuity in the development of xylitol products. Later on several other chewing gum and confectionery producers have also had xylitol-containing products.

Turku University, Institute of Dentistry under the leadership of *Professor Arje Scheinin* was an important partner especially in the beginning. *Professor Kauko K. Mäkinen* who also worked at the same institute has been a leading figure in xylitol research since the beginning of dental applications. *Dental associations* in different countries played also an important role by giving official endorsements concerning the products. The *WHO* (World Health Organisation; a UN organisation) was also interested in xylitol to prevent caries and supported research linked to it. Dental caries is a problem all over the world.

5.1.3.2. Activities

The importance of scientific research as a whole was well demonstrated in this case. It gave the foundation for the development of the products but it also brought results that nearly made the foodweb to collapse. The results that were obtained already at the very beginning, concerning the caries preventing effects of xylitol were of major significance. Later on research mainly verified and brought more understanding to the results obtained at the beginning. It was not until at the end of the period under research that researches brought up results that were not any more linked to the original findings in dentistry.

When it comes to the research what was also noticeable was the contribution of a single researcher, Professor Kauko K. Mäkinen, to the development of xylitol products.
He seemed to be during the period under research the leading figure in the research concerning dental applications of xylitol. Not only in research done at the University of Turku but also as far as international research is concerned.

As far as production is concerned there was a certain technology already available and new products were looked for that could be produced by it. As xylitol production seemed possible what happened was that the existing technology had to be adapted to the production of xylitol. What was special here was the need to change to a new raw material source, which originated from wood processing. There were special development needs mainly concerning the primary process stage. What actually happened was that a forest product chain and a food chain merged in the early processing stage.

In marketing the role of health specialists in the field was noticeable. When the relationship between producers of xylitol products and consumers is considered the role of professional associations, dental associations became important. Dental associations were middle actors in a dimension where at one end are personal relationships between a doctor and a customer and at the other end there are direct media relationships between a producer and a customer. The credibility of products are obviously higher if they were recommended by specialists than if it is based only on information provided by a producer.

By the time of xylitol came to markets product approval was taking place on a national level. No major additional safety tests were required. It was obvious that the previously made safety tests in a medical context were considered sufficient. In case of communication concerning products there was a special situation before new food legislation came into force in 1995. At that time legislation concerning pharmaceuticals was extended the food area and based on that usually health claims were not allowed to be made. The domain of foods was subordinate to that of pharmaceuticals in that respect.

In consumption activity a change in attitudes and use of chewing gum was noticed. There was a difference between consumption of traditional chewing gums and chewing gums containing xylitol. Xylitol made the chewing gums more acceptable also to adults that had previously been negative concerning the use of chewing gums.

5.1.3.3. Resources

In this case the existence of a specific natural resource was partly a starting point. However, xylitol and its sources did not become valuable until an application area was found. In Finland forest products and especially birch trees are a source of raw materials that can be obtained in industrial quantities. Other possible raw material sources were beech and corn. Until the end of the 1990s birch was also the main source for xylose. In 1997, a new factory was built in Lenzing, Austria where a sidestream of a wood pulp production was utilised for making xylose, the raw material for xylitol production.

The technological development that led to the xylitol production within Cultor did not take place by chance. During the 1960s professor Melaja headed the Research Centre of the Finnish Sugar Company. At that time a chromatographic separation method was developed that was first used to improve the yield of saccharose from molasses. At the same time the technology of crystallisation was under research. At the end of the 1960s and at the beginning of the 1970s the production of saccharose was no longer considered as a growth area for Cultor. With support from the Director General Gustav von Herzen, a lot of resources were allocated to research and development activities. Special sweeteners were seen as a future growth area and new personnel were hired by the research centre and new facilities were build. The competence acquired in chromatographic separation made possible the production of fructose and glucose at an industrial scale at the end of the 1960s and it was used also in the production of xylitol.

The Institute of Dentistry at the University of Turku had already during 1960s chosen development of preventive measures in cariology as one of its strategic areas. The Professor in Cariology, Arje Scheinin who was also the director of the Institute, was already looking for alternatives to sugar. At that time Kauko K. Mäkinen was Associate

Professor in Dental Biochemistry. The background information needed for xylitol research had already been acquired by previous research done at the institute.

There had been overcapacity in the confectionery branch that led to rationalisation where different producers concentrated on the areas where they were strongest. Leaf Hellas became especially strong on chewing gum markets in Finland. More resources was, however, needed as the development of xylitol based products began. The production of xylitol containing confectionery products was technologically more demanding than the production of traditional confectionery products. For Leaf Hellas the development of xylitol products became a key development process requiring two to three persons continuous work input. Some production related problems could only be solved after a long research and development period. For example it was not until 1991 that Leaf succeeded to produce a xylitol based hard sweet on an industrial scale.

5.1.3.4. Development dynamics

The key events in the development of xylitol products are presented in Figure 13. The events presented on a time scale reveal that there are times when development takes place at a faster pace and times when it is more gradual. Xylitol was first used in foods for special purposes. From those experiments it took over ten years before the applications in main stream foods were considered. There were no direct contacts between these different research approaches for people or even countries. What was common was that both the early and later applications have their origins within medicine. It was not a typical start for food product development.

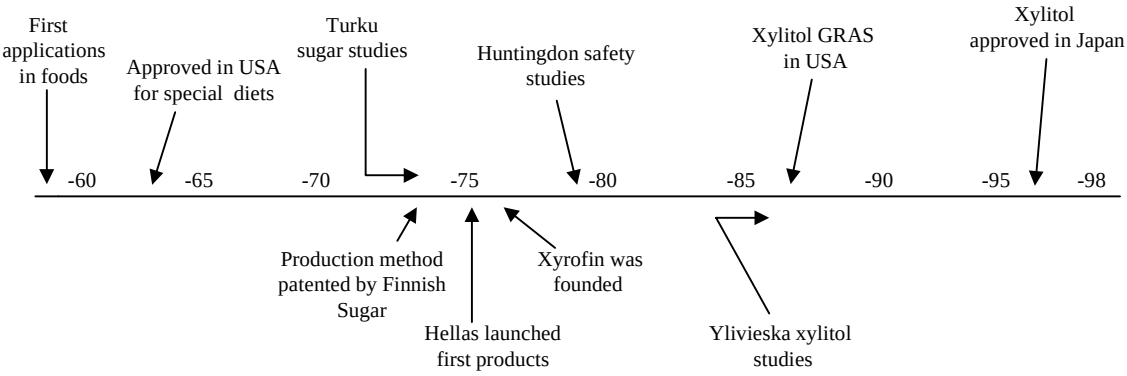

Figure 13. Key events in the development of xylitol products

From the initial contacts that took place between Cultor and University of Turku, it took about five years until Leaf Hellas launched the products on various markets. The rather fast development was possible because there were not very many factors that retarded its advancement. The positive effects of xylitol were so obvious that only one long-term study was needed before the first products were launched. Technologically, there was no insurmountable problems concerning the production of xylitol and xylitol containing products. No long term toxicological tests were required because obviously the background that xylitol had was considered to be sufficient.

Then there was the negative development. At the end of 1970s it was thought that the research studies that were to be done were just a formality which would confirm previous knowledge. After the alarming results that were received from toxicological tests made at Huntingdon the development drastically slowed down. For example it took almost ten years in the USA before xylitol was finally given the GRAS. What was however noticeable was that the core of the foodweb survived over this period.

In Finland a more dynamic period was encountered as sales of xylitol products began to increase after the first results of theYlivieska studies were published in the middle of the 1980s. The results of those studies as such were not radically new compared with results from previous studies. Within a few years time xylitol became a dominant sweetener especially in chewing gums.

5.1.4. Conclusions drawn from the case

The initial development of xylitol products took place during the time when no such category as health-functional foods was generally known. It simply was a step by step process that eventually led to the development of health-functional foods in a very modern sense. There was even the foods-medicine dimension represented. Xylitol based products had not only preventative but also therapeutic significance.

Applying the framework of functional foods that was introduced at the beginning of this study a change between categories could be identified. Although Falk (1992) identified a general change where the role of the pleasure function for foods is increasing, the case of xylitol showed that there are also opposite developments taking place. A product group that used to be clearly pleasure-functional changed significantly in the direction of health-functionality.

If it is assumed that foods in general are a product area which is tradition orientation and conservative. Then there has to be special reasons that ease the way to even more radical changes. In this case there seemed to be such factors. Firstly, Finland is often considered as a country where health matters in food context have a high priority and also legitimates significant changes in foods. Secondly, there was already very strong pressure against saccharose based on the health concerns, which eased the acceptance of even non-traditional solutions. Thirdly, the product groups: chewing gums and sweets, although foods, were not in a very central role within foods and there were for example no active interest groups trying to protect the traditional products.

What the case pointed out is that for new radical food products there can be many separate uncoordinated developments, leading to situations where certain opportunities arise. It is then a question of either taking advantage of them or not. The development of production technology by Cultor, the willingness of Leaf Hellas to find new products and the orientation of Department of Dental in University of Turku were all on a short perspective factors that were given. At the stage as the new product was created no fundamental changes were possible.

During the globalisation phase one interesting feature is that as the international markets were approached there was a systematic approach. In every country the aim was to first approach regulators and health professionals, which required that for example additional new research has to done in that country. What it actually meant was that the aim was to

accomplish networks that would start to operate within that country. The aim of the Finnish actor (both in case of Cultor and Leaf) was to sell its products, but before it was possible it was necessary to create a network (e.g. research- government officials-health professionals- retailers) that could support the product before or at the time consumers were linked to the network.

The later development indicated that cultural differences matter even if the same marketing approach is being used in different cultures. In the case of xylitol it could however be that besides the health-functional dimension other factors are dominant. It can be that in some cultures the chewing gum is not accepted no matter what it contains because there are other reasons (e.g. 'chewing' as a not proper conduct, the litter caused by chewing gum etc.).

5.2. The case of Hyla

5.2.1. Background of the health-functionality

Unfermented milk products contain lactose. In the small intestine lactose is hydrolysed by lactase enzyme into glucose and galactose which are then absorbed from the intestinal tract. Hypolactasia means the lack of this enzyme in general and lactose intolerance refers to an enzyme deficiency that results in symptoms of intolerance. In lactose intolerance lactose is transported into the colon, where it is fermented by intestinal bacteria. The fermentation results in gas formation and water retention causing discomfort in the stomach.

Primary lactose-intolerance means that production of lactase in the body ceases at a certain age. The phenomenon was noticed at the beginning of the 1960's. In the global perspective lactose intolerance is a common phenomenon whereas the tolerance of lactose is a dominant hereditary trait. When there is a change from lactose tolerance to primary intolerance, it usually takes place between the ages 2-15 depending on the cultural and racial traits. In international perspective hypolactasia and lactose-intolerance are least common in Central and Northern Europe. By Nordic standards in Finland a relatively large portion of the population suffers from hypolactasia. According to modern estimates about 17% of the population has hypolactasia whereas in Sweden and Denmark the respective portion is 3-4%. About 3% of the population in Finland have lactose intolerance.

A secondary lactose intolerance that is also called acquired lactose-intolerance, is a transition phase and it is not dependent on age or race. The reduced activity of lactase has been noticed in most illnesses of the gastric system as well with the poor nutritional condition. The use of alcohol and certain drugs may also reduce lactase enzyme. In Finland, secondary lactose intolerance is not thought to be very common.

5.2.2. Periods in the development of Hyla products

In the case of Hyla four major periods were identified in the development of products. Those periods were: 1. Technological choices, 2. Internal uncertainty, 3. Generic brand, 4. New technology.

5.2.2.1. Technological choices

The research concerning the hydrolysis of lactose was one of the key research areas at Valio's R&D at the beginning of the 1970s. The technological development in the hydrolysis of lactose led to a situation that at the pilot plant in Lapinlahti a semi industrial state was reached. There were tests made using both immobilised and soluble enzymes in the process. The process using immobilised enzymes was a new and more demanding way to hydrolyse lactose. The reason for it being developed was that enzymes are quite expensive and the immobilised system aimed for a continuous process were the enzyme to product ratio would be as low as possible. At that stage the new system was however not utilised, but it was decided that the soluble enzyme system would be used for the production of the first Hyla product - a milk powder.

The price of the product was an important factor as the choice of production process was made. Low lactose products were not unique on global scale. It was known that for example in Milan in Italy a dairy company Central Del Latte had started to produce lactose hydrolysed milk, which was guaranteed to contain less than 1.3% of lactose. Due to the specific process the price of the product was more than 30% higher than that of ordinary milk. Also in Holland low-lactose milk based products came on the markets. Valio was not in contact with these actors and there were no imports to Finnish markets. At Valio, however it was thought that a major price difference compared to standard products was not tolerable. If Valio had used the new immobilised production system the price of the product would have been too high due to small product volumes.

There were production systems available on the markets using the soluble enzyme alternative. Such a system was acquired from the Tetra Pak International located in Sweden. In the production of such Hyla products the beta-galactosidase enzyme is added to milk that is heated to a high temperature for a very short time period (UHT-milk) before aseptic packaging. The enzyme hydrolyses the lactose during storage. The same process has been used to produce low lactose spiced milk products, ice-cream mixes and whipping cream

The faster the hydrolysis the more expensive is the production process. As UHT-milk goes through the distribution chain slower than pasteurised milk it was possible that the hydrolysis could take place in the storage and distribution chain. Based on experience the guaranteed level of hydrolysis is 80% even though if, for example, the UHT milk is stored at room temperature, hydrolysis reaches almost 100%. In products stored in cool temperatures (like yoghurts) the lactose is hydrolysed using a batch type of a process prior fermentation.

5.2.2.2. Internal uncertainty

In 1970s the per capita consumption of fresh milk in Finland was the highest in the world. Valio was a dairy company owned by the farmers and they also sold their milk production to Valio. In Finland Valio had a dominant position when it came to milk based products. On the other hand by that time hypolactasia and lactose-intolerance were not very well known phenomena by ordinary consumers. All these factors meant that acceptance of Hyla products to the product range were not self-evident.

The reason for the doubt was only partly based on the uncertainty whether consumers would buy the products or that they would compete with the company's own products. It was feared that the new products would be detrimental from the viewpoint of the reputation of the traditional milk products. It was thought that if Valio launched products indicating a weakness in milk products it would affect the sales of milk products in general.

By that time the key integrating mechanism in R&D questions within the company was the product development committee which consisted both of specialists and top management. The top management of the company was very much involved in the decisions concerning new products. Hyla products caused controversies and serious discussions until they were finally accepted in the product range. It was understandable that after such a process they were for a long time low-profile products which were not considered as a business opportunity but more as a necessity that has to be produced for those that suffered from lactose intolerance.

5.2.2.3. Generic brand

The first Hyla product, low-lactose milk powder, was test marketed in 1978 and it established its position at the beginning of the 1980s. In 1983 the production of the first low lactose UHT product; Hyla milk; started. The first fermented Hyla products were introduced in 1986. Since then the product range has gradually expanded to cover almost every dairy product group and there are over 30 different Hyla products.

For a long time Hyla products were practically the only low lactose milk based products on Finnish markets. It was not until 1990s that the domestic competitors, especially Ingman Foods and Aito Maito, entered these markets. Hyla became almost synonymous for low-lactose milk products. Later on Valio used this in its marketing to enhance a brand-in-brand type approach. Producers of ready-made foods were given rights to use the Hyla –trademark in their products made with Hyla-products.

Organoleptically Hyla products differ from the corresponding basic products to some extent. As lactose is hydrolysed to glucose and galactose the products become sweeter. This difference is most obvious in UHT-milk, which tastes clearly sweeter than the ordinary UHT-milk. In other products the difference is not as remarkable.

Sales of Hyla-products have grown gradually. No rapid growth periods have been experienced. There has been a correlation between the sales and the number of people who have been diagnosed as being lactose-intolerant. Market shares vary very much depending on the product type (Table 1).

Table 1. Market shares of Hyla products in 1997 in respective product groups (Source AC Nielsen Scantrack, includes grocery shops)

Product type	Market share %
Yoghurts	3
Milk	5
Creams	22
Ice-cream	1

Hyla-products were from the very beginning aimed only at domestic markets. At no stage had Valio plans to enter international markets on a major scale with Hyla-products. However, at the end of the research period exports to Sweden with selected products were under consideration.

5.2.2.4. New technology

It was not until 1990 that the technology using immobilised enzymes developed and patented by Valio could be utilised in commercial scale to hydrolyse the lactose. This took place in the production of Gefilus drinks (see LGG), as the cheese whey is hydrolysed by immobilised lactase. By that process it was possible to reach a hydrolysis degree of up to 95%.

Hyla was not linked only to the traditional products, which were based on the use of milk as such. In Gefilus drinks Hyla was used as a brand-in-brand. Even though the drink did not contain whole milk as such but a special fraction of it, the Hyla brand on the package told consumers of the low-lactose characteristics of the product.

Hyla products typically contain a certain amount of lactose. Even these small amounts cause symptoms for some lactose-intolerant people. The next step was to remove lactose altogether from milk. This means that a solution of milk proteins and salts is obtained. Valio developed a chromatographic separation method in order to does that. In the middle of the 1990s a series of ice creams was launched that were based on lactose free milk and sweetened with special sweeteners. It was also expected that there would be international markets for these new technologies.

5.2.3. Identification of the respective foodweb

5.2.3.1. Actors

When it comes to research of lactose-intolerance there were no specific actors, which would have been especially influential as far as the development of Hyla products is concerned. The situation was different for the research into the hydrolysis of lactose. Inside *Valio*, especially the role of *Ph.D. Matti Heikonen* was significant. Valio co-operated with the *Department of Biochemistry at the Technical Research Center of Finland* (VTT) and with the *Department of Chemistry in University of Technology in Helsinki.*

The Hyla based foodweb was in commercial sense very much centred on a single food company *Valio Group* (turnover in 1997 FIM 8 billion). It was initially founded by the milk co-operatives to export their products at the beginning of the last century. In the 1970s and 1980s Valio was a dominant player in Finnish milk based product markets with a high market share.

A key partner in the supply and development of the technological equipment and production systems was a Swedish company *Tetra Pak International* located in southern Sweden. Valio had good working relationships with the company already from the past. Also within the Valio Group there was a specialist engineering company *Valio Engineering Ltd* which was involved in the process developments.

Inside Valio a key role in the development of the products was given to a *product development committee* which consisted of both specialists as well as of the top directors of the company. The marketing of the Hyla products was the responsibility of the same organisational units that were responsible of the marketing of respective traditional products.

5.2.3.2. Activities

What was known about the lactose-intolerance phenomenon was very much based on articles in scientific publications. By that time the research concerning the body-related phenomena was not linked to the activities that directed the development of milk based products. Research results concerning lactose-intolerance were taken as a general background that directed the development.

By the time Hyla products appeared the role of the milk as a basis for foods was changing. It was already typical that certain modifications in milk (e.g. concerning the amount of fat) had been made. Technological development made it possible to take this process even further. Attempts were made to make most of the Hyla-products to resemble the traditional products as much as possible. Therefore also production processes were to large extent traditional ones. Hyla process could be considered as a new subprocess in those processes. In this respect the Gefilus product was an exception because in it the basic product itself and the respective production technology were different from the traditional major products and technologies used by Valio.

The marketing of the Hyla products could be called low profile marketing. One indication of this was that HYLA (HY=Hydrolysed, LA=Lactose) was actually a working name that was simply registered as a trade name. Although the leaflets and brochures of Hyla products were spread to health centres and maternity clinics no major marketing campaigns took place at the beginning of the process. The use of the support of nutrition specialists in marketing was not intentionally planned. There was a slow and continuous growth of the awareness of the products as the phenomena of lactose intolerance became more known.

Consumption of the product was mainly by lactose intolerant people that bought the products. There was also a price difference towards standard products that probably deterred some people using products even if they had benefited from that. What added to consumption was the fact that in institutional kitchens and also partly in restaurants a change took place later on where low-lactose products were being used as standard products in order to avoid the need to produce low-lactose products separately. Partly this same phenomenon was noticeable in domestic usage as there are families where some members are lactose intolerant or when lactose intolerant visitors were expected.

In the beginning there were no special regulatory procedures concerning Hyla products. Under the recent legislation Hyla products were registered as special dietary products.

This meant that besides standard food labelling requirements a special labelling is used: dietary product or diet product, which indicates that the product is meant for special groups. Otherwise these products are sold under the same regulation as other food products. This means that for example health claims are not allowed unless otherwise specified.

5.2.3.3. Resources

Valio has traditionally allocated resources to research and development. It has long traditions that go back to the time of the Nobel prize researcher, A.I.Virtanen, who was also head of the Valio Laboratory. The research in the Laboratory at the beginning was very much oriented to problems in primary production even though there was also a research specially concerning cheese and also a link between nutrition and milk.

A key research area in the beginning of the 1970s was the hydrolysis of lactose initiated by Matti Heikonen, Ph.D. The research had no direct connection to the lactose intolerance phenomenon but the interest was on whey. Whey is a side product from the dairy processes. There was a search for ways to utilise whey and also to improve the yield of lactose from it. This development resulted in growing knowledge on technology of hydrolysis that was later on needed in order to produce low-lactose milk products.
Especially as the technology used involved immobilised enzymes the research done in the Technology Center of Finland was an important basic resource.

Being a dominant player already in milk product markets meant also that Valio had no major difficulties to get the new products through the very concentrated Finnish food distribution system. Valio and its products had a good image among the Finnish consumers which was a positive asset when the new Hyla products were launched.

5.2.3.4. Development dynamics

The key development events are presented in Figure 14. It took almost twenty years from understanding the phenomenon to the first products in Finland to appear on markets. However, it was not until the beginning of 1970s that experts in Finland became aware of the lactose-intolerance.

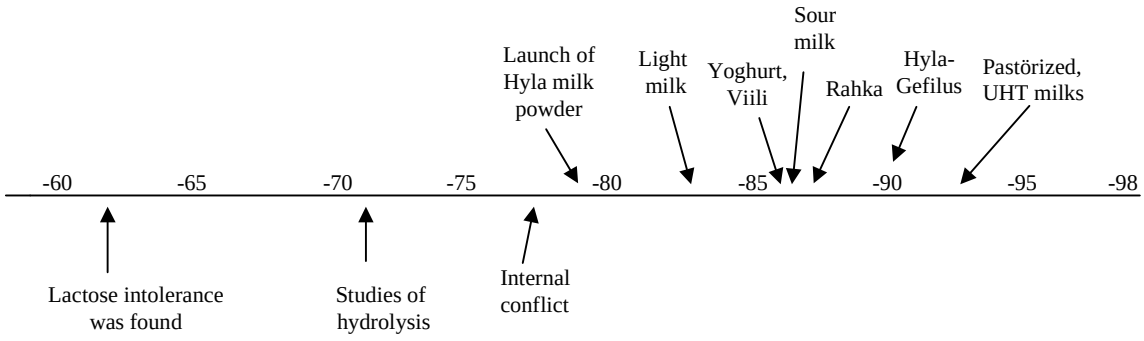

Figure 14. Key events in the development of Hyla products

What has been typical for Hyla-products is a steady and incremental growth in scope of the products. Information concerning detailed long-term volume growth was not available. However there seems to be no periods when more drastic changes have taken place. It seems that products grew very much in an evolutionary fashion following the growth of the natural lactose-intolerance phenomenon.

5.2.4. Conclusions drawn from the case

The Hyla case can be considered as a within a company case, which therefore is close to the traditional view on product development, in which a single organisation dominates the development. However, even here the foodweb framework was applicable. Basically the situation is the same whether it is a single organisation case or multiple organisations because the organisational boundaries as such are not the main subject of interest.

In the case of Hyla there were reasons to examine the starting points for products. What is special in case of lactose intolerance is that it is not a disease in the traditional sense. In primarily lactose intolerance it is a matter of a genetically determined change, that according to what is currently known, is not reversible. In this sense it can be anticipating future. It is probable that there are more genetically determined changes that are of significance even though they may not lead to such obvious symptoms as lactose intolerance.

The health-functionality of Hyla products involve a controversial situation. If it is assumed that a lactose intolerant individual prefers to eat milk products in every case it is evident that the products are health-functional, if thereby the negative body reaction can be avoided. However, if such a link to preferences is not made, it can be argued that this is not sufficient for health-functionality, unless the product has some specific properties. For example if it is a matter of a traditional milk based product in which no other changes than hydrolysis of lactose are made, it can be argued that such a product is nutrition-functional as the change makes it possible to utilise the nutritive content of the milk product. It is a different situation if it can also be shown that such a product has some other health-promoting effects.

What was noteworthy in this case was the lack of extensive clinical research concerning the actual effects of the product at the time products was launched. It was simply assumed that a reduction in the amount of lactose was all that was needed. The company itself was not involved in the research concerning lactose intolerance. Even the standards of low-lactosity seemed to be based more on production technological factors than on research on what are the critical amounts of lactose from the consumer point of view.

As to the technology what was also evident that the latest technology could not always be used. In the Hyla case it was necessary to return to old technological processes for hydrolysing lactose. The situation could have been different if there had been a simultaneously strategy to enter international markets with Hyla products as then the product volumes would have also been higher and the advantages of the new process more evident.

What this case also brought out was the difficulty within a one organisation context to bring out the different aspects that drive product development in a balanced way. It is very probable that every single organisation is biased toward some interest group. In the case of Valio it was towards the primary producers of milk. The company was very much

tied to the use of specific raw materials and this meant it was difficult for them to attempt to enter certain development paths that seemed to be in conflict with this basic bias.

Instead of marketing the respective activity could better be characterised as informing from a modern perspective. There were no major marketing efforts at the beginning. It seemed also that the introduction period was very critical. Even later on when marketing in general was more advanced Hyla products were still marketed very much based on the old approach of informing customers. What was especially noticeable was that there was no attempt to broaden the customer basis even though secondary lactose intolerance could have given a proper basis to obtain a broader customer base.

Despite the low profile marketing because Valio was the first and for a long time the only producer of low- lactose containing milk products it gained a very strong position among both professional customers and individual consumers. In that respect Hyla became actually stronger than a brand because it is typical that brands are in competitive positions whereas Hyla was almost synonymous for a certain generic product group. When Hyla emerged, branding was not a well-advanced activity at least in Finland.

What was also typical to case of Hyla products, is that they did not get any special support from health professionals. This can partly be based on the fact that lactose intolerance was not considered to be a major health problem and later on probably partly based on the fact that milk products were not favoured because of the saturated fats they contain and which were considered to pose a health risk.

5.3 The case of LGG

5.3.1 Background of the health-functionality

Probiots are defined as living microbe products that promote health by supporting the natural microbial balance in the colon. The term probiotic was first used in domestic animal research and later on it came to be used also in a food context. A specific term colonic foods has also been suggested to characterise this food category.

The health promoting properties of lactic-acid bacteria has been studied since the beginning of the 20th century. The first studies were made at the Pasteur Institute. From the modern perspective the problem was that the effects could not be properly verified. Today it is known that many microbes that have been thought to be beneficial are not, as they do not influence the intestinal milieu.

The differences in strains of harmful bacteria have been known for a long time. There has not been so much knowledge about the differences in strains of useful bacteria. Often in studies in this area only the collection is mentioned from which the used microbe stems, and not the specific strain. As an example there are differences in the properties of *Lactobacillus acidophilus* strains. It has also been suggested that such microbes should only be considered as probiots, which are part of the existing microbial flora of human gut.

5.3.2. Periods in the development of LGG products

There were four different periods identified in the development of LGG products: 1. Purposeful research and expert involvement 2. A slow start 3. Aggressive marketing 4. Business-to business internationally

5.3.2.1. Purposeful research and expert involvement

At the beginning of the 1980s doctors Sherwood l. Gorbach and Barry Goldin at Tuft University in the USA come to the conclusion that none of the *Lactobacillus* strains that they have studied and which were used in dairy industry had the necessary ability to implant the human gut. They did not simply start to search for a best possible new microbe but first defined the qualities that would be required from a strain that would improve the health and could also be used in dairy industry.

In 1983 they started a new research project in order to find a proper strain of Lactobacillus. After a two year research in 1985 a microbe was found that existed in human gut and which met the previously set requirements. It was given the common name *Lactobacillus* GG. Researchers then applied for a patent, which was granted in the USA in 1987, and internationally in the middle of the 1990s.

By the same time as the researchers made their findings, the Valio Group was looking for new microbes that were health promoting and could be used in dairy products. By a connection established by professor Adlercreutz at the University of Helsinki the then research director of Valio, Kari Salminen, contacted the researchers and soon after that Valio signed a licensing agreement with the researchers for international rights for the strain. The commercial product is known by its trademark LGG.

When the project began it was not known very much which factors affect the colonisation of gut by microbes. There was first a need to do some basic research work to understand the phenomena. A lot of resources were used and efforts made to secure the background. The early research was mainly done in Finland but later on many research institutes and laboratories requested LGG for their own work. As a result of these efforts Lactobacillus GG gained the most extensive safety assessment record of the probiotic strains. LGG became also one of the most studied probiots internationally. The more its characteristics became documented the more LGG became an important part of the knowledge building process for probiots.

This meant that a lot of effort and resources were already committed before there was a single consumer product on the market. In 1989 an information campaign was directed at health professionals in Finland even though the products were not yet ready but under development. Valio decided to start marketing all the LGG containing products under the Gefilus brand. The aim was to launch two different types of products: a drink and a spoon food product.

5.3.2.2. A slow start

First the Gefilus drink was introduced in 1990. It was a new type of fruit drink based on whey from which the lactose was partly hydrolysed. The spoon food product was a yoghurt product. It was developed in order to maximise the amount of LGG in products and

therefore only LGG microbes were added. The yoghurt had a lot of production problems and consumers did not like the consistency of the product, and therefore production was stopped after a short period of time. Improved yoghurts were introduced five years later. Meanwhile a LGG sour milk was introduced that was intended to modernise the image of sour milks products.

It was then noticed that the key results that were obtained concerned children even though there were no products that were specifically intended for children. Even the yoghurt was of a type that children did not like. A result of this was the introduction of milk products. The next product introduction was also based on the research results and consumer aspects. All the previous products had milk based raw materials. However, it was found that LGG was helpful in alleviating gut and skin symptoms of those children who were allergic to milk. A pineapple-banana fruit drink was then introduced.

A difficult year for Gefilus brand was in 1994 for despite major investments sales had not grown as expected. Marketing the product only internationally was not considered to be viable option. In order to be successful on the international markets a good reference from domestic markets was also needed. There were discussions concerning withdrawal from the markets. However in 1995 a slight increasing trend in sales was noticed.

5.3.2.3. Aggressive marketing

What Valio had noticed was that although health claims concerning foods were explicitly forbidden by the new food law in practise claims were being made to an increasing extent. A specific campaign was planned to introduce Gefilus-milk in 1996 where the bacteria LGG was introduced as a ”rescuer bacteria” and claims were made which were directly based on the research results. Specifically it was for example mentioned that LGG is effective in cases of diarrhoea and protects the stomach from the irritation of antibiotic treatment. As the campaign was running the authorities approached Valio and requested them to change the above-mentioned claims when they changed their marketing materials. After the campaign the sales of the LGG products started to increase and the awareness of LGG brand was 89% by 1996. It was not known to which extent the specific claims contributed to this.

For LGG products it was learned that in contrary to foods in general the so called moment of truth was difficult to establish. This is usually for foods the first time the product is tasted, the flavour of the product etc. In the case of the LGG products it was linked to the experience of usefulness either to a user or her/his family. LGG products were bought mainly by the mothers of a family. Who is the user of the product depended on the type of product. Mainly it was adults that were using the products. In case of families with children the products were usually linked to a cure that lasted a certain time.

It was also not known very well to what extent they were used as substitutes to standard products and to which extent they expanded consumption. The difficulty here was that in most cases the sensoric qualities of products differed from basic products also in other respects than just the inclusion of LGG. The sour milk was not as sour tasting as traditional products, the yoghurt was of a more full-bodied and thick gourmet type than basic products. The only one that differed from basic product with regard to LGG was the milk. The only reason to buy LGG milk was for health reasons.

The better profitability of LGG products compared to ordinary products was an advantage seen from all the commercial actors' point of view. However there is a problem that if all parties increase their margins, the end result is that product becomes too expensive from the consumer point of view. It was also found out that there was a link between traditional products and LGG products. As the prices of basic milk products were typically going down this caused a similar trend to LGG products. LGG products were thus very much linked to the corresponding traditional products.

Table 2. Market shares of Gefilus products in Finland 1997 (source: AC Nielsen Scantrac; incl. grocery shops)

	Market share %
Gefilus drinks (within juices and juice drinks)	4.4 %
Gefilus milk	0.7 %

5.3.2.4. Business-to-business internationally

From the very beginning it was not only the domestic markets that were aimed at. The agreement made with the inventors of LGG obliged them to take an international approach. International markets were approached more in a business-to-business fashion and there was no attempt to make direct consumer contacts abroad. It was LGG what was the basis of licensing activities and it was more like an ingredient brand in contrast to Gefilus that was a food brand on domestic markets. The awareness of LGG within research community however made it possible to broaden the product base further away from the traditional milk products.

The licensees were granted a right to certain products within a certain territory for a limited period of time. In Japan, a product containing LGG was a first probiotic product that was approved within the FOSHU system[16]. LGG is not the only probiotic on the markets. Internationally the most important competing probiots are LC1 produced by Nestle, which is based on the strains owned by the company and Yakult, which is produced by a Japanese company. What was evident was that probiotics were becoming an established category also known by health-conscious consumers. However there were no binding rules concerning probiotics and it seemed that in many cases also microbes that did not have scientifically valid basis were called probiotics.

5.3.3. Identification of the respective foodweb

5.3.3.1. Actors

The key actors at the early phase were two researchers: *Drs. Gorbach and Goldin at the University of Tuft* in the USA and the research organisation of Valio represented specially by its director *Dr Kari Salminen and Dr. Maija Saxelin.* Influential actors already

[16] FOSHU= Foods for Specific Health Use; a specific approval system that seeks to specify health claims that can be made only on approved products in Japan

at the beginning were also *Dr Seppo Salminen at the University of Turku* then employed by Valio, and *Dr. Erika Isolauri at the University Hospital of Tampere.*

The actor basis gradually expanded among research institutes and laboratories all over the world as the research results concerning LGG were published in scientific journals and as they were presented at scientific conferences and other occasions. The interest of such respected institutions like John Hopkins Hospital in the USA was accelerating the expansion of the actor basis. In 1997 it was estimated that LGG had been used for research purposes in over *40 research institutes and laboratories in 14 different countries.*

In Finland, the Valio Group was the key commercial partner. Within Valio the *Fresh Product Division* became responsible of the Gefilus products on Finnish markets. The *Research Division* was responsible for the international LGG business. There was no separate organisation set around Gefilus or LGG neither domestically or internationally. Valio had been in international markets very much on an export basis and was by that time scaling down its own international presence. The licensing activity was handled directly from Finland and licences were granted on a territorial basis. In 1997 there were licensees in 17 different countries.

As far as food regulation was concerned, the *National Food Authority in Finland* played a key role as a general food authority not only as far as product contents were concerned but also as the content of product specific information was concerned.

5.3.3.2. Activities

Basic research activities played a key role because the research took place during a time when a clear change in the knowledge base was taking place. The traditional knowledge concerning the microbes proved partly to be insufficient. Many of the microbes that were previously considered useful actually did not turn out to be beneficial in the gastric system. The research had to take a new start first considering whether and which of the microbes would have an positive affect.

From the food perspective the production of LGG actually meant that a food ingredient is being produced. Valio and specifically its R&D Division thus became an ingredient producer. What makes the production of microbes special is that the added amounts to foods (e.g. 20 g/t) are typically not the same as the amounts that are needed in the food. This is due to the growth of the bacteria in foods. What this means is that the actual amounts of ingredients that have to be produced in the first place are smaller and therefore all the logistics linked aspects took place on a small scale. This in turn means that the change from laboratory scale to industrial production scale was not as significant volume wise as in case of many other ingredients.

In marketing there were several layers even though it is not certain to what extent there were explicit strategies on all the levels. Firstly, there was the researcher level. The aim was to establish a good position for LGG among researchers. This required that LGG was exposed on conferences and that there were publications about it in respected journals. Secondly, there was a need to approach the health professionals who were influential in matters concerning LGG. The consumers were involved only on a tertiary level in the process.

In regulation of the respective foodweb the role of Valio was noticeable. For example it initiated the setting of specific safety requirements and contributed to the setting of generic standards for probiots. There were no specific requirements concerning the safety of probiots although there were guidelines for testing of safety of microbes in general. Valio was also trying to set its own norms concerning communication with consumers as it deliberately exceeded official norms.

5.3.3.3. Resources

In this case natural resources did not play any significant role. The microbe as such was of human origin and the products that were then produced were based on quite ordinary sources that are used in the dairy industry. The only different aspect was the use of whey as a raw material but even here there was nothing special about the sources of whey used.

Valio had long history in the development of souring agents for the needs of the dairies that belong to the Group. For special microbe based souring agents it was considered that its capabilities were in some respects even more advanced than firms that specialised in the field. Valio had made products that contain Lactobacillus acidophilus bacteria since 1980s. The claimed advantages of these product were based on published sources and international research. Valio did not do its clinical research at that time. What were the specifically new and required new capabilities was the involvement in clinical studies.

The first Gefilus drink was also based on the results of the technological developments in the hydrolysis of lactose. In that special product the technology and capabilities which were considered in the development of Hyla products could be fully exploited for the first time and this meant that the development of Hyla products was integrated with a development that had started in order to find new beneficial microbes to be used in dairy products.

5.3.3.4. Development dynamics

The key events in the development of LGG based products are presented in the Figure 15. It took five years from the finding of the *Lactobacillus* GG bacteria to the first products appearing on the markets. Especially the initial research period both before Valio was involved and as it was co-ordinating the research were an intensive period. What is significant is the subsequently long stable period, which lasted for five years, before the sales of the products began to increase. The increase was so slow that withdrawal of the brand was already considered. As sales in 1996 started to increase the brand achieved a critical mass and expansion to different traditional product categories became possible.

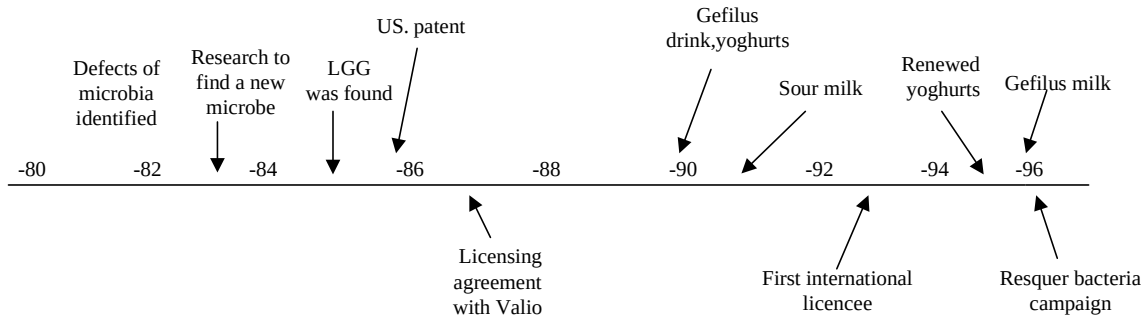

Figure 15. Key events in the development of LGG products

5.3.4. Conclusions drawn from the case

The health-functional background of LGG does not involve life-threatening diseases or diseases in general that were especially on focus when the products appeared. This is not to say that the health problems that the products were addressing were of no significance. On the contrary they are often of major significance both from the individual and public point of view. For example if the absenteeism of children from schools and kindergartens due to diarrhoea can be reduced it will have positive indirect consequences both socially and economically. Such issues are though not very often raised.

What was special in the beginning was the goal-oriented research where both the needs of the body and requirements set by the production was set prior to research. A more common approach would have been either to start with a specific microbe that has been found and find some use for it, or to start looking for new microbes and stop as soon as a microbe was found that in some respects seemed promising. In the latter case the end result could be that it in some respects the microbe could be excellent but in other critical respects it might not fulfil the requirements.

What makes this case special is that the key natural resource in this study was the human body. The human body was not only the consumer of the new products but it was the initial source of the specific microbes that were then added to new products. This does not mean that microbes were produced in the body for industrial purposes. However, this brought a new dimension to the question of what are natural resources. Key natural resources are not necessarily those that are needed directly for production but they can as well be more informational resources. In this case a microbe was found that already had the characteristics that were needed. No direct manipulation of the characteristics of the microbes were needed as nature had provided a microbe with the right characteristics.

In case of LGG the background for safety and health-promoting characteristics of LGG was specially emphasised. At no stage were there noticeable doubts raised concerning this. Also internationally the microbe was well exposed within the research community. This was probably made easier because there was an international approach from the very beginning, an emphasis on openness for the research results and that LGG appeared as the subject area was new and therefore especially interes ting.

In LGG case no internal conflicts within Valio between old and new products were observed. LGG was actually not a natural part of milk, even though the products it was applied were based on the tradition of making milk based products. Within Valio brand

based thinking was in a stronger position than in the case of Hyla. The raw material was not a critical issue. Under the Gefilus brand there were side-by-side products based on milk with products a non-milk base.

In the international business dimension there are specific characteristics in Valio approach. It was very much a business-to business orientation. It was evident that the purpose of Valio was not to reach international consumers in any deliberate manner.
It was up to the licensees how much they emphasised the role of LGG as such in their marketing. However, not even Valio on domestic markets emphasised LGG as the marketing of products took place under the Gefilus brand. Probably not many consumers were even very familiar with LGG other than it was a "rescuer bacteria". What was also special in this case was that the R&D department remained responsible for LGG business even when the strategic and financial significance of the project were increasing.

On the regulatory side, the legislation that prohibits the use of health claims become an apparent impediment in this case. There were not such well-known markers like cholesterol that could have been referred to and therefore the consumers were left to make the final link to health. However, it is difficult to know to what extent the specific advertising claims contributed to the success of the products. Considering the whole spectrum of marketing operations covering groups from researchers to consumers it can be questioned what was ultimately the significance of the specific wordings in the claims.

5.4. The case of Yosa

5.4.1. Background of the health-functionality

There were two factors combined in Yosa products that formed the basis of health-functional properties. One factor was the use of oatbran to lower the cholesterol level of blood serum. High cholesterol levels pose a health risk. It has been shown that there is a connection between high cholesterol levels and cardiovascular diseases. It is not only high levels of total cholesterol that are a risk factor but it is the proportions of different types of cholesterol that is important. Especially a high level of LDL cholesterol is considered to increase the risk. Another factor was the use of probiots based on their health promoting effects (probiots: see LGG case)

The effect that oatbran and oatflakes have on cholesterol level was discovered during the 1980s. It lowers both the totals as well as the LDL-cholesterol levels in blood serum. It is thought that the effective ingredient is beta-glucan that is located in the aleuronic and subaleuronic layers of kernel of oat. There are several mechanisms by which it affects cholesterol levels. According to the FDA (Food and Drug Administration in the USA) the total scientific evidence shows that both total cholesterol level as well as the level of LDL-cholesterol are lowered by about 5% if the intake of soluble nutritional fibre of oatbran exceeds 3g/day. The result is based on 37 clinical studies made on human beings.

5.4.2. Periods in the development of Yosa products

Five different periods was identified in the development of Yosa products: 1. Development of the product idea 2. The search for an industrial partner 3. Emphasis on process development 4. Distribution barriers and media push 5. Learning about consumers

5.4.2.1. Development of the product idea

Professor Hannu Salovaara, professor in cereal technology at the University of Helsinki, invented the idea that led to Yosa. The starting point for the method of making Yosa was the procedure used to make the traditional cereal oat pudding called kiesa. The product had been typical in the former southeast part of the Finland called Karelia, but it was no longer very well known. Grounded whole oat corn was used to produce it from which part of the husk and the fibrous parts were removed using a piece of canvass. Souring the oat with sourdough and then cooking the pudding made Kiesa. However, the product obtained by this process did not contain those health-promoting factors that had emerged in research concerning the health-promotion of oat. Also the microbes that were naturally in the product died as the products were cooked.

Initial funds were obtained from different research funding institutions. First small scale experiments were done to see whether the product idea worked and what kind of characteristics the product had. The choice of main raw material was coarse oatbran obtained by dry milling. It gave the highest fibre content and best structure to the product.

The experimentation resulted in a process that takes place in reverse order compared to the traditional kiesa. First the pudding is made then the microbes are added which sour the product. By this it guaranteed that the microbes will remain alive. The intention was to produce a snack type of product to which fruits and berries were added. In the beginning the yoghurts were considered as a reference point. The brand nameYosa is actually based on words yoghurt and kiesa.

5.4.2.2. The search for an industrial partner

In 1990 the production method was ready to be patented. At that time some food companies were approached in order to commercialise the product. However the product idea was not yet finalised. Professor Salovaara considered that the product might be of international interest. An international patent needed significant financial resources and outside support was needed. The Alko Group was at that time developing a fractionating process of oat and they were interested in oat based applications. A co-operation agreement with the company was signed and an application for an international patent became possible. Later on the Alko Group stopped its process development. The agreement with Salovaara concerning Yosa remained valid. There was now a need to search for a new industrial partner. All the major food firms in Finland were not interested and the search was directed towards smaller firms. Also some international contacts were made but the lack of reference in Finland was a major barrier. Interest in oat bran was also temporarily declining.

Bioferme Oy, a company owned by Scharlin´s family, was looking for new products. Due to the economic downturn at the beginning of the 1990 the outlook for organic

products was not very good. Also the problems concerning the availability of raw materials for organic foods meant it did not seem possible that new products could be developed for that sector. Merja Scharlin was at that time interested in the possible use of probiots in the products and contacted Professor Seppo Salminen at the University of Turku. He told her of the product that Salovaara had developed at the University of Helsinki. After that she contacted Salovaara who was then negotiating with another firm. The activity and interest shown by Merja Scharlin finally resulted in Bioferme entering into a licensing contract with the inventor and Primalco (previously the Alko Group). A schedule was established according to which products should be on the markets.

The patent concerned the method of production and laid the foundation for an industrial process. To start planning and developing the industrial process funding from Tekes (the National Technology Agency) was applied and the application was successful. A development process involving Universities of Helsinki, Kuopio and Turku began. The purpose was to develop technology for industrial scale production, to generate product variants and to make initial clinical tests.

5.4.2.3. Emphasis on process development

The development of a new industrial scale process in a limited period of time was a demanding task for a small enterprise with limited resources. There was no production system that was directly applicable. The machines and equipment closest to this application area were for use in the production of sourdough's or yoghurts. It was necessary to invest significantly in the technological development and building of production facilities There were also problems in guaranteeing the raw material supplies as Primalco stopped its oat related developments and could not supply oat bran. There was only limited availability of oatbran without husk.

Another critical area was the selection of proper strains, which would act properly on a large scale. Oat as a raw material creates special demands in this respect. Many strains and combinations of them had to be tried until a proper combination was found. Development in this respect was considered as one of the most important competitive advantages that the company gained in the development process.

Discovering ingredients that create the desired flavours with oat was more difficult than expected. For the sake of flavour it was necessary to use flavour additions. A development group had been established at the University of Helsinki, consisting of members from the cereal technology research with Professor Hely Tuorila from sensoric food science. The group suggested one taste variant and Bioferme selected another variant.

Initial tests were made among school children and elderly people to study attitudes towards products. The results were promising. Clinical tests made in Kuopio also showed that the use of Yosa had positive effect on the functioning of stomach as far as elderly people are concerned. It had also been established that oat bran can promote the growth of some probiotic bacteria in human gut.

The technological problems linked to products and processes were solved in the specified time. This took place partly at the expense of the commercialisation process. A small enterprise has not much resources for such activities as the design of packages and

promotional materials. It was also to large extent an open question what would be the retail chains attitudes towards the products.

5.4.2.4. Distribution barriers and media push

The launch of the first products to markets took place on the 17th of November 1995 (a month before Benecol was launched). The place was the historic milieu of Koskipirtti near Turku. All the major food journalists were invited and a busing was arranged from Helsinki. Merja Scharlin was known for her work as a pioneer in promoting the use and production of organic products. Shortly before the launch she was rewarded for this work by one major women's magazine in Finland. After the occasion there were several articles about Yosa in many journals which spread the awareness of the product.

There was a distribution agreement with Reformikeskus, which was a wholesaler specialised in marketing of health and natural products. Bioferme had used the same wholesaler before. The problem was that it mainly distributed to specialist shops and the goal of Bioferme was to reach a more broad customer base than only those who use specialist shops.

Retail chains were not interested in the beginning. The buyers of the chains advised that individual retailers should be contacted directly. This meant that distribution needed to be handled by the company itself. There were direct deliveries to areas nearby. To other parts of Finland a contract concerning logistics was made with a general transport company, Transpoint Oy. When retailers ordered products, Transpoint handled the deliveries. That was not a very common distribution channel in Finland as far as foods are concerned.

The product gained a lot of publicity in the media and Salovaara wrote many articles to the trade press. Especially after one article had appeared in a major Finnish evening paper in late autumn 1995 one of the major retail chains contacted Bioferme and asked whether they could start selling the product. In spring 1996 also the other major retail chains accepted the product to their product sortiment. Yosa was frequently in the public eye and in 1997 it received a special prize in the Food of the Year competition.

Within shops the placement of the product was problematic. It was a new product and it had not established its position within stores. Typically the product was in the beginning besides the yoghurts. However it turned out that yoghurts were not a proper reference group. In many cases consumers were disappointed because they were expecting the product to have loose structure, which is typical for yoghurts, sold in Finland. The product was later on typically located near the low lactose special products.

The position of the product within foods caused some concern. According to Salovaara the closest counterparts to English product types are vellie or flummery. The generic type used on labels and accepted by food authorities is a soured oat-fruit product. Based on the type of use the product is referred to in advertising as a snack, which has not been very common for these kinds of products.

Bioferme contacted the National Food Administration before the product launch. It was asked of the possibility to add calcium to the product. As the product did not contain milk products it did not either contain calcium which is a necessary ingredient from a

body point of view. This was considered to be a disadvantage. The Administration replied that the application should be made not until the product was already on the market. Later on the permission was granted and the new taste variety launched in 1997 contained the same amount of calcium as yoghurts. Otherwise there was no contacts with the food authorities.

A concern that was always present as Bioferme made development and investment decisions were their role as a licensee. Yosa was becoming a major product for the company and they were becoming more and more dependent on that. The trademark and the patent were however owned by the licensors and there was always a fear that they would lose the rights when the renewal of the contract was negotiated. It would have been difficult to find a replacement product at least at short notice.

5.4.2.5. Learning about consumers

As it is typical for a small business it was not possible to make large investments in large-scale media campaigns. Spreading product information and in-store presentations by sales promoters were ways to bring the product to the consumer's attention. A lot of positive feedback was received from the consumers especially on occasions like food fairs. These were the ways how understanding the desires of the consumers increased.

It was found out that there were many special groups that preferred Yosa. One such group were vegetarians and people looking for a vegetable based diet. Another important group were families with children who had milk allergy. In general consumers who had milk allergy, lactose intolerance or celiac used Yosa products. Feedback from consumers directed many development activities. For example at the beginning there were complaints that level of sweetness was too high and consequently it was reduced. It was also considered whether organic raw materials could be used. However, celiac set requirements that no wheat should be in the raw materials. No organic oat bran was available that was guaranteed to be wheat free.

The fibre content of the product was raised to the levels that were required by FDA in US in order to make health claims. In Finland it was however not permitted to use similar claims. From the consumer point of view the availability of the product was still a problem. It was still a relatively small product (yearly total sales about FIM 10 million) for retailers and it was not necessary included in the product range of smaller shops.

5.4.3. Identification of the respective foodweb

5.4.3.1. Actors

Professor Salovaara, professor in cereal technology at the *Department of Food technology in University of Helsinki* was a key actor in early development of Yosa products. In the precommersial phase as the method was patented the *Alko Group* (later known as Primalco, a group that had monopoly rights for retail sales of alcoholic drinks and produced besides alcoholic drinks also feeds and biotechnology products) was also of significance.

A key actor in the development of product as the technology development and commercialisation phase was reached was *Merja Scharlin*, managing director and co-owner of *Bioferme Oy*. Bioferme Oy is a family run company, with three family members involved and five employees. The company was founded twenty years ago and is located near Turku. It produced fermented vegetable products and organic products, most important products being sauerkraut and vegetable juices.

Other influential actors were *Tekes*, the National Technology Agency, which is the main financing organisation for applied and industrial R&D in Finland. Other significant actors were the *media*, especially the *food editors* in different media, as well as the *retail chains*, which controlled the main distribution channels to consumers.

5.4.3.2. Activities

Research in health issues in this case can be characterised as applied research. The health-functional features were very much based on existing research. A knowledge of health-promotional aspects of oatbran and probiots were taken as given. In the case of cholesterol lowering the reference point was the instructions given by food authorities in the USA. What was unique was the development of a new foodstuff. It differed significantly from the current food products on the markets even though it had predecessors among traditional foods.

What is special in this case is that two entrepreneurial activity periods can be associated with it. One is the period from incubation of product idea to the signing of a licensee agreement with Bioferme. Salovaara had clearly an entrepreneurial role although there was no formal enterprise or concrete products involved. There was however a base for concrete products and expectations concerning their value to consumers. This activity took place very much in a business to business type of a context. The second period, led by Scharlin, is the one, which is typically considered as a normal entrepreneurial activity because it resulted in concrete products for consumers.

5.4.3.3. Resources

There is a link to the natural resource base in a sense that in Finland the consumption of oat products had been on a relatively high , which in turn had supported the maintaining and developing of cultivation and production of oats. However, in this case there were no special reasons why oats specifically grown in Finland would be of higher value.

The Department of Food Technology at University of Helsinki, with a professorship in cereal technology, was a key resource at the beginning because it was a major centre in Finland concerning oat products. There were facilities and equipment that made possible experimentation and the small-scale production of the products. At the department there was also the section with deals with the sensoric food science which also forms a link to consumer sciences. These resources were used in developing the consumer related characteristics of the products. Food Chemistry Department at the University of Turku was a partner in microbe related developments.

The technological adaptation and process modifications took place by trial and error. Local resources and knowledge in process technology were utilised. Financially Tekes

supported this development. Tekes funds R&D work by grants (25-50% of developing costs) and risk loans. Later on clinical tests were carried out also at the University of Kuopio.

Professor Salovaara's key role was to modify the old traditional food process to form a base that could be used to produce a heath-functional food, which responded the requirements of modern markets. The starting point in the technological respect was actually very close to that part of food technology, which could be called traditional home food technology. This was then adapted and modified to make an industrial product that was no longer linked to home food technology as it was a ready-made food. At that stage also financial resources were needed,. this was provided by several funds and foundations.

Bioferme had already a relatively long history in small scale vegetable processing and also in organic products. As Mrs Scharlin is as an entrepreneur she was well aware of the market developments and was actively responding to changes in them. She had already established positive relationships with members in the media who specialised in food, which formed a significant resource in the case. Her energy and capabilities to integrate many different kinds of demands finally to a successful new food product were of crucial importance in this case.

5.4.3.4. Development dynamics

Professor Hannu Salovaara was the source of the idea led to the development of Yosa at the University of Helsinki. The actual research and development work started round 1987 (see Figure 16). After three years the development was at a stage where a patent application could be made. Then a five-year period of slower development started. During that period the aim was to find an interested industrial partner.

After a licensing agreement was made with Bioferme Oy, a period of accelerated development followed. Within a year the product was commercialised. Even the distribution related problems were sorted out in a relatively short period of time and the sales of the product began to increase as consumers joined the foodweb. This was followed by a more stable period when new taste variants of the product was introduced.

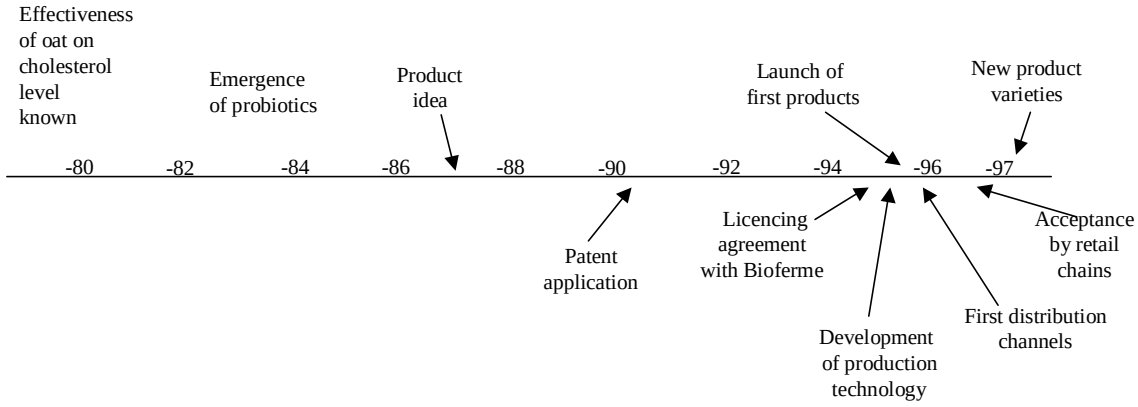

Figure 16. Key events in the development of Yosa products

5.4.4. Conclusions drawn from the case

What was special in the Yosa case was that the food product itself was a new product. In contrast to other cases there was not a well-established traditional food to which a new bundle of health characteristics was added. This newness of the food brought with it new possibilities but also some difficulties because it was not only the health attributes that were of concern.

In fact if the health-functionality is considered in its strictest sense there were concerns about the health-functionality of the product especially in its initial form. Initially the oat bran levels were not high enough, which was later on requested by FDA to validate health claims. It was also uncertain to which extent the product contained truly tested probiots (see Gefilus) and to which extent certain microbes were needed because the fermentation of oats have special requirements. The tests performed at University of Kuopio showed the product had positive health effects. However, they were of a general nature and did not concern cholesterol levels or the significance of certain specific probiots.

A small business entrepreneur does not have the resources to do detailed market surveys. The direction of their development processes are very much based on the fragmented feedback from different sources. When the products reached the consumers it seemed that the traditional health related factors had a more important role to play than the new factors. The cholesterol lowering effect and the probiots were not very strongly expressed in the feedback. The absence of milk and wheat proved to be even more significant factors.

In the case of Yosa there were several single development options: the scientific based healthy characteristics, the lack of milk and wheat based ingredients, the newness/tradition of the product as such, or appeal to developed tastes (high quality ingredients). What actually took place was that a certain balance between different factors was attained. The product still preserved its image as a natural product even though there were elements related to scientific/technological products.

The difficulties small business have with retail chains are a well-known phenomenon. What added to the difficulty here was that it was a matter of a new product concept. The difficulty was not only the general acceptance at the chain level. The proper place within a store was also of concern. The traditional division of a food store is very much based on an ingredient or raw material basis (milk, meat etc) and the basis of the use context (main dishes, desserts, snacks) or customer characteristics is still developing.

What is evident here was the key role of individuals and their personal contacts Professor Salovaara gave credibility to the product and could promote the product among food professionals . Mrs Scharlin had a good knowledge of the media and previous contacts. What probably played at least some role here was her university education that made it easier to operate in the new science based food environment.

It was also an advantage that during the early development of Yosa health-functionality in foods in general (especially in relation to Benecol and Gefilus) became a largely discussed theme. Along the products of the bigger companies there was a also a place for small business products. Yosa was introduced to the general public at a right time.

One special controversy concerning the regulation of health related information of foods came out in this case. In the marketing of Yosa there was reference to the health status that certain oat products had received in the USA, which makes it possible to make specific health claims. However, it is not generally allowed to make specific health claims in Finland. Then it can be asked to which extent such references can be made without actually making a health claim.

5.5. The case of Benecol

5.5.1. Background of the health-functionality

The cholesterol level of blood serum can be affected by diet. Usually the decrease of cholesterol by means of diet requires radical changes concerning foodstuffs that can be included in a diet. This usually means a significant change in one's food habits. Changes in habits are, however, difficult to accomplish. Another approach to lower the cholesterol level is to alter the composition or characteristics of foods.

Plant sterols correspond to the cholesterol of mammals. They are, like cholesterol in mammals, necessary substances for the functioning of a living cell. Our normal diet contains small amounts of plant sterols. Vegetarians get more of them than non vegetarians.
It has been noticed that plant sterols reduce the cholesterol levels in the blood serum. This effect has been known for a long time. The first studies are from the beginning of the 1950s.

In studies made in the USA it was shown that certain sitosterols significantly reduce the cholesterol of blood serum. There is no certainty about the mechanism but based on studies during the 1970s it was concluded that plant sterols displace cholesterol in the digestive tract and therefore prevent some of cholesterol being absorbed. The crystalline and homogenised sterol products used by that time were however not very effective in lowering cholesterol levels.

In the middle of 1980s interest among researchers started to focus on saturated plant sterols (including sitostanol). In Germany clinical studies were carried out on humans and in Japan on test animals. The results indicated that sitostanol could be more effective in lowering cholesterol than its precursor sitosterol. Sitostanol had also the advantage that it was not absorbed into blood serum. The disadvantage with all the plant sterols, including sitostanol, is that they have a low solubility in fat, which restricted their use.

5.5.2. Periods in the development of Benecol products

Five different periods were identified in the development of Benecol products: 1. Search for complementary partners, 2. A technological solution, 3. Path to product approval 4. Launch without introductions launch, and 5. The product leading the company

5.5.2.1. Search for complementary partners

Kaukas Oy approached Åbo Akademi University in Turku in the middle of the 1980s asking whether there would be applications for the plant sterols. Åbo Akademi advised to contact the University Central Hospital in Helsinki(HYKS) where Professor Tatu Miettinen was aware of the developments made in medical research and where small-scale experiments had also been done.

The low solubility of sterols was however a major obstacle in the research and no good solution to solve the problem had been found. Miettinen contacted Valio in 1987 but there was not enough interest in the matter and no further progress took place. At the end of 1988 Miettinen contacted development manager Tapio Palmu at Raisio. Raisio showed interest and the development that lead to Benecol products started.

5.5.2.2. A technological solution

Finding a technological solution was of crucial importance to the development of a product. There had been earlier attempts and it was known that already during the 1970s the researchers of a US based company Procter and Gamble had esterified plant sterols. They had not used sitostanol and they had not added the product to foods. Later on it was found that also the researchers at Hoffman la Roche (see xylitol) had already esterified sitostanol. They had used phosphoric acid, the use of which can be problematic in food context.

Raisio´s R&D manager Ingmar Wester tried to find a solution first using different adjuvants and utilising different temperatures that were possible in refining process. They were not successful. It seemed that no solution could be found even as the clinical tests were about to start. Esterification with the fatty acids of rapeseed oil emerged as a solution as soon as Wester considered what was the natural form for plant sterols in rapeseed oil. Fatty acid ester is their natural form, which then breaks down when plant sterols are extracted. The trans-esterification process brought the technological solution to the problem and clinical tests could be started.

At the beginning tests were made in which stanol ester was in a mayonnaise type emulsion which was packed in tubes. Because the use of mayonnaise is not very common in Finland a margarine that was enriched with stanol ester was developed. Margarine was a proper product because it is being used regularly in association with meals. The absorption of cholesterol is reduced as stanol ester margarine is used at mealtimes and that leads to lower cholesterol levels on a more permanent basis.

In small scale studies and experiments the cholesterol lowering effect was repeatedly observed. It was concluded that 2-3 g/day of stanol ester lowers the total cholesterol of serum about 10% and LDL cholesterol about 15%. In order to reach this amount of sitostanol it was necessary to consume 20-25 g of margarine that contained 9% of esterified sitostanol. No negative side effects were observed. Especially after the research carried out by HYKS and KTL (Public Health Institute in Finland) involving 67 test subjects, the researchers became convinced of the advantages of the product.

However, without studies of long-term effects and possible side effects it was not possible to think of the commercialisation of the product. It was decided to conduct a study as part of the North Carelian research project It was going to last one and a half years and there would be 150 test subjects. The results of the study confirmed what was already known and finally results were published in 1995 in the New England Journal of Medicine, which was a highly respected journal within medicinal science.

5.5.2.3. Path to product approval

As the commercialisation of the product seemed more and more certain, interaction with food authorities was increased. The food authorities were contacted two years before the launch of the product. The more certain the launch seemed to become the more there was interaction with the authorities. The authorities suggested a year before the launch that a seminar should be organised where the different product related aspects would be examined. Company representatives, researchers and authorities attended the seminar. Official application for the addition of stanol ester into the raw material of margarine was sent to the Ministry of Trade and Industry. In the reply it was said that there was no need for special permission but that it was necessary to indicate clearly the addition on the label of the packaging. An other application was made for the use of stanol ester in vegetable oil. Vegetable oil could not only be used in margarine but also in other products like mayonnaise and salad dressings. At that time there were no plans to launch such products on the markets. Permission was granted in May 1995.

5.5.2.4. Launch without introductions

A big concern was the price of the product. Due to the high costs of stanol ester production the product price was going to be much higher the prices of ordinary margarine. According to the marketing people the maximum difference to other margarine products should not have exceeded 1.5 FIM/package. The actual price was going to be 5-6 times higher because a certain amount of sitostanol was needed. No research was done concerning the acceptance of price among consumers. The risk remained whether the high price would be accepted.

In other aspects the product was tested by small consumer groups in order to develop the product concept. What made the development easier was the fact that consumers do not organoleptically notice the difference between stanol ester and ordinary margarine. The Benecol trademark had been chosen already between 1992-93. Finally, a smaller consumer package than the packages of standard margarine's was chosen in order to keep the price per package lower.

The product was kept in secret so that only a small group of people was aware of the product before its introduction to the market. The launch of the product took place on November 16th 1995. At the same time as the results were published in the New England Journal of Medicine there was a press conference held in Finland for the media and in the USA the results were reported at an occasion arranged by the American Heart Association. It was not until this that the deliveries to wholesalers and retailers started.

The high price of the product was tolerable. The market share of Benecol rose faster than was expected. The availability of the raw material was soon to become a bottleneck and the product could not be produced to meet the demand. At the beginning it was only Kaukas that could supply the plant sterols and the saturation of sitostanol were made partly by pharmaceutical companies before a new factory to produce esterified sitostanol was built. Later on plant sterols could also be acquired from a French company DRT(Les Dérivés Résiniques et Terpéniques) which had specialised in the production of wood based chemicals and which had forty years experience in extraction of plant sterols.

The sales of Benecol rose in two years to FIM 80million which meant an eight percent share of the total margarine markets in Finland (see Figure 17) Benecol was received favourably also by retailers because its sales margins were higher than those of standard margarine's. In case of consumers it was found out that typical consumers were over 50 years old and there were even more regular consumers in the group over 60 years old. It seemed that it was those people who already had high cholesterol levels or who were the risk group that were typical consumers of the products

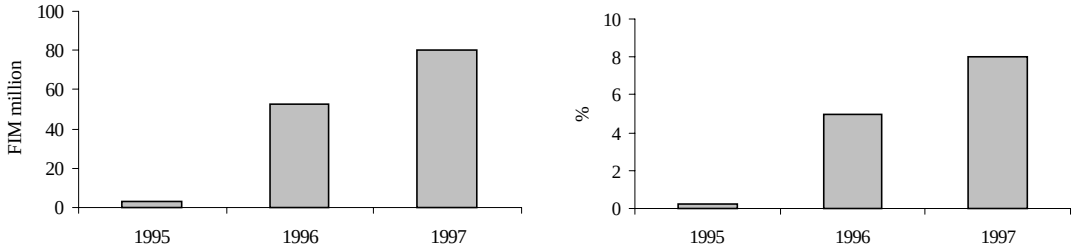

Figure 17. Development of sales and market share of Benecol margarine in Finland (source: AC Nielsen Scantrack; incl. grocery shops)

In autumn 1996 the National Food Administration was informed that Benecol margarine was considered as a special diet product. The intention was to position the product clearly differently from other margarine. At the same time it was wanted to make sure that the claims that were going to be used would be acceptable. The food authorities requested several changes to the suggested claims.

As preparations were made for entering the international markets more research was needed. Many experts were approach and their opinions asked to direct the research to key areas. The problem was that it was not possible to base the next research on the results of the previous one but it was necessary to start simultaneously research in many areas in order to fill the possible research gaps. Even though research in Finland is well respected there was also a need to repeat the studies abroad for the sake of international recognition. Also such safety studies were made to secure the background that experts considered as not anymore necessary at that stage of the development. The differing requirements for official permissions in different countries however demanded them to be done. By the end of 1997 there were about 15 clinical intervention studies and about ten studies toxicological studies that had been carried out, which resulted in over 20 scientific publications.

5.5.2.5. The product leading the company

As Benecol gained an established position on the markets there was organisational responses within the company. A separate brand based business unit was formed in 1996. The importance of the brand was further emphasised as a Benecol division was founded in 1997 beside the other divisions of the group. At the end part of 1997 there were about 50 employees including one in England and one in the USA. Benecol Division was responsible for the business operations concerning Benecol products: marketing, licensing, R&D, and also production of stanol ester. In Finland the Benecol Division sells the stanol ester internally to the Margarine division.

Based on the success in Finland a search for an international partner began. It was understood that Raisio alone did not have resources to enter international markets. In May 1997 a contract was made with McNeill Consumer Products. McNeil was granted sole rights to patent and trademark within North-American markets. Raisio in turn had exclusive rights to supply McNeill and was committed to build a factory to produce stanol ester. In November the contract was expanded to cover world markets excluding only Finland and the neighbouring regions. Raisio received a lump payment and were going to receive remunerations based on the development of operations and royalties based on the sales of the products.

The role of the Raisio was then mainly to secure the availability of the raw material and to build new processing capacity for stanol ester. In order to reach that goal Raisio and UPM-Kymmene made a initial contract in 1997 to establish a joint venture company to which both companies would transfer their know-how and which would develop the extraction method of plant sterols and sell them to wood processing industries. Also Raisio supported the capacity expansion that took place in DRT factories reserving the extra capacity for its own use. In the USA a joint company Westerol LLC was founded in cooperation with Westvaco Corporation to build a plant sterol recovery unit. Also with a Chilean company Härting S.A a joint venture was established to extract plant sterols.

It was calculated that when all these investments were made, Raisio would have an annual capacity of 4000 tons of plant sterols. If the consumption per person level would be the same as it were in Finland it was estimated that this capacity would be sufficient to meet the needs of a 200-million people market.

There was a lot of international interest in Benecol already at the beginning. It gained a lot of publicity from the trade press. It became one of the most well-known Finnish food brands even before there was any concrete product on international markets. The expectations were also influencing the value of the stocks of the company. Initially there were estimates that the value of the Benecol patent could be even FIM 12 billion and there were expectations among investors that Benecol could achieve a share of 3-5% of the margarine markets in developed countries.

5.5.3. Identification of the respective foodweb

5.5.3.1. Actors

The University Central Hospital in Helsinki (HYKS) was an actor in the web. It had been a Raisio partner already during the 1980s in the so-called fat studies in which one aim was to study the effects of rapeseed oil on cholesterol levels. The head of the Clinic of Internal Diseases *Professor Tatu Miettinen* was also a cholesterol metabolism researcher and was familiar with the research on plant sterols in medical science.

Another actor was *The Public Health Institute in Finland* (KTL). It had been active in investigations of the role of diets in national health. The Institute was strongly involved in the North Carelia project, which had been a major public funded project established already during the 1970s to reduce the high occurrence of cardiovascular mortality in the North Carelia region. One aim of the project was to improve the food habits of people living on that area and to investigate the consequent effect of that change in their health.

One key actor was the *Raisio Group*, an enterprise with an annual turnover of FIM 4.9 billion in 1997. It was mainly active in the food and chemical businesses where products where mainly derived from potato- and wheat starch. Its international turnover was about 50% of its total turnover and it had production plants in 16 countries. Raisio Margarine division had an annual turnover of FIM 1.7 billion in 1997. About 10% of its output were sold on Finnish markets. Raisio had about 50% share of the Finnish margarine markets, the other half being controlled by Paasivaara Oy (a 100% Unilever owned company). Within Raisio the influence of the previous director of Raisio Margarine *Folke Gustafsson* should be mentioned. In important roles were also development manager *Tapio Palmu* who brought the idea to Raisio and R&D manager *Ingmar Wester*, who invented the key technological solution.

One commercial actor in the web was *Kaukas Oy* (later on part of the UPM-Kymmene Group). It was a wood processing company, which also produced pine oil. Kaukas had developed together with researchers at *Åbo Akademi* in Turku a process to improve the quality of pine oil. An other actor was *McNeill Consumer Products*, a company that belongs to the US based Johnson and Johnson Corporation(turnover about USD 22 billion) which in turn was one of the biggest producers in the world of health related products. McNeill was not a food but a healthcare company with a product range, which consisted mainly of non-prescription pharmaceuticals, e.g. lactose-intolerance products. *Tekes* (see Yosa) was also an actor in the technological development.

There were two food authorities involved. One was the *National Food Administration*, a public authority controlled by the Ministry of Trade and Industry (see Gefilus). It had the main responsibility for the control of the Finnish food product markets. Parts of the responsibilities (especially for animal based products) were divided with the authorities that operated under the *Ministry of Agriculture and Forestry*.

5.5.3.2. Activities

On a food medicine-dimension the area of activity in this case is obviously closer to medicines than foods. A specific indication of this is that Benecol products were frequently compared with medicines (even though this is typically not permitted in

consumer contacts). It was not only long-term effects as in many cases with foods but also short-term effects that were of importance. This is typical for medicines. Sitostanol has also a specific influence, which is typical for medicines. On the other hand what points in the direction of foods was the aim for uncontrolled intake. It is assumed that the required amounts of sitostanol ester would be taken without special attention given to the intake. The amounts and the intervals of product intake of medicines has to be the controlled more carefully at least by the user her/himself.

The activities in general were a combination of practises from the food and medical context. The clinical research was more than is usually done in food context but less than is typical done for new drugs. As the products were already on the markets there were criticism, saying that there should have been a more extensive research basis, specially concerning the different safety aspects of the product.

As the technology was developed food production was a reference point. The key advantage in the new technological invention (esterification of sitostanol) was that it was based on the processes already common in the industry processing edible fats and there was no need for example to use chemicals foreign to the food industry. In marketing even though there were different messages to professionals and consumers, both groups were approached simultaneously which is a typical food marketing approach.

Regulation activity was a special issue in this case. At the time the Benecol product entered the markets there was not special regulation concerning new foods on the EU level. The legislation and respective norms of every EU country were effective. In Finland it was not self-evident what was the position of sitostanol in food context. At that time the ingredients of margarine were mainly regulated under the Ministry of Agriculture and Forestry, whereas National Food Authority located under the Ministry of Trade and Industry, gave directions concerning product labels . Authorities then considered sitostanol to be a nutritional supplement like vitamins and minerals.

A specific activity was the valuation of the product. As international markets were approached a significant interest arose within capital markets even before there was products or certainty of product approvals on international markets. The expectation of international success multiplied the value of the stocks of the Raisio Group in a short period of Time even though later on there were fluctuations in this value. It was not as if they technology stocks, which are usually linked to high-technology companies. In this case the company was more traditional but it was the product that was radical in nature. To bring about that effect there was no need for Raisio to go even beyond the relative small Helsinki Stock Exchange. However, even the valuation was linked to Benecol products it was not only the product itself that was considered. Every act, like the choice of a partner, affected the stock value. Therefore it can be said that even though the valuation changes were seen in the value of the stocks of a company it was to very large extent the whole network that was valued.

5.5.3.3. Resources

The raw material and its availability were of significance in the case. Even though plant sterols are common in plants there has been no industrial use for them. Kaukas had together with researchers in Åbo Akademi in Turku developed a process to improve the quality of pine oil. In that process plant sterols were extracted from the oil. That resulted

in a sterol powder that contained 15% of stanols. This was still a useless sideproduct. What it meant from the further development point of view was that a raw material supply at least up to certain industrial scale was secured.

The finding of a technological solution played a key role in this case because in the very early phase it was known what kind of characteristics were required from the product but the technological solution had not been found. In case of Raisio even though there was a separate chemical division within group, there was no significant interaction and the development that led to the technological innovation took place independently. It was not only a matter of a purely technological solution but it was also necessary that it should be suitable for a food context.

The development of Raisio's capabilities had historical roots. During the 1980s there were still five factories in Finland producing margarine. The director of Raisio Margarine at that time Folke Gustafsson understood that if Raisio was going to stay on this business area, it was necessary to acquire more knowledge and improve the company's capabilities. At the beginning of the 1980s a research laboratory was founded besides the already existing product development laboratory. New research personnel were hired, among them was the research chemist, Ingmar Wester. Also a pilot-plant was built that covered the whole margarine process. As a result of these investments to increase knowledge and capability basis, it was later on possible for Raisio to participate in fat research.

During 1986-88 clinical studies were made to test the effects of rapeseed oil on cholesterol levels. Raisio's partners were the Department of Pharmacy at the University of Helsinki and Helsinki and Turku University Central Hospitals. The favourable results of the research were key factors in the commercial success of rape oil. This meant that the company had already a positive example of the significance of health related factors in food context.

The earlier scientific research and knowledge can also be considered as a resource.
Coronary heart diseases have been a major health problem in Finnish society. Research knowledge and capabilities on that area were well esteemed internationally. It was not only the treatments of the diseases but their prevention that had been highly prioritised. As foods and diet were already considered important factors and as medicines to treat the diseases were already common it can be thought that from the public health point of view a positive attitude would be taken to the exploration of overlapping areas. This is also what happened. What was also significant was Professor Tatu Miettinen's experience and knowledge of the previous research that had been done in the area. He could direct the development efforts to the most critical and promising factors.

5.5.3.4. Development dynamics

The development (see Figure 18) of Benecol started when a wood processing company Kaukas Oy produced plant sterols as a by-product and was interested in finding applications for them. At the same time there had been interest in sterols as possible substances to be used to lower cholesterol. There had been a slow development towards the product idea. At the end it was more of a matter of a solution to be found to a technical problem.

A more intensive period started as the contact between Professor Tatu Miettinen at the University Central Hospital in Helsinki and Raisio was established. This led in about two

years time to a technical solution. The technological basis of the product was established. Then a more stable and slower development five-year period followed during which the clinical tests were made and regulatory approval was obtained.

An intensive period started again in 1995 as the product was successfully launched on the markets. Domestic sales increased rapidly, international markets showed significant interest on the product, and then there were many kinds of informational needs that has to be responded to. Benecol received publicity on many fronts.

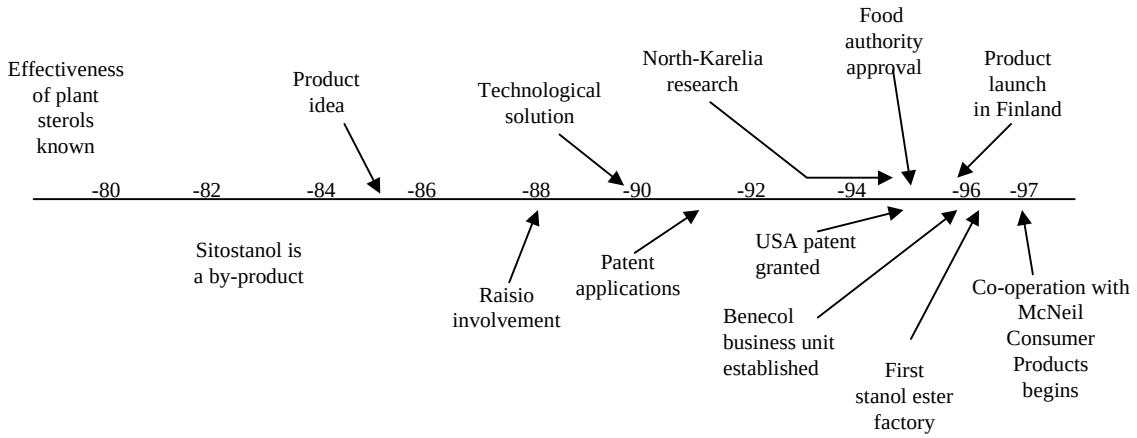

Figure 18. Key events in the development of Benecol products

5.5.4. Conclusions drawn from the case

What was new concerning stanol ester was that it found applicability in a food context. However, what is especially significant in here is that it introduced a new element to foods. Previously it has not been very usual to focus on the borderline between foods and the body. No matter what the foods originally contain, there are possibilities to control what ingredients of a food will be incorporated into the body. It could be thought that there are many phases in the food flow where this control may be of significance.

On a food- medicine level Benecol and Yosa can be compared because they partly aimed at the same purpose: the lowering of cholesterol. In case of Benecol the quick effect, the clearer mechanism of influence and the isolated key ingredient (stanol ester) made it more of a medicine type whereas for Yosa the long term effect, the more obscure mechanism of influence and the low level of isolation of key ingredients (oat bran, not any specific part of it) made it more like a food. These differences are not necessarily linked to the actual effectiveness of products to lower cholesterol levels.

In the case of Benecol the official food (food laws and other official instructions) regulation was clearly not prepared for such a new food product like Benecol to appear. The consequence of this was that there was a need to rely on an internal regulation that was based more on the expertise and knowledge of the people involved than on official regulation. The deficiencies of this approach became evident when the international markets were entered. There was a big step from the domestic context where less was demanded to international context where in every country there were different requirements. On the

other hand it is very probable that if there had been very extensive (like in case of medicines) and formal requirements, the product would not have entered Finnish markets.

On a foodweb level it is interesting to compare the Benecol and Xylitol cases. There are many similarities. Both have strong medicine related backgrounds which are linked to the main health concerns of their times. There are also similarities in the geographical actor constellations. In both cases the activity of the raw material producer was a significant development trigger. The raw materials, at least at the beginning, are from wood processing industry. In both cases there were also concerns for product safety in the early development phase. Both had as their major international partners companies that are actually not food companies.

There are also differences concerning the development. In the case of Benecol the key ingredient and consumer products are produced within the same enterprise. There was a more direct foods-to-consumers approach. There were no sitostanol capsules or concentrates available and also the international partner sold products directly to consumers. However, what makes this comparison difficult is that in case of xylitol the period under observation was two decades and in case of Benecol about two years.

Comparison with LGG reveals that development is possible with different emphasis. In LGG there was a goal-oriented research to find an ingredient (a microbe) that met the requirements set in advance. In the Benecol case the product was more or less known whereas technological solutions were of more importance. In the LGG case safety issues were given more attention initially and there was also attempts at standardisation within the field. For their marketing and partners Valio used double branding and international customers were approached directly whereas Raisio had only one brand and one major international partner.

It is obvious that if Valio had become the industrial partner and technological problems had been solved the foodweb around ”Benecol” would have become very different. On a product level it could have meant a more defensive approach. If stanol ester or some other corresponding plant sterol were added to butterfat it would have meant that part of the negative effects that butterfat have would be eliminated. It would have defended the position of butterfat as a food even though it would probably also brought up more clearly the tensions between the good and bad characteristics in a food.

The development process behind Benecol, at least to the point as Finnish markets were entered, could be characterised as a development process at its limits. There were no extra resources to do much more than what was necessary. This is evident whether it is matter of the research basis, production capacity or the marketing approaches. However it is understandable that the initial aim was to make a niche product for Finnish markets with only some export potential, no extra resources were allocated to the development.

The Benecol case also showed how health-functional food markets are in many aspects tied to global markets. The knowledge of the Benecol product spread rapidly among professionals. However, not necessary only food professionals. It could be asked at some point whether Benecol was better known among professionals in capital markets than among professionals among foods and nutrition?

6. Foodweb of the health-functional foods – a broader perspective

The aim of this part of the study is to broaden the perspective. In the previous section the focus has been mostly on single cases. The purpose was to describe and to understand the processes that empirically take place in a foodweb of health-functional foods. Broadening the perspective means above all two things. Firstly, based on the findings from the individual cases steps will be taken to make initial generalisations concerning the factors that need to be taken into consideration in a foodweb of health-functional foods. Secondly, even though the single cases brought up many different issues they all had a Finnish context as a common basis. This meant that in all the cases there were many common elements. In the following also topics that were not especially on the forefront in the cases are also considered. In what follows, for the sake of brevity a foodweb means the same as a foodweb of health-functional foods unless otherwise mentioned.

6.1. Structural properties of the foodweb

Structural properties of foodwebs are analysed using the framework developed in section 3.2.2. Product development is a structural part of a foodweb but because it is of importance in this study, it will be evaluated separately.

6.1.1. Foodweb activities and activity patterns

Activities

It was assumed that in a foodweb there are at least two kinds of activities: production and consumption. Based on the cases it seems that such a division is too simple. There are other activities that also have a significant importance. Based on the cases three additional activities were identified which were of significance in all the cases: research, marketing, and regulation (Figure 19). Research is used here in a broad sense to refer to an activity that produces new knowledge. Marketing is thought to consist of a positive and intentional relation formation in a web. Regulation in turn is an activity that gives directions to operations in a web. In a foodweb the relation of activities to products are of special interest. Therefore it is the new knowledge of products, the relationships that have a product dimension, and the regulation that concerns products that are of primary concern.

research production marketing

consumption regulation

Figure 19. Basic activities on foodwebs of health-functional foods

In the following activity features are described that were found to be typical in a foodweb. They are not meant to be tested generalisations but they are more like initial hypothesis based mainly on the cases and other information that was available.

Research was in a key role because it was the prerequisite for the emergence of the new products. Especially scientific research was emphasised. It was typically demanded that the basic validation of health-functional foods would have to take place using scientific methods (of natural sciences). However it was not the scientific basis as such which made the difference towards foods in general. What was different was the broadness of substances that were considered. Also the post-oral influence of products in the body went beyond that what has been typical in food context. This all meant that the scope of research was broader than in case of traditional foods.

It was found that the production of health-functional foods has a diverse basis. Production of health-functional foods is often an end process where different transformation chains are integrated. The individual transformation chains often have no initial links to food products but their main emphasis is on other product areas (e.g. wood processing products, pharmaceutical products). There were also indications that in a foodweb the outcome of the production, a product, and its qualities were more emphasised than the process itself. This takes place if the safety aspects have been secured. Situation would probably have been different if technologies were used towards which consumers are more sensitive (e.g. gene modification technologies). This to some extent is in contrast to the traditional food context where in many cases the way a product is made has more significance for the consumers.

In marketing in a foodweb there were typically features of both business-to- business marketing and service marketing. The relationships were not only short-term exchange relationships. There were long term relationships between commercial partners. On the other hand there were also short-term exchange types of relationships for example between a research partner and a producer or a producer and a food authority. What makes these interactions service type is that typically several actors were simultaneously involved in a foodweb.

A difference to traditional foods in consumption was the importance of the informational content of a product compared to the dominance of the hedonistic characteristics in foods in general. However, in the study there were no cases where the trade-off between hedonistic characters and health-promoting content of foods could have been studied. No major compromises were made in traditional food characteristics. It could be assumed that in cases where the health-promoting effect is of very remarkable value, even a sensorically inferior product could be accepted.

What was typical as far as regulation is concerned was that there were few specific formal regulations specifically concerning functional foods. General food regulations were applied to this product area. In many areas there were clearly self- regulation taking place. The special properties of functional foods however meant that they located on the boundaries of foods in the regulatory sense and small differences in interpretation of norms could have significant implications on the product point of view.

In regulatory approaches there seems to be a basic difference between eastern and western societies in attitudes in dividing the line between foods and medicine. In the west there is a more apparent tendency to separate foods and medicines whereas in east foods

and medicines are closer to each other (see e.g. Weng and Chen 1996, Kojima 1996). Part of this difference could be explained by the differences in current medical systems. The development taken place especially in Japan though indicates that the differences may have a deeper cultural origin.

Activity patterns

Even though the above mentioned activities can be positioned to form a linear chain where each activity is carried out only once, it seems that such a situation is an exception. A more typical situation was that the same kind of activity occurred many times. As an example it was typical that research was carried out before and after production activities. A typical pattern was that firstly there was relationship that was formed between research and production, secondly between production and marketing, and thirdly between marketing and consumption. At every such stage product development had a different emphasis.

It seemed also typical that it is not matter of one-time contact between activities. There was a tendency for relationship formation, which also seemed to change the content of the links. For example, at the beginning there seemed to be informal contacts which then turned into more formal ones. This was true especially for activities taking place between organisations. To which extent this is also true for activities, which take place within single organisations, was not clear because such aspects did not get much emphasis in the study.

An attempt was made to differentiate cases based on what activity was most emphasised at the early stages of the development (Figure 20). There were five cases and five activities, which meant that one case was allocated to one activity. This was very subjective procedure and does not mean that in specific cases other activities were not emphasised.

Research emphasis	LGG
Production emphasis	Benecol
Marketing	Xylitol
Consumption	Yosa
Regulation	Hyla

Figure 20. Cases classified based on dominant activity

In the LGG case what was special was the broad international basis of the research. In the Benecol case the key to the product formation was technological innovation that was made in the beginning. In the Xylitol case the strong approach to include health specialists to foodweb meant that marketing activity was specially emphasised. In the Yosa case it was the feedback from consumers that directed the product development. In the Hyla case self-regulation was at the forefront as Hyla defined to large extent standards for low lactose milk products in Finland.

A special activity pattern was noticed that took place in the case of Xylitol. It relates to the internationalisation process. Here the commercial actors were in the leading role. As a product was on the markets in Finland and international markets were approach there was a tendency for a certain activity pattern that is here called network marketing. It meant that there was an attempt to produce a similar process of network formation that

had already taken place in Finland. It was more than just traditional marketing of services or more tangible products. Typically there was an attempt to initiate relationships between research institutes, health professionals, food authorities, wholesalers and retailers before or by the time the consumers were approached. This same pattern was implicit in all the cases to some extent but it was most evident in the Xylitol case.

6.1.2. Foodweb actors and actor coalitions

Actors

As was initially assumed different kinds of actors were found in different cases. It was also observed that one-activity-one-actor type of an approach would have required analysis on a micro level. In a higher analysis level actors typically appear within the institutional settings that give them more permanency. As an example of the former it is possible to assume a temporary actor without permanent relations to any specific organisations. An actor would then be a temporary construction within or between organisations. In this study the level of analysis was on a higher level and the institutional setting that gave them permanency became more apparent.

Based on the findings from the cases four main types of actors were identified: scientific research actors, commercial actors, authorities and consumers. Even though there are links to the different types of activities described above, there is a clear difference. In case of actors it is the permanency and dominance of certain activities that plays a decisive role. For example commercial actors in the food industry also do scientific research and also regulate their own activities but it is not their primary role.

Scientific research actors

In the cases there was no independent research actors specialised only to this area of research. Research concerning health-functional foods was made in other research areas and in forms of research programmes. In the Finnish context the importance of the area has grown and it was for example a major part in a technology programme, Innovation in Foods 1997-2000[17]. However not all activities within that programme can be defined as scientific research. Participants were food companies and research units and it was partly the developments that were already described in the cases that continued.

In the cases the start of the development was often based on opportunities coupled with good preparedness to react when they appeared. It is probable that many developments still start similarly but as the field matures and more resources are directed to the area, it is probable that the scientific basis broadens. This means that a more goal oriented approach will become possible.

Also at the international level, a typical situation was that research were made along some other areas and that research on health-functional is based mainly on research projects. There were though examples of more permanent settings. An example of this is Functional Foods for Health (FFH) programme[18] at the University of Illinois in the USA. What is important is to notice that there are a lot of research taking place that is not

[17] see e.g. http://www.tekes.fi
[18] http://www.ag.uiuc.edu/ffh

taking place as foods or even nutrition as the common denominator but that can actually become of direct relevance to these areas. Example of such disciplines could be those that are specially orientating to preventative measures in different medical fields and those that study different biological phenomena.

Commercial actors

In the studied cases all the industrial actors were traditional food or food ingredient companies. The business area that was related to health-functional foods was part of their overall business portfolio. As the companies started to internationalise in this area, specific units were established. In the case of Cultor this meant an affiliation (Xyrofin) and in the case of Raisio that a separate division (Benecol Division) was established. Among the small businesses there are already specialised operators. In the Finnish context examples of such actors are Multibene Oy (salt replacers) and Omecol Oy (meat products).

Internationally it is much more difficult to assess the situation. There are big industrial companies that are mainly active in the manufacture of foods, health products or pharmaceuticals, which are also interested in the area of health-functional foods (see Childs 1999). What attracts food companies are better profit margins. Pharmaceutical companies used to consider this as a low profit area but as margins in drugs have become lower they consider this a lucrative market as nutraceuticals can be brought to markets for a fraction of the cost and less time than drugs (Brower 1998, 728).

If also the supply side of these industries is taken into consideration (e.g. agricultural products, food ingredients, technology producers) there are many more actors already in the business area. There is also a growing number of small businesses that are specialised in certain specific area. The only area where there seems to be much less interest in the area is the food service industry. In that area mainly retail chains have shown interest in these products.

Industrial actors are not the only types of commercial actors in a foodweb. As the size and extent of foodwebs grow the more there will be need for special commercial operators that support and integrate the foodwebs. An example of the existing group of commercial operators is the printed media[19] that is concentrated in this area. Their orientation is typically business-to-business or specialist-to-specialist but it is possible that also media that address to general public will appear if the field becomes a distinguishable area for general audience.

Authorities

The permanent food authorities on the field have naturally an important role to play. In the Finnish context it was only in the case of xylitol that direct contacts were made with administrators that handle questions linked to medicines. However, it seems that often administrations concerning medical affairs are influential in this context at least indirectly. For example if a specific substance is classified as a medicine this alone may prevent the use of that substance in foods. There are, though, examples of substances used both for medical and food purposes (e.g. vitamins)

[19] e.g. Functional Foods – magazine, Journal of Nutraceuticals, Functional Foods and Medical Foods, New Nutrition Business –newsletter.

In medicines there can be separated two different kinds of medicine types: hard and soft medicines that are different from a regulation point of view. Hard medicines are typically those that can be acquired through authorisation by medical experts. Then there are soft medicines; including the so-called over-the-counter products. It is specially the latter group that is of special interest in the context of health-functional foods.

Usually anyone can buy over-the-counter medicines. There is seldom even age limits for the sale of these medicines. Depending on the outlet there is more or less expert advice available at the point of sale. In many cases these products can be purchased from the same shops as foods. However, often there is an underlying expectation that the same individual buying over-the-counter medicines and foods from adjacent shelves in a shop is actually a very different person when it comes to rationality of choices. It can be asked how valid is such an assumption? If it is not, why are there then typically separate public authorities for both product groups?

There are international organisations (e.g. WHO, Codex Alimentarius) that have regulatory power over questions also concerning health-functional foods. Usually it is though that national level that has been of most significant importance in food regulation (e.g. USA, Japan). That has been true also in Europe. Now what seems to be taking place within the European Union is an attempt to centralise at least part of the food authority. What is typical also both at EU and national levels is that health-functional foods have no specific status within legislation.

It is not only public bodies that have authoritative influence on foodwebs. In these cases, for example, the role of professional associations is evident. There are other types of authority possessing bodies for example in research (e.g. ILSI[20]) that have a permanent influence on the field. It seems also that on a temporary basis it is possible to assemble groupings that can contribute as an authoritative actor in a foodweb (see e.g. the group behind the Keystone Report).

Consumers

The question concerns how consumers should be defined in relation to a foodweb. Basically it could be assumed that every consumer has a unique position towards a foodweb. There are no formal organisations that would unite them and make official statements. There are organisations that represent consumers at a general level. Typical examples are consumer organisations that aim to represent the interests of consumers. However, there is a difference in thinking of consumers as members of a foodweb and thinking how consumer interests in a foodweb are represented. There are also other representatives, like health professionals, who can say that they also represent consumer interests, but who are not actually the same as consumers.

A typical approach is to consider consumers as a segment within a general population. Consumers then form a true virtual organisation that is not necessary very aware of each other in a concrete sense. There are suggestions how consumers should be categorised when it comes to health relates subjects Wrick (1995) suggested that consumers should be segmented along the lines of health consciousness. She made a distinction between consumers and patients who have already been medically diagnosed to have a disease or for which they are at risk. Those who were health conscious and those who were at a risk

[20] http://www.ilsi.org

were considered as the most potential consumers. A different approach is to classify consumers based on more permanent attitudes on food and health related matters. Consumer segmentation obtained in the HealthFocus trend report (Gilbert 1998) included the following categories: Managers, Investors, Strugglers, Healers, Unmotivated, Disciplines, Wizard Managers, Savvy Managers, Casual managers. The problem with these approaches is that they do not very well describe consumers as active members of a foodweb.

It could be thought that there is an average consumer. According to Childs(1999, 81) a definable nutraceutical consumer exists in the USA who is generally female, middle aged, affluent and educated. However there are problems in generalisations. The Finnish cases showed that fore example consumers using Benecol and Gefilus type of products are very different as a group.

It can be asked do consumers desire products that are more health promoting? A pan-European survey revealed that 70% of EU subjects believe that they do not need to make changes to their diet as it is already healthy enough (Kearney 1999, s136). As a health is to large extent a subjective matter this has to be taken as a starting point. However, very broad generalisations can be misleading. Decisions concerning foods are made at the product level and even if it is thought that there is no general need to make changes in diets, still individual products can be chosen based on their health-promoting effects.

Actor coalitions

In the following actor coalitions are examined only based on the number of actors that have a significant role in a foodweb. Significance refers here mainly to the role in development process. Based on this a dimension is assumed where at the other end is one actor and at the other many independent actors (Figure 21).

one major actor----------many independent actors

Figure 21. Actor dimension

If the initial basis of actors was as reference point a typical example of a foodweb where is one major actor is Hyla-case where the industrial producer, Valio, was central in all activities. An example where there were several actors already at the early beginning is Xylitol case (Finnish Sugar Co., University of Turku and Leaf Hellas). In other cases a start-up took place with two major actors in a respective foodweb. There were no such cases where, at least based on the information that was available, a start-up took place among several independent actors. This could also be interpreted that in the formation of a foodweb there is a certain stage where the role of a few actors is critical for the future formation of commercial products. On a longer perspective there was a tendency that the number of actors in a foodweb was increasing even though the original actors still remained in a significant position.

6.1.3. Foodweb resources and resource constellations

Initially two types of resources were assumed to exist: natural resources and technology. As resources of foodwebs were examined based on empirical data, it was found necessary to add a third type of resource that would reflect more the direct human contribution in the foodwebs. It is called capabilities. Capabilities consist of those human related aspects that make product development activities possible. As such the role of capabilities is not a new finding. Also human resources were explicitly part of the resources in the industrial network model. The significance of these, however, was not initially appreciated as the content of resources in health-functional foodwebs was defined.

Natural resources

Natural resources have historically been considered to be of major significance in food context. Natural resources usually refer to nature's capability to provide raw materials for food production. Food production has been directly dependent on natural resources. This is also true in the case of functional foods even though there are features that make the situation different from many other foods contexts. It is not so much a matter of absolute scarcity of resources that guarantee short term bodily needs but they are linked to more elaborate needs. It is often the matter of scarcity of specific resources for specific production.

What seems to be typical for functional foods is that the value of different types of natural resources is changing. In these cases a typical situation was that a substance that was not typical in old foods was added to them. This actually meant that the basis of foods from the natural resources point of view was broadened. Even more significant was the importance of these new substances to the value of a product. Even though functional foods often contain traditional materials, its share of the value of the product can be small. It could be hypothesised that if there is certain amount that consumers are willing to pay of foods and if there are new characteristics that foods are expected to contain then there will be significant pressure to lower the costs of that part of a food product that consists of standard commodities.

Functional foods need not to be based on significant changes in the nature of foods in chemical or biological sense. There seems to be, however, a phenomenon that could be defined as a change from natural to non-natural products. Previously it was natural that there was shortage of foods. This resulted in famine. From a natural perspective a situation without famine is not natural. In the case of nutrients this same trend is obvious. For example, it could be thought that in a natural situation there is at least a temporary shortage of vitamins. A situation where foods always contain certain level of vitamins is not natural. From nutrition point of view this variation is problematic. In case of functional foods the situation is basically same even though the substance base is even broader. It can be claimed that it is not natural to have a high and consistent amount of xylitol or sitostanol in foods no matter how beneficial they are from health point of view.

One question concerning the raw materials is their relation to traditional food material sources. What was observed in these cases was that links to traditional basic natural resources are weakening. Natural resources (e.g. from a forest) were significant as soon as they had been processed to certain extent (e.g. xylose and plant sterols). What was important in these cases was the proximity to specific existing processes (wood processing) and not to the resources as such. This was noticed especially at the early phases of

product development. At later phases the basis of raw materials was typically widening (e.g. from woods to plants in general) as more raw material sources were exploited.

What were actually been seen here were two different types of phenomena. Natural resources can be considered as the basis for raw materials for production and they can be considered to be a material-forming basis for new knowledge. The former emphasises the physical volume and the latter the qualitative aspects of resources. For example for Benecol it was actually plant sterols that were the natural resource. Plant sterols already existed they were not invented. A different question was how and in which context they were produced.

It has not been typical to consider the human body to be a natural resource but the more natural resources are considered as source for increasing knowledge rather than production, the more relevant it is also to include also the human body as a natural resource. Specifically the LGG case showed that the human body could be a natural resource. LGG was a bacteria strain that was found to exist in the human gut. The human body was a natural resource base for it.

Technology

The role of technology in product development in a foodweb is different than in a single organisation context. Here the emphasis is on product related matters. For example, the ways that actors in foodwebs used technology in to order to communicate with each other was not examined. It was more the relation of technology to products that was of interest. Despite this it is obvious that in many cases the role of communication technology can be crucial, especially as it seems that technological development often takes place in a situation where several development groups are close to the same technological solution.

Technology played a role in all the cases. There is however differences in how important its role was. If only the production technology is taken into consideration it seemed that in the cases of Xylitol and Hyla it was very much a starting point. In the case of Benecol technology gave a key advantage and in cases of Gefilus and Yosa it was a necessity.

New technology opened up new possibilities. A good example of the new relationship between foods and the body revealed by the new technology was the lactose intolerance. The availability of certain nutrients (lactose as a carbohydrate) was not sufficient as there were more or less permanent changes taking place in the body. In the case of lactose intolerance there were immediate body reactions which made it easier to define the cause and affect relationship. Using modern technology it was possible to go behind the obvious symptoms.

Capabilities

What the cases made evident was actually the crucial role of capabilities as a resource in foodwebs. A typical starting point was that natural resources and basic technology were already available but what makes the difference was the capability to use them in a specific product development context. What was also noticed was the need for very different capabilities in different phases of development.

In the cases all industrial actors were traditional food industry firms. As these firms entered the new area of health-functional foods new capabilities were needed. In that sense

there were different strategies concerning capabilities. Basically there are two different approaches. Capabilities can be developed internally or acquired from outside. Raisio (Benecol) and especially Valio (Gefilus) were examples of firms that had developed internal capabilities to enter also the body related research field and even they needed new capabilities as the development process proceed. In the Xylitol and Yosa cases the key industrial actors Cultor, Leaf Hellas and Bioferme relied more to external expertise in this respect.

From an industrial actor perspective another critical relation is the product and customer relation. Special capabilities are needed in order to direct this relationship. Ideally it is a learning process where all the actors learn from each other. The cases seemed to show that the capabilities that were sufficient in a Finnish context were not adequate in an international context. This is partly probably based on the fact that the Finnish food industry is not very internationalised. A typical approach seemed to be that capabilities were acquired from international partners who did not very much deal directly with food consumers (e.g. Roche in Xylitol case, McNeill in Benecol case). This left gaps concerning the capabilities to operate within an international consumer base.

There are also capabilities linked to regulation. Depending on the level they have achieved development can be retarded or promoted. Here the balance between self-regulation and outside control is of significance. It could be thought that if there are high capabilities in self-regulation there is little need for outside control. What seemed obvious based on the cases was that especially prior to the EU-regulation became effective in Finland, regulation was very much based on scientific and industrial actors' self-regulation in the foodweb. The role of the domestic food authorities was not very significant. When the EU regulations came into force the situation changed and official systems became more influential and visible.

Consumption also needs specific capabilities. In these cases the capabilities were not linked to subjects like the capability to prepare foods in technical sense. The products were either ready-to-eat products or products in which the preparation of food is simple (e.g. spreading fat on a sandwich). Capabilities are more needed to take advantage of the health properties taking into consideration for example the individual values and preferences, other food choices and economic resources.

Resource constellations:

Resources can be thought to consist of all the above mentioned resource types. A resource constellation could then be a combination of natural resources, technologies and capabilities (Figure 22). It could then be assumed that in different development processes different types of resources could dominate.

Type 1.	***natural resource*** – technology - capability
Type 2.	natural resource – ***technology*** - capability
Type 3.	natural resource – technology - ***capability***

Figure 22. Resource constellations with a single dominant resource

An example of a constellation where natural resources dominate, could be a situation where certain natural resources or a rich variety of them are more valued at the same time as technology and capabilities are in a more stable state. In technology or capability dominated constellations other resources are respectively in a more stable state.

Based on the cases it seems that natural resources and technology-based constellations are dominant especially in the early phases of the product development. It seemed that as the development proceeded they did not become unimportant but their weight diminished as the significance of capabilities increased. Foodwebs based on the dominance of natural resources or technology may therefore be more unstable than those based on capabilities especially in a dynamic development environment, because capabilities open up more development possibilities for both natural resources and technologies.

6.2. Product development in the foodweb

As the development of products on the foodwebs was examined, four subprocesses were identified which describe the overall development of the products. These four processes were (Figure 23): choice of initial product characteristics, formation of product barriers, product-related communication, and progress of product design.

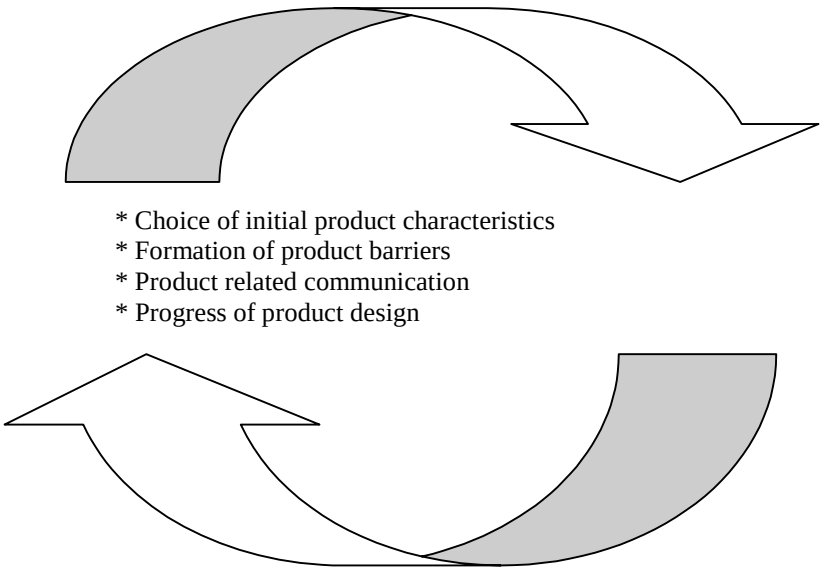

Figure 23. Four subprocesses in the development of health-functional foods

It was seen that the initially chosen product characteristics are of major significance also in the later phases of the development. The formation of product barriers refers to the fact that not all the characteristics are changeable but that often as the development proceeds many of them become fixed. Product related communication is important because it forms the basis for relationships within a foodweb. The progress of product design emphasises that there is continuity in the development.

6.2.1. Choice of initial product characteristics

It was assumed that within products there is a hierarchy of characteristics. This means that there are some characteristics in the products that are more fundamental than other characteristics from a product point of view. In this study the starting point was that it was the health-functional characteristics that were of special importance in a product.

What kind of characteristics?

It seems that there are two basic strategies in the choice of health-functional characteristics. One starts by looking at health aspects. There are health-related factors and problems that are not specific only to certain foods even though they may have a relation with foods. In another strategy specific foods are the starting point. There are no clear-cut boundaries but it seems that of the cases examined Benecol and LGG were the best examples of the former and Hyla of the latter.

As the first strategy is being followed, it means that the actual choice of foods does not take place until the characteristic and its relation to health has been established. Even if a food is actually involved from the very beginning, there is always a possibility that a different foodstuff will be chosen that will provide a better context for the specific health-promoting characteristics.

In these cases it was typical that the health characteristics were linked to a single substance. Even in the case of Yosa, which contained several health characteristics, each of them was related to a single substance. In principle it could be thought that in a food there are several substances that are linked to certain health characteristic (e.g. to lower cholesterol). The single substance approach means that there is a strong dependency on the qualities of that specific substance. The health related aspects could be taken into consideration only to the extent that these qualities make it possible.

The health characteristic level starts in principle from an immaterial level. First, there is the general level where different factors have a relation, for example, with the health condition described as cardiovascular disease. Secondly, there are certain markers (e.g. cholesterol) that indicate whether the risk of the disease is growing or decreasing. Thirdly, there is a substance level that has a relationship with the markers. It is not until we are within this third level that also the food level becomes of significance either for the importance of whole foods or parts of them.

Typically in the cases there was a relation with specific medical states. The relation was though not a medicine-disease relation. It is probable that the substances, at least at the levels that they were considered, would have been classified as non-effective as medicines.. Still the development of products was very much dependent on that relation. Benecol, Xylitol and Yosa were particularly linked to the diseases that were considered of major significance at the national level at the time their development started.

The other strategy starts with foods. It is assumed that foods are health promoting to a different degree. A key question here is how a food can be made more health-promoting? There are several alternatives: A food product can be made functional (or more health promoting) by using five different approaches (Roberfroid 1998):

1. to eliminate a compound
2. to increase the concentration of natural component or to increase the concentration of non-nutritive component
3. to add a component not normally present in most foods
4. to replace a component
5. to improve the bioavailability of food components

Approach number three is the one that is least dependent of the actual existing foods. In other cases there is a foodstuff that is modified to make it more health promoting. The problem here is that there are actually no reference points. Any change towards the health-promoting direction can make the foods health-functional.

Who makes the choices?

In the cases that were investigated, the choice process seemed to be rather straightforward. There were usually no alternatives at least in the short term when the initial characteristics were chosen. In such a situation it is actually the research actor who makes the initial decisions, which from an industrial actor point of view becomes a yes-or-no situation.

If the situation is considered in the long term there are several actors that are involved in the choice processes. There is typically some major health problems that are considered as more important than other problems for example from a national health perspective. Cardiovascular diseases are an example of these. Resources are then allocated to the research. The results of researches then form the basis from which different characteristics can be chosen. If these research results reach the consumers it can be thought that they actually make the choice and then producers can respond to that.

At the time the research was carried out there were no strong pressures from the consumer side to demand foods with specific health-characteristics. A more common situation was that consumers just reacted positively or negatively to foods being offered. The choices of health related characteristics were therefore to a large extent made by experts in different areas.

Health-promoting characteristics in relation to other food characteristics

The substances that form basis of health-functionality may also have other characteristics that are important from a food point of view. The Xylitol case was an example of this. A sweet taste was a food typical characteristic for chewing gums and sweets. There are different ways to include a sweet taste in a food. There are for example different kinds of artificial sweeteners, which are even tooth friendly, and do not cause caries. In the case of xylitol the advantage of the xylitol as a substance was its physical structure which made it possible to produce food products that were physically similar to chewing gums

and other sweets made using sugar. Xylitol therefore contained both health-functional and other food relevant characteristics.

In the Benecol case another food relevant feature is displayed. Margarine is a food even though it is not eaten alone but is used in combination with other foods. It is not a food supplement because it is a food itself but it is not an independently edible food.
There will probably be more and more such components in the future. This will add a new dimension to the question of health-functional foods. Who is adding health-functional components and at what stage to those foods that are being eaten at certain occasions. Will there be for example health-functional "spices" in the future?

6.2.2. Formation of product barriers

A health-functional food is not an open bundle of characteristics, but there are many factors that lead to the formation of product barriers. Previously, when the different functional areas were examined some differences towards other product groups (e.g. medicines, pleasurables) were considered. In here the perspective is more within the foods barriers. Some barriers are explicit and some of them are implicit in a sense that there are no written rules concerning them. What also has to be remembered is that in the long run most of the barriers will probably change but in the short run some of them can be considered to be fixed.

Body related product barriers

Not all foods have a similar position in food flow. For example if the desired body reaction requires that a certain substance is ingested within certain intervals, it limits the choice of foods. A product barrier rises between those products that meet these requirements and those that do not. This was evident for example in the Benecol case. In order to lower cholesterol level a certain regularity in way the foods were used was needed. Spreadable fats satisfied this requirement.

In case of Xylitol another requirement appeared. The mouthlag of a product became of significance, If xylitol was simply swallowed in a food product the desired health effect would not have been reached. There are not many foods that stay naturally in the mouth for a long period of time. Therefore the body related factor gave a natural product barrier for chewing gum and lozenge types of foods.

Food specific barriers

Health-promoting characteristics are typically not organoleptically recognisable in the physically eatable product. This does not mean that they are not of significance. There may be changes in organoleptical quality as something is added, removed or modified.
Even though such changes may be positive in isolation, the problem is that there can be strong expectations concerning the sensoric qualities of these specific foods, which can make any changes intolerable.

One source of a food specific barrier is based on the fact that there are foods whose contents are officially protected without link to sensoric qualities. These foods typically have a specific cultural background that has led to a situation where there are specific norms concerning the origin and the characteristics of these products. Health-functional

characteristics can be added to these foods to a limited extent and therefore in those rare cases where this is possible a further protection is achieved.

Patents and trademarks

Patents and trademarks are significant sources of product barriers. Especially in the early phases of the development patents seems to be of significance. If development results had not been patentable it is very probable that in most of the examined cases, the development up to consumer products would have not been taken place. During the examined period it became possible in Finland also to patent new foods. However, in the examined cases it was mainly the results of the technological development that were patented.

It was also common practice to register trademarks for products. Trademarks also give legal protection for an activity called branding. What was noticeable was the change in significance that was given to trademarks. In the products that originated from the 70s (Xylitol, Hyla) trademarks were merely logos given to products whereas later on they were considered as integrated parts of branding and more attention was given to them.

Brands

Branding was one of the major themes for product development in the cases that came to markets during 1990s. What is special in branding is that it directs the product development based on social-and psychological factors whereas earlier products were produced more based on technological development. A brand defines a space in the social and psychological space. What this means is that the technical similarities in the products do not necessary make them substitutable. From a consumer perspective health-functional foods are not necessary comparable with respective basic foods but with other health products. The examined products contained different layers of brands.

For example in the LGG case LGG was branded for experts whereas Gefilus was a brand for consumers. Different aspects were emphasised when they were marketed. In the LGG –Gefilus case what was special was that branding took place within same enterprise. This multiple branding was more obvious as there was more actors in the foodweb. Xylitol, although also a generic substance, was a brand name whereas Xylitol-Jenkki was a consumer brand, although very much linked to xylitol, by a different company.

In all of the cases the brands were very much attached to a certain substance basis. There were no brands that would have been more generally linked to health-functional foods. Based on the information that was available this was not even very common in international context.

Information barriers

Consumers have few means to validate health-functional characteristics in concrete physical sense. This means that the information attached to the product is of major importance. It is of more significance than in the case of traditional foods where health related information is based mainly on the basic nutritive content.

Information barriers are based on the fact that either because of a lack of information in the absolute sense or if information is available, because of the actor differences in capabilities to interpret the information, not all the products are in the same position. A lack of information can mean that certain aspects of the products have not been studied even these products may contain specific health-promoting features. The problem here is that research itself does not make the products more health promoting but without research it is not possible to validate their health-functionality. Not all foods are equally researched due to differences to the interest that has been shown to them.

Differences in consumption capabilities mean that even if generic information is available it does not lead to proper conclusions. Product can be overvalued or undervalued based on misinterpretation of the information that is available. The problem is not only that of consumers but concerns many other actors as well. The faster there are changes in the ways that information is produced the more difficult it will be even for experts to follow the developments in the field and interpret the results.

6.2.3. Product related communication

In the foodweb there are as many communication links as there are actors in the web. In every link there are special features. For example some have a formal basis (e.g. producer-public authority) some are more informal. In some more interaction is needed whereas others are more of a one-way type. In the following emphasis is especially on product related communication with consumers.

Information media

Communication with consumers takes place using different kinds of media (Figure 24). Electronic and printed media are typically associated with advertising, which usually means one-way communication. However they make also an interactive communication possible even though printed media (e.g. posted letters) are usually less convenient for that purpose. Personal media are used, for example, as a health professional meet with a consumer face to face or when consumers rely on other consumers as sources of information.

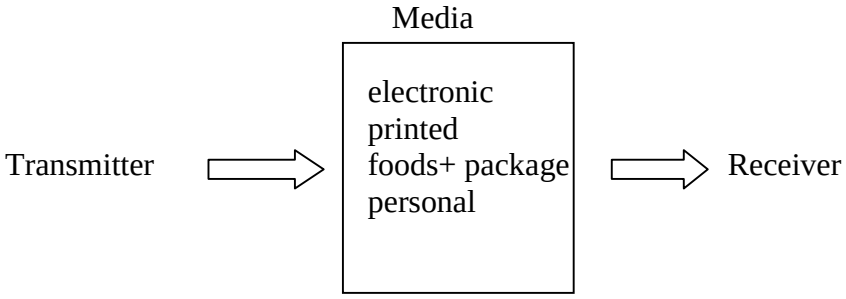

Figure 24. Types of media in food related communication

In the food context the role of foods and its package as a media has traditionally been emphasised. This is very much based on the knowledge that in many cases the actual choice of foods does not occur until at the shop level. It can however be assumed that there are certain limits to these spontaneous choice processes. Not all foods are alternatives, which can be used in making such decisions. Then it can be asked at what point are functional foods included to food choices? It can be expected that also other media than foods and their labels are of significance specially before a health-promoting food enters a consumer's potential selection basket.

Health related claims

Health related claims have become one of the most debated subjects in the health-functional context. They are thought to be of major significance when the consumer acceptance of functional foods is considered. It has even been suggested that the core category of functional foods could consist of those food products that make specific health claims on the packaging or advertisements (Hilliam 1999).

This significance is understandable from a commercial actor point of view, if the choice of health-functional foods takes place in a similar fashion as traditional foods, where not very much information concerning products is looked for and the information is required at the last minute just before the purchase decision. Health related claims are then expected to be able to convey the implications of the research to consumers.

What specially raises the issue is the fact that there is a lot of regulation concerning health-related claims. In the Finnish context direct health claims concerning foods are as a rule forbidden. This situation applies to most developed countries. In some countries though health claims are approved for certain generic ingredients.

Health claims are not specified in the Finnish norms, but according to the FDA they are: any claim made on the label or in labelling of a food, including a dietary supplement, including "third-party" references, written statements (e.g., a brand name including a term such as "heart"), symbols (e.g., a heart symbol), or vignettes, characterising the relationship of any substance to a disease or health-related condition.[21]

Within health related claims in a broader sense nutrition claims are in a special position. What is typical is that nutrition claims are more often allowed in advertising than other types of claims. There are two basic types of nutrition claims. There are claims concerning nutrition as a whole. Such claims emphasise the totality of the diet. They are usually highly ambitious and not disease specific. Their purpose is usually to lead to more significant changes in food habits than just a change in a consumption of single foods. Another type of nutrition claim is linked to specific details within the domain of nutrition. For example concerning the advantages of vitamins.

Internationally there are different kinds of procedures for how health claims can be approved. In such systems health claims can even be extended to factual medical claims (relationship with a disease). In a system that exist for example in Sweden and USA general substance specific claims are approved whereas in other systems, for example, in Japan also food specific claims are approved.

[21] 21 Code of Federal Regulations § 101.14(a)(1)(1995)

There is also a third category of health related claims which is called functional (or structural) claims. They are often permitted in the food context. In such claims there is no extrapolation to the health level but they concern the relationship of a food and a specific function (or structure) within the body. These claims could also be called expert claims because obviously it is expected that it is the health experts who can evaluate the respective food's significance for health.

Another factor concerns the tightness of the control of how the rules concerning health claims are being followed. When the cases were examined it was observed that a tightening of control was apparent in Finland as the significance of the EU regulations and their context were increasing. In these cases the regulation concerning communication was not a major barrier, probably because there was not yet very many such products on the markets and the products that were on markets received a lot of free publicity in which the relation to health was a major topic. It is probable that the more health-functional products there are on the market the more important role will communication related questions have. It is also probable that if health claims are defined in the above mentioned broad sense and if the credibility of the control is going to be remained, a significant control machinery will be needed, in order to monitor the daily activities on the markets.

From a consumer point of view the basic problem with a health related claim is that they indicate a direction but they make it difficult to assess when a change to use certain specific product is actually advantageous. Usually there are several ways to improve the health promoting effect of a food flow. Every individual, however, sets limits to what changes are optional and it is within these possible changes that a value of a specific health-functional food product needs to be assessed.

This lack of clear reference points means also that health claims are actually context bound. With time goes and as new improved products appear on markets the old claims may lose their true significance. Also the more there are different kinds of health-functional products the more there will be pressures for more diversified claims, which take into consideration the special aspects of individual products. If almost every product claims to be cholesterol lowering such a claim will probably gradually lose most of its significance.

Labels

Because in the food context the physical closeness to products is so emphasised the role of labels or in a larger sense the information close to a physical product in a place of purchase in general is of major significance. Then it can be asked what kind of information is needed on the labels and what kind of information needs to be otherwise available?

From a health point of view every food has both positive and negative characteristics. They could be called health active characteristics. In principle it is not so much the ingredients than the outcome that matters. However, food labels do not reflect this. Otherwise it would be required that a producer should have to know the content of its products and then health active characteristics would be labelled, no matter how they became part of the foods in the first place. In a transparent information system it could be thought that a large amount of information would be available in some form and only some key information concerning most of the consumers would be required on the labels.

Communication – behaviour relationships

It can be asked why communication concerning the relationships between foods and health has been so regulated? It is hardly that scientific information as such is too complicated to be interpreted in order to make proper claims. There are many other products groups which are based on use of scientific information and which do not need similar regulation. It is not a matter of products that have significant negative side effects and would therefore need to be controlled (like strong alcohol and medicines). However, there must be reasons why they are considered as potentially harmful. Regulation of communication is in today's world a strong control mechanism.

The reason for this control is probably linked to the proper ways to achieve nutritional goals. There is a highly recommended way to achieve a proper nutritional status, which is based on the selection of certain traditional foods or food components. New developments are easily a threat in such a situation. It is not difficulty to find examples of such potential conflict situations. For example, there are certain edible fats that contain negative characteristics from a health point of view. They are traditionally found in certain foods. If ways are found to eliminate the negative aspects in specific foods, an obvious conflict situation emerges. These fats are still harmful but no longer in these specific foods. The normative system is not well adjusted to cope with this kind of situation. It cannot make product specific exceptions. Such a development is a threat because it complicates the original messages. The easiest solution is therefore to rely on the old basis and try to keep new developments on the sideline.

Food specific communication

It was proposed that health-functional foods are from the communication point of view different from many traditional foods. The significance of indirect, especially cognitive information was emphasised. This could mean that actually the value of a health-functional food would be decided before it is actually tasted. However based on empirical experiences it seems that the situation is not as simple. Especially, the experience from the LGG and Yosa cases indicated that it is difficult to anticipate which characteristics are the most significant. It seems more realistic to assume that different consumers weigh food characteristics differently.

From a communication point of view it seems that if all the communication is based only on cognitively identifiable health attributes it will mean that only very specific types of consumers are reached. It can be thought that based on the indirect information consumers are being persuaded to buy health-functional products. Consumers thus become like temporary members in a foodweb. In such a situation there is a risk that if the actual organoleptical properties do not meet the expectations customers would not stay but would leave the foodweb.

Another risk is that the products are accepted based on their organoleptical qualities but no extra value is given to their health-functional characteristics. In practice this could mean that for example the price of a product will be considered too high and consumers will leave or will not even enter the respective foodweb. In the studied cases these risks did not actualise but then it has to be remembered that the case were chosen because the products had been successful and these risks were avoided. However, even these successful cases seem to show that there are always communication gaps in the foodwebs. This brings major uncertainties to the development process.

6.2.4. Progress of product design

Progress in product design means that products evolve gradually. If the characteristics of products are considered to be their elementary building blocks, then there are concerns for bundles of these characteristics. Based on the initial assumptions concerning products in a foodweb it is assumed that not all characteristics can be substituted at every phase of such a flow. There are restrictions to what extent the design can take place.

Design properties

It can be assumed that the progress of product design consists of phases in which major changes concerning products take place (Figure 25). It is not necessarily only one actor that is influential in such a phase (e.g. the producer). It need not even be matter of only one activity (e.g. production).

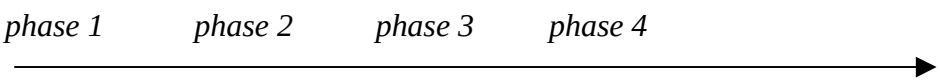

Figure 25. Progress in product design

In the cases that were examined there were different kinds of phases that were critical from the development point of view. The cases showed that such phases are complex in their nature. For example in some cases the technological problems were so evident that they formed a separate critical phase in the development (e.g. Benecol).

What was seen in the Finnish context was that individual actors were functioning rather independently. Especially at the beginning of the development it was not typical that permanent forms of co-operation (e.g. organisations) could have been formed. Development activities were typically embedded in the existing structures of the actors. This meant also very much reliance was placed on certain persons.

Design does not mean only changes in the physical products, although such changes are common, it is also matter of the design of the image or mental picture of the product. At certain time interval, even if the physical product remains the same, the image of the product may change significantly. Example of such change can be seen in xylitol-based chewing gums. Even though the products remained physically practically the same, in the 1990s their image was very different from that what it had been in the 1970s. This also indicated that as design takes place in a foodweb context, part of it can be considered intentional and some of it unintentional.

There are also value-related changes taking place. In contrast to the usual assumptions of the value chain on markets, in a foodweb it seems that it is not a matter only of increasing the value of a product. It may also be that for one reason or another the value at least temporarily decreases. For example a negative research result may cause such an occurrence. It also seemed that in a development process there is a certain tolerance for temporary decrease in product value if the expectations for future value are not being severely reduced.

Relation to a foodweb

Based on the cases it seems that behind the progress of product design, that can consist of many different separate phases, on a foodweb level there are three major states: the internal state, transition state and open state (Figure 25). These three states could be described based on the three basic elements of a foodweb: activities, actors and resources.

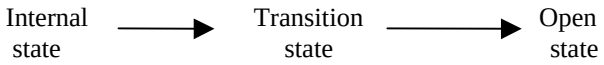

Figure 25. Different states of a foodweb in the development of a product

In an internal state there is a limited number of actors and it is typical that there are no major changes in actor compositions as soon as a core group of actors has been found. In its activities research is very much oriented to basic natural or body-related phenomena. Production takes place on laboratory scale and marketing means relationship building among the existing actors. Regulation is very much based on self-regulation within the foodweb and consumption is represented by assumptions concerning consumers. Resources are local, natural resources, technology is aimed to produce robust products and capabilities are based on the histories of the core actors.

In the transition state a foodweb itself orientates outwards. New actors are still mainly experts in different fields (e.g. health, business etc.). This same difference in orientation is apparent in foodweb's activities. Production is on a semi-industrial scale. Market research is being done and outside relationships are formed. Outside regulatory aspects are taken into consideration. Consumption is still dominated by expert influence.

In an open state the actor base is changing. This does not mean that the original actors are not any more members but it means that as a whole actor base is changing for example as consumers enter and exit the web. Activities are oriented very much along this openness which means that the borderlines between what is inside and what is outside the foodweb become more difficult to distinguish. The broader foodweb may then divide into smaller sub webs dominated by different types of activities, actors and resources. On a product level this means the emergence of differentiated products.

Dynamics of the progress

It is to be expected that the timeframe within which the development takes place vary. Because it was assumed that different phases are not necessary commensurable, another basis for comparisons of cases is needed. In the following, four key events are chosen that can be distinguished in all the cases: emergence of the product idea, finding an industrial partner, launching the product on markets, and beginning a major sales growth. These events are set on a time dimension in Figure 26. Only in the Hyla case could the emergence of the product idea not be dated and also sales growth was relatively stable during the period under consideration.

	Product idea	Industrial partner	Launch of the product	Major sales growth
Xylitol	1972	<1	3	11
Hyla	not identified			
LGG	1983	4	3	6
Yosa	1987	8	1	< 1
Benecol	1985	3	8	< 1

Figure 26. Time in years between key events in the development

When the dynamics in different cases are compared it is difficult to find clear patterns. The most recent products did not necessarily reach consumers more quickly than older products. The more there was need for basic safety and clinical studies the longer was the research period. Even if these tests can be rationalised to certain extent, it does not necessary mean that research time will be shorter as new demands will arise concerning what needs to be studied. What seems to have happened is that newer products are expected to enter major sales growth periods sooner than in case of older products. There is less tolerance for organic sales growth.

It seems that any of the stages can take several years and that the total time from the emergence of a product idea to the major sales growth, that means that consumers are joining the foodweb, is easily over ten years. A long development period means that there are many uncertainties. If this is combined with the trend that sales are expected to grow in an ever shorter time, this means that the timing in market entry is becoming ever more important.

The above mentioned time periods do not give a picture of the intensity in the change. It could be assumed that the shorter the time period the more intensive are the changes. However this is not always so. It may well happen that in a development process, that is longer in years, there are more difficulties than in another that is shorter in years. The actual changes may then take place in a very short period of time. Or there can many different activities, actors and resources involved, which complicates the development. Therefore, it is difficult to compare development processes based on very simplified measures.

Factors behind differences in dynamics

In the cases examined only in one case (LGG) did the development start with a health characteristic level. In the other cases the characteristics were already in those substances that were to be basic substances in the products. The product ideas and a specific substances were linked to each other at the very beginning. In this latter case actually one phase in the development is passed as the development starts from the material level.

One key factor that affected the time needed for development was the amount of research needed to guarantee the safety of the product and then establish the health-promoting effects in clinical studies. The newer the subject under consideration the more such basic research was needed. The safety issue seemed to especially cause concern. Clearly it was difficult to evaluate how much research should be done at an initial phase, especially if it was a matter of a subject that was already to certain extent known. To what extent it was possible to rely on studies that were done with a similar type of substances or earlier in time (see especially Xylitol and Benecol)?

Research results were one of the most influential factors behind the progress of product design both in a positive and a negative sense. Positive research results were a necessity as the product characteristics were developed. However, as the Xylitol case showed negative research results can have drastic consequences from a development point of view.

With positive results it was also noticed that research results are not necessary universally accepted even though there is an assumption that scientific methods are same all over the world and even when no differences based on population differences was expected to be. From the flow point of view this means retarded development as the results have to be duplicated in different contexts.

Even if it could be assumed that after a process where health experts are first thoroughly informed before consumers are approached, the sales of products would increase faster, the cases do not support such an assumption. In the case of LGG health experts were informed of the developments even before actual products were ready. However it took over five years until a more significant increase in sales was observed. In the case of Benecol, the product was introduced simultaneously to the consumers and experts and still the sales started to rapidly increase.

It seems that there are certain times when sales of the products start to increase, which probably cannot be based on any single factor. In the case of Xylitol this happened in the middle of the 1980s and in case of LGG, Yosa and Benecol this took place in the middle of the 1990s. It was only in the case of Hyla that a more gradual growth in sales took place.

6.3. Change in the development environment

In this section the change in the development environment is under consideration.
A foodweb is an open system and therefore what takes place in the development environment will affect the development itself. There are many change factors. The difficulty is that there is seldom a clear causality from a certain single change factor to a certain specific consequence. Usually, there are several factors that are needed to produce this. For example it is well known that the proportion of elderly people in western societies is increasing. However, it is difficult to predict what kinds of consequences this alone will have for the development of health-functional foods. It is therefore not the intention of this section to predict how the development of health-functional foods will actually take place in the future, but to describe what kind of factors influence changes and how the exploitation of these changes could possibly take place.

6.3.1 Change factors

In the following some major change factors are considered. It is not expected that the entire field of factors be covered. The approach is very selective in nature. Especially such issues are raised that have not often been considered in the context of health-functional foods.

1. Knowledge concerning human body

An increase in knowledge concerning the human body will probably be one of the key factors affecting the development of health-functional foods. Clydesdale (1998, 417) presented a scenario for the components that will affect functional foods (or all foods) in the future. According to this the development of health-functional foods will in future be based on the knowledge that is acquired of the relationship between chronic diseases and specific genes. As the genes are identified the impact of food ingredients on the gene expression can be studied. Combined with biomarkers that are used to predict development of specific diseases, this would form the basis for the development of new individualised health-functional products.

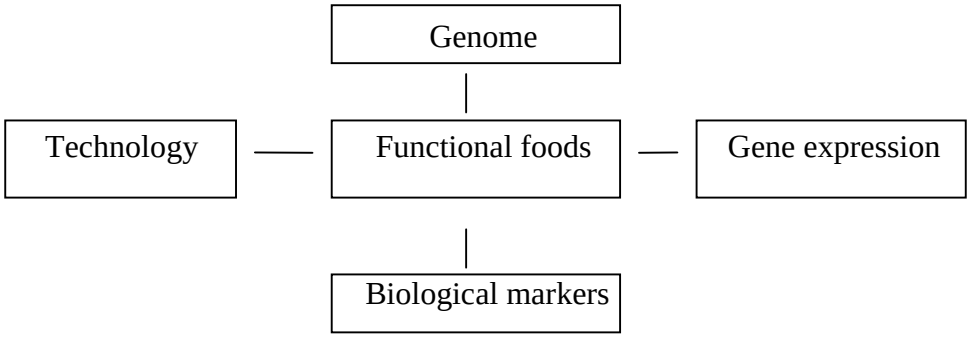

Figure 27. The components necessary to define the physiological functionality of foods in the diet Clydesdale (1998, 417).

There is also another aspect here that is based on the key role of foods as the material basis of the body. Whereas foods have been considered as a general raw material for repetitive bodily metabolism on a daily basis in fact they simultaneously affect other processes and the body structure in which those processes are taking part. As has been stated above the influence of foods can probably be noticed even behind gene expression. In fact there are no genes without foods first being involved. Modifying the old saying it could be said that a body (including genes) could only be as good as the raw materials (foods) that are used to build it.

2. Knowledge concerning traditional foods

As interest at the more and more elementary biological (and other material) level is increasing this means that simultaneously the complexity of traditional foods is becoming more apparent. It is already known that foods contain a large number of substances whose health related significance is not known. It was previously not possible to examine these substances. In the future this will change. It is very probable that some of these factors will exhibit positive and some negative potential from the health point of view. The wish to avoid negative factors and to strengthen the positive factors will be a strong leverage that will validate changes in traditional foods.

Many foods are linked to natural cycles which mean that the characteristics that foods have alter as natural conditions vary. In developed societies the link to natural cycles is not any more so strong that it would lead to a lack of food in an absolute sense. A famine is not a major threat. However, the more there are demands concerning the qualitative aspects in foods the more probable it will be that there are situations where even the

natural variation that is tolerated in today's foods will not be positive from a health supporting point of view in the future. This does not only concern the open nature conditions where foods are produced but that also natural processes that take place in factory type settings. In fact, the whole physical food chain causes a certain natural variability that will affect the health-related quality of foods.

3. Technology

Technology plays an important part as a change factor. Information technology here does not mean only information technology in social communication. Of special significance is technology that makes it possible to receive information from nature. In this case the sensors put into the nature are of specific importance. The more sensible and specific the sensors are the more deeply it is possible to go to gain knowledge about it. This means that natural processes can be followed more closely in their early phases. Like in social communication the more capacity there is in technological sense, the easier it is to follow natural phenomena even on-line. Natural phenomena taking place at a molecular level can be magnified and visualised to make them easier to follow. This in turn is of importance when issues are looked at in a social context with an intention to raise interest towards them.

Materials technology has advanced and it has become possible to operate on a miniature scale in nature. It is common to modify natural macro objects (like plants) by different technologies. Now more precise modifications are possible even on the micro (cell) level. Technology can even be embedded within natural objects. It means that new opportunities are opening also to steer existing food processes. This will open up new possibilities for controlling and directing the formation of health relevant factors in foods. The technological focus in food production changes. As the primary production of foods takes place on a molecular and cellular level, then it is only of secondary importance whether it will be taken into industrial scale on a field or in a factory. If a cell is considered to be a factory it can be asked how small is the relevant size of elementary food components?

4. Social trends

In developed countries the ageing of population is one of the major tendencies that is of significance when health related matters are examined. Age brings with it special requirements for the nutritional content and for example organoleptic properties of foods. People who have already reached a later senior phase in their lives, probably value the readily apparent effects rather than the very long-term effects in their foods. This means that for them the area between foods and medicines will be of special interest.

Children and teenagers learn their food habits at home, at school, and from their friends. Their food choices are also influenced by youth culture. In the relationship between youth culture and health there are two different aspects. Firstly, it can be thought that in youth culture health is of certain value as such and secondly it can be thought that youth culture can have positive or negative influence on health related matters that is not intentional. For example, a growing tendency in Finland has been the growth of number of pupils at schools who choose a vegetarian diet. However, it can be asked what are the directing forces in this development. Is it long-term health concerns or more temporary social pressures? There is no certainty that young people will start eating healthier diets than their parents. What is a fact is that from health-functional food perspective young

people are an important group because in their case the long-term perspective is of most importance.

In matters of health consciousness of consumers in a food context, it is the middle-aged women who are the most knowledgeable of the relation of foods and health (see e.g. Childs 1999,81). What is of importance here is that their influence is not only limited to themselves but for example they are often responsible of the food purchases of families and typically they have a significant role in public and commercial foodservices.

What has been a major trend also in food context is the growth of service type of operations. More and more service type food solutions are expected to appear. Typically food services have been linked to the very physical preparation of foods. As health-functional foods are concerned the information content is of special importance. This means that in food service these aspects should be taken also into consideration.

Despite all the changes in food context there also seems to be a significant inertia in changing food habits. For example in the USA the top-ten lunch/dinner entrees consumed at home in 1996 were almost the same as they were in 1987. Only the order of these entrees had changed (Sloan 1998,37). This does not tell us whether the content of these entrees, which is more significant in health sense, has changed. Also it does not tell about changes of the roles of these entrees in relation to other food components that are used daily (e.g. snacks). However, the more difficult it is to change food habits the more viable option it is to change the composition of those foods that are part of the food habits.

5. Food related policies

There is no single policy area that affects the development of health related foods but there are many policy areas that are of relevance. Especially of relevance in the health context are nutritional policies because they deal explicitly with food and health related matters. The policies consist of subjects like what are the aims of the policies, who are key parties involved and what are the means by which these aims are to be a ttained.

Traditionally the nutritional policies have been targeted on a national level, they concern the average consumer, and the means that are used are very traditional There may be special groups, who do not get proper attention as the focus is on the national level. Every consumer is also different and therefore it can be assumed that the more there are different means by which certain health objects can be attained, the more probable it is that a proper combination that suits a specific consumer can be attained.

Agriculture provides most of the raw materials for foods. Agricultural policies therefore directly affect the development of health-functional foods. For example there are questions of what are the incentives to produce special raw materials for health-functional foods. Why would a farmer take into consideration special demands that the production of such materials might require? Compared with, for example, production of organic foods these requirements could be more demanding as there are often more specific requirements concerning the content of foods. It can be asked whether agricultural policies support such developments or whether they more support production of traditional food commodities and respective raw materials.

It is probable that new questions will arise involving consumer policies? For example a situation can be assumed where products are being developed which give significant health benefits to certain consumer groups but the prices of which become so high that they practically prevent the use of such products. Then it can be asked should there not be financial measures taken that make those products available to these specific consumers. The general question of what kind of foods should be available to citizens of a nation is a complex one. In a developed country it can hardly be the aim that only the daily subsistence level is guaranteed.

In the long run health policies are dependent on changes in general attitudes. It is already known that some food products cause negative health effects. Often it is tradition that validates such products. In the long run changes are possible. What can be learned, for example, from the development in tobacco industry is that at some point a producer of traditional products that cause negative health effects, can become responsible for the negative consequences that the products cause. It is not impossible that at some point in the future also a food producer might be held similarly responsible.

6. Changes in the health care system

Significant increases in costs in health care systems have been a major trend in developed countries. There are many reasons for this like ageing populations, new advanced treatments for diseases and generally the growth of medical domain as far as the body is concerned. To slow down the increase one alternative has been to put more emphasis on prevention of diseases. It is here that the role of functional foods are of special significance, because there are many diseases where there is a causal link between foods and diseases.

In principle, it is already possible with proper selection of current foods on the markets to achieve positive health effects. For individuals it usually means making significant changes compared with their present food habits. However, it can be expected that change of habits are difficult to achieve and if such changes are to be made a lot of resources have to be available. It is doubtful whether such resources are available in future taking into consideration the general trends in health care. Health-functional foods could be considered as an alternative way of achieving the same goals, which would bring with it cost savings. In the USA it has been found that with health maintenance organisations there is already an interest in using nutraceuticals to maintain patient health, and to reduce prescription costs and the number of office visits (Brower, 1998, 729).

On the other hand, the need for more information is a factor that increases costs. If health-functional foods become mass-market products just like current foods the costs will not necessarily be very significant. However, the more there is pressure towards individualised products the more there is also a need to first invest in supporting infrastructures which make it possible to analyse and monitor individual needs that are then used as a basis for the development and production of new foods. It is questionable whether such investments will be done only for food related purposes. If they are done for example for medical reasons, they could be used also in the food context.

7. Return on invest opportunities

For commercial partners to get interested in the area there have to be profit opportunities. It is useful to examine the subject based on a return on investment approach as there can be seen two different basic starting points in one investments have already been made in the other investments have to be made in the future.

When there are investments that have already being done and which are not fully utilised it means that in principle the return on investment can be lower, at least temporarily, than in case of a new investment. There are many parties that have already made such investments that are of significance for health-functional foods but which have not been utilised in the food context. An example of such obvious parties are actors operating in the pharmaceutical context developing new medicines. The more there are new investments that need first to be made the higher will be needs for return on investments and consequently the higher will be barriers to invest on this area. This is typical in traditional food context.

Based on the cases it seems that the role of the various capabilities are critical. Investments in infrastructure and technology are necessities but the returns are very much dependent on the development of different kind of capabilities. For example not only investments in research capabilities guarantee commercially successful products. They are as well dependent on how many consumers invest in new consumption capabilities.

What also influences expectations concerning the return on investment are uncertainties. In the case of functional foods there are more uncertainties than simply uncertainties concerning the acceptance of products by consumers. For example there is a continuous uncertainty concerning research results. There is also uncertainty concerning product approval and if a product is approved what kind of communication is allowed. On the other hand these major barriers also protect those products that succeed getting in pass them and consequently increase the return on investment opportunities.

There are many bioingredients that used to be part of specific natural products, towards which there has been only a little commercial interest. This has led to concerns that this would lead to a situation where most biomaterials will be patented and the natural product industry will be completely controlled by pharmaceutical multinationals (Rona 1999). This same concern could be raised in case of foods. New foods altered in some respect from traditional foods can already be patented.

8. Globalisation

Globalisation has in traditional food context been seen in the context of the differences in food habits in the relationship between national cuisines and respective foods. This basis is different for functional foods, as it is more based on body related differences. There can be factors that are related to differences in race or some other genetic factor that unite consumers in different parts of the world. In principle even now there could be actors that serve globally, for example, consumers suffering from celiac.

In the foodweb context it is not only a matter of globalisation among certain types of actors, like firms. Research actors, authorities and consumers have a global position as well. In the food context such a positioning is not very typical even though there are

global firms. In the pharmaceutical context research, production and consumption are to a large extent global. Probably consumers are seldom interested inn the country of origin of a certain medicine.

Globalisation means that the control of communication becomes more difficult as the borders between nations do not hinder information flows. Technology makes it possible for an individual to search for globally available information. For example if health claims are allowed in one country but not in another, it will become more and more difficult to prevent information from spreading among those who are interested in a certain issue.

9. Environment

Environmental changes have effects both on the body and the foods. The body is influenced both by heritage and environment related factors. There has been a lot of interest in heritage and gene related factors. It is probable that environment related factors will also continue to be of major significance. Whether it is a matter of an individual with the right genes in the wrong environment or with the wrong genes in the right environment is not a major issue in a food context. In every case there will be new challenges to the development of health-functional foods in future as foods need to be adjusted to new demands.

6.3.2. Dynamics in change

When the dynamics of change is considered three types of changes can be assumed. Gradual changes in which there are minor developments taking place one after another. Radical changes, which means that major changes take place within a short period of time. A third alternative is based on a learning type of a process in which the structure and the way of operation changes.

Gradual changes are probably the most common type of change. There are continuously changes taking place in the foodwebs and in the development concerning functional foods. What is special for food products is that the changes that are taking place are not always very obvious at the physical product level. Or at least in appearance there are many food products on the markets that have not changed very radically in hundreds of years.

Radical changes take place, when food products that have never before existed appear. Radical here is a relative concept. It can both relate to physical appearance or content but in health context it is mainly related to content. An analogy can be taken from another necessary product group: clothes. Clothes also have certain basic features, which have remained unchanged throughout history. In the case of raw materials at certain periods of time new materials have appeared besides the traditional ones. There are also noticeable changes in styles when clothes from different periods of time are compared. Behind these changes there are also the changes that have a health dimension. Even it can be argued that new clothes are not necessary more healthier in all respect, it is very probable that if it were necessary to rely only on old raw materials it would be detrimental to many health aspects.

What is a radical change in clothes is not the appearance of a new material as such. It is the combination of a raw material in a product used for a special purpose. New raw material can be used in many ways in combinations with old traditional raw materials. It may mean for example lighter, more protective clothing. There is no reason to assume that these same considerations could not be valid also in a food context. New foods and food materials are probably not superior in all conditions, but they add new possibilities to respond to the needs of modern times. It can be asked how food 'nylons' and modern casual foods should be compared with more traditional materials?

It could be asked what kind of changes could trigger major changes in foodwebs or in the development processes of health-functional foods. Technology combined with research is a major potential trigger of such changes. For example if a new health relevant layer is found behind the nutrient substances that are currently considered as critical from health perspective. Radical changes could also take place if specific links between genetic factors, foods and diseases could be established. These kinds of findings would alter the whole basis by which the value of foods can be assessed in health context.

A major change could also take place if some regulation barriers were removed. For example concerning the commercial communication with consumers. It would give new incentives especially for the commercial actors in foodwebs but also for all others who are potentially included in a process that aims to develop new commercial functional foods. What makes such a change appear radical is that probably in the beginning there would be overreactions like in most cases when a major regulated phenomenon is freed.

If a long perspective is taken even dramatic changes are part of a gradual change. For example Elias (1978) studied changes that have taken place historically in meal habits under the theme of the civilisation process. Civilisation was considered as a long process that took hundreds of years. It can be assumed that in the food context there are similar processes taken place that are not only limited to the consumption of foods. Besides meal habits also the selection of raw materials, processing, and preparation of foods have changed. Certain products simply fit better with new conditions. It could be argued that if meal habits today are more civilised than before the food system as a whole is probably more civilised than it used to be.

Change that is attached to a learning process can have gradual or radical nature. What is special is, however, that due to the learning process is not only a single incident or collection of such incidents but it is related to the behaviour of foodwebs or especially to the product development activity in them. As a result of learning there can be many kinds of changes. What is typical is that they have a relation to the past whether it is based on one's own activities or whether it is learning from others.

A typical area in case of functional foods has been that linked to research. A learning process is needed in order to be able to assess to what extent and to what kind of research it is necessary to get involved and for example what kind of new resources are needed. This does not concern only commercial firms but other actors as well are included in this learning process.

What is evident from this study was that consumers were also involved in the learning process and at certain point of time they were ready to participate in a foodweb as consumers. When the physical products are being introduced to consumers it is not an end of the development process but it actually means that the development continues with

consumers being potential members of a foodweb. All that is happening within a foodweb and even outside will give input also to the learning process that consumers are involved in.

7. Discussion

7.1. Conclusions from the study

The overall purpose of the study was more to describe and to increase understanding than to explain and to predict the development of health-promoting foods. What was noticed was the difficulty of fully separate these two different approaches. Especially the description of a foodweb of health-functional foods on a general level is inevitably intertwined with explanation and prediction. However, these should be seen from the perspective of a qualitative research and therefore they are very tentative in nature.

There were four questions that needed to be answered in order to fulfil the aims of the study. They concerned the position of health-promoting foods within other foods, the content of a foodweb as a framework for the development process, the special problems encountered in an empirical development context and the initial generalisations that could be made concerning foodwebs and product development in this special context. Even though these questions were presented separately they are to large extent interrelated. Answers to one of those questions were dependent on the answers given to the other questions. This made the study particularly challenging, as there were many different kinds of themes that have to be dealt with.

As an example of these interrelationships, the significance of the first two questions can be examined. When the position of health-promoting foods within other foods is concerned, a new reference point of body-centred foods was compiled. Foodwebs were in turn based on the industrial networks, which gave a framework to describe development processes. The former helped to understand the possible development directions and the latter the actual development. If either of these had been lacking, it is probable that many empirical developments would have been less understandable than they were now.

The study revealed that it was not only matter of foods. The relevant question concerns not only the position of health-functional foods within foods in general but within a larger spectrum of industrial consumer products. It has been usual to refer to tradition in a general food context. However, the more technology brings new opportunities and the more there are actors who come outside the traditional area of foods the more difficult it is to rely only on tradition. It seems that health-functional foods are part of a change where the traditional area of foods is becoming ever more diversified and where foods overlap even more with other non-food product areas.

It is difficult to predict what will be the future of functional foods. It may happen like Winkler (1998,193) suggests that " In time, the term 'functional foods' will lose its connotations of futuristic trendiness and may be discarded. But the perspective of functionality will continue and strengthen….". To this could be added that on a longer perspective it may happen that even the term "foods" will be discarded at least, as far as consumers are concerned. What is then ingested is a composition of what is now called foods, medicine, pleasurables etc. under different brands targeted for specific individuals.

At the present time functional foods (or equivalent concepts) however seems to form a valid concept under which certain developments that are taking place in food context can be examined.

Compared with the traditional approach in food product development (see e.g. Graf and Saguy 1990) this study had a new perspective. In organisation centred development the emphasis has been on the concurrent participation of actors representing different organisational tasks. What was specially emphasised in this new approach is the breadth of factors that influence the product development. Product development is not an isolated activity within a single organisation. Specifically it would have been difficult to describe and understand the development processes of health-functional foods starting from the traditional producer-consumer or producer-customer dyads. What would probably have happened in such cases is that the role of those activities, actors and resources that did not take place or were located within the focal organisation, would have been undervalued.

What is also obvious is that the traditional food chain approach (see e.g. Street 1990) is not very well tuned to development aspects. The idea of a food chain emphasises the constancy of products and the repetitive nature of their production. In a development context it would either mean only minor changes or such a distant perspective that all changes are minor changes. However, it is possible that as/if health-functional foods becomes an established part of food products, there will also be development processes that will justify an analytical approach based on a food chain model.

This study indicated that in very many cases there are activities and actors that are not part of the traditional food chain but which are of crucial importance from a product development point of view. In this respect it seems that the foodweb approach represents a change towards market orientation where the value chain and the value of a product is in a dominant position irrespective of the specific types of activities or actors.

Foodwebs can be considered as a change towards market orientation also in another dimension. This is due to emphasis on products in a foodweb. Products can be assumed to form an essential part of markets. Not in a specific technical sense but as a basis of valuation. It is very difficult to assume markets without products, even though the content given to products can vary. Even relationships can be considered as products. In health-functional foodwebs the starting point is the industrial network structure where the relationships between industrial actors dominate. Product development also takes place mainly between these actors. Markets in turn form a more complex setting for exchanges and interaction where industrial actors are in monopolistic position in only specific cases.

Products are not only important in the foodweb structure from the market point of view. Compared to the basic model of industrial networks (Håkansson 1987) the foodweb framework could be considered as a special case where a specific activity - product development- is raised to a dominating position. However, when it comes to product development it can be argued that it is matter of critical activity within industrial networks. It is a key ingredient that ties networks together. Industrial networks are not just social networks even though they are also social networks. They are also not only economic networks where pure price values would dominate. To demonstrate the value of a product in networks it could be assumed that there are no products, not even ideas for products. A very critical part of the identity of networks would be missing.

What was necessary to elaborate was the content given to concept of product. A product is not only a tangible exchangeable item or even an intangible service product produced by a firm and its customer. In a foodweb there are many different types of actors with different interests all of which do not have similar influences on products. A product is therefore not a homogeneous structure of attributes but it consists internally of hierarchical layers. What in a market context are choices made by a producer and a consumer concern typically only some layer of attributes within a total product.

The well-respected model of dominant designs[22] represents another approach to the subject (Utterback 1996). In that it is postulated that a dominant design appears usually due to major changes in the background factors. For foods it could be assumed that there are several levels where dominant products can appear. If foods were seen from a distance some dominant products could appear that were considered to be new dominant foods. They could represent for example foods typical for specific decades.

On a closer look it can be thought that there are dominant food products, for example, within health-functional foods. It could be though that in case of foods the new dominant foods are foods that break in some sense the typical boundaries for foods. They would respond to different questions than the old foods. What this study shows is that evidently there is a change going on that will lead to new dominant foods to appear. Whether those already on the markets are dominant products was not of concern in this study.

The foodweb, as it was derived from the model of industrial networks, was described on a very general level. In examining the cases were examined it was used mainly in order to assist the description of cases. There was also the intention that based on empirical data, a foodweb would be constructed in order to describe the general characteristics of the development of health-functional foods. Because the study was very much based on cases and it was not possible to assume that they would represent the whole phenomenon sufficiently, the respective foodweb (Figure 28) is hypothetical in nature.

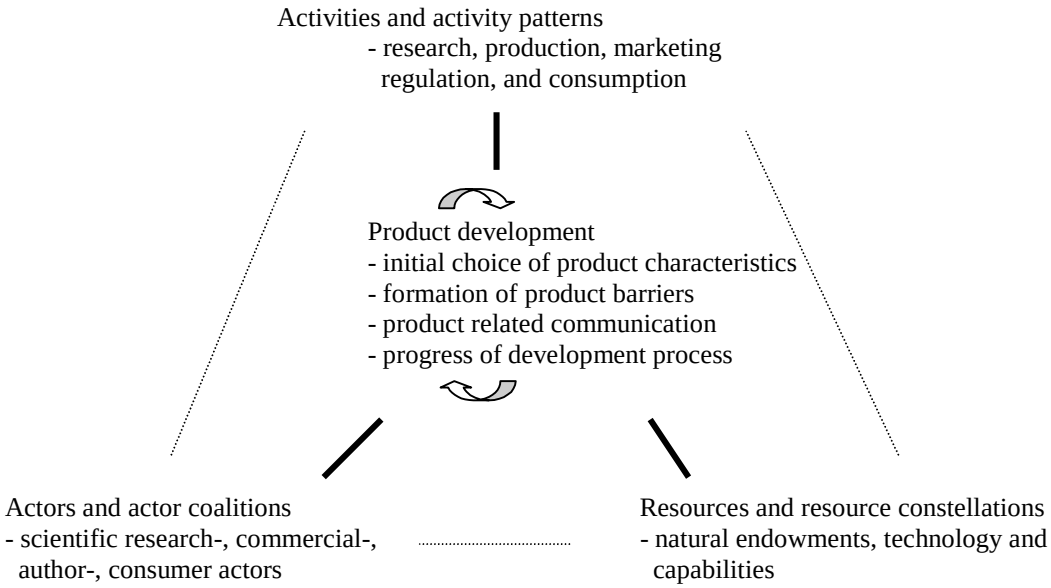

Figure 28. Hypothetical foodweb of health-functional foods

[22] Dominant designs being those that win allegiance of the marketplace within a product class (Utterback 1996).

The activities that are often considered only on an organisation level were extrapolated to the foodweb level because empirical reality seemed to show that this is the case. For example it is not only firms that perform marketing. Research institutions and public bodies have for a long time been involved in the marketing of issues such as proper nutrition. Actually it is matter of different types of activities. They could have been given different names but in this study the use of activity categories typically used in business context seemed appropriate. It is another question whether the quality of the respective activity is good or bad from some specific perspective. In this study, however, it was not the purpose to assess the quality of any specific development process or part of it.

There seems to be two basic strategies that industrial firms can follow. In one the minimum amount of research is done to meet different demands. Another strategy is to do research that goes well beyond these minimums. In the former case research is considered as a necessity that needs to be done. An industrial partner acts like a reactor to different demands. In the latter case research enables a more powerful position within a foodweb to be acquired. An industrial partner is also a proactor in the foodweb.

Actually no specific assumptions was made concerning actors other than that they were not necessary the same as formal organisations. What was learnt is that trying to determine the actor basis is a difficult task. This was one of the main shortcomings of the study. A formal organisation or part of it gives a specific context. In this study the perspective was however not on administrative questions and therefore the relationship between a specific development process with formal organisations or with other development processes taking place in this context, was not explored.

Another approach to define actors would be to start from the individual level. This would though have required very detailed knowledge of the case and would probably best be suited to a single case study. In this study much reliance was placed on the opinions of the interviewees in how they spontaneously interpreted the role of individuals. Individual's roles were not explicitly asked for. What was noticed here is that in some context and some interviewees it was more natural to bring out the role of individuals whereas in some other contexts and with some other interviewees it was more natural to emphasise the collective effort. All in all it is evident that more should have been done to define properly the informal actors that lie between individuals and formal organisations.

What was found also in this study was that compared to typical traditional food development projects different resources are needed. Natural resources have been in a key role in many traditional development projects especially the more foods have been considered as natural products. It can be argued that even health-functional foods are natural products, but then the content of the concept is very different.

When technology as a resource was examined a broad basis of technology was observed. Technology is not always directly related to something to be achieved. What has been in a key position even in the food context has been technology that makes the new information concerning nature possible. It has opened up new views to nature and makes possible controlled operations in this new microcosm. It seems that in product specific technology there are often combinations of general food technology combined with other major technologies. It is probable that for example combinations of traditional food technologies with new information and biotechnology will have major significance in the future.

Development of health-functional foods clearly shows the broadness of capabilities that are needed as products are developed. Capabilities from many different professions and individuals with very different backgrounds are needed. It is however not necessary that they have to be located in a single location. In most cases it is not even possible to assume that a self-sufficient development within a single organisation would be possible. A key special capability in this context is related to consumption. Consumption capabilities here do not mean the same as how products are physically prepared or eaten but they are more related to how products are used as bundles of information. How a consumer can relate a product in relation to his/her health needs.

The role of health experts in the foodweb is important not only in the research phase but also, when consumers are involved in the development. It is often a matter of such complicated subjects that it seems that it is even for a well-informed consumer difficult to take a stance on a product. When it comes to health experts it seems that in many cases it is easier for those that work within medicine to see the positive contribution of these new products than for those working with nutrition with strong ties to specific nutrients and traditional foods. This is understandable because in medicine a specialisation has developed and the contribution of these new foods is seen from the point of view of this specialisation.

The cases that were examined were often pioneers in their field. There was a lot of discussion concerning them and they received a lot of publicity. This meant that commercial communication with consumers was only part of the total communication. The regulation concerning specially health claims was then not as crucial as it can be if a new product is entering markets and the general media interest on the subject is not as high.

When it comes to consumer acceptance it was seemingly difficult to anticipate consumers attitudes because it was a matter of significantly different products compared with traditional foods. Consumers were used to link foods, nutrients and health but in these products it was in many case a matter of links between foods, unfamiliar substances and specific diseases or corresponding unbalanced body states. However, it seemed that there was a significant proportion of consumers that were ready to accept these new solutions and buy the respective products.

Analytically a distinction was made between the development of products and the development of the foodwebs that lay behind them. This did not mean that product development is a separate activity within foodwebs. It meant that the development of products is a result of the functioning of foodweb and that the development of products has to be considered at a general product level, which consists of product characteristics. Based on the empirical findings it was concluded this development could be described under four themes: initial choice of product characteristics, formation of product barriers, product-related communication, and progress of the product development process.

In the product development process the beginning seems to be of crucial importance. It was already at the very beginning that the basic feature of the products was established and usually they did not change significantly as the development continued. By the time the products were introduced to consumers they were already in such a form that the consumer was left only with the choice of either to buy or not to buy the product. It also seemed that in many cases the opinions of experts differed. There were some that supported new developments and some that did not even if they did not deny the results of specific studies. Usually a result concerning physiological effects was just a starting point

and many other factors were taken into consideration as the results were interpreted in a social realm. The internal and transition phases were not necessary smooth and trouble free.

Formation of product barriers is of major significance in product development. Usually this is considered only at the level of barriers to existing commercial products. From the development perspective the question of barriers is far more complex as along the development path the question of product barriers comes up in many phases. The kinds of characteristics included in a product influence the shield that a product gets from other products. Even in the health-functional food context it seems that health-functional characteristics are not the only source of barriers that needs to be considered. Traditional food characteristics are of significant importance.

Product related communication was of specific significance in the health-functional food context as there are special uncertainties concerning communication possibilities. They especially concern communication with consumers of the characteristics that are the core of the health-functional foods. In the cases that were studied the key concern was usually how to communicate of the complex issues in a way that would give enough information but would not be too technical from a consumer point of view. As there were not many new products on the markets the issue was not so much how to differentiate, for example, competing cholesterol lowering products from each other.

Progress of development was not always a smooth process but there were times when in a short period of time, a lot of things happened that were significant from the development point of view. Then there were times when development took place more gradually. It was also discovered that there is a certain amount of stability in the development process. For example even in the cases where serious difficulties emerged, the development process did not immediately cease. It seems that different kinds of assets (e.g. human, financial, infrastructure) that have been allocated to the development raised the opportunity costs of this option.

In the cases that were examined the development was based in a certain amount of preparedness. Typically there was research that had been done for a long time in some other context. As this research was then by some link brought to the food context an opportunity arose. What is however probable is that in the future the importance of more targeted research will increase. A certain health effect is the starting point and using research new ways are looked for to produce these effects.

The validity and reliability of the empirical part of the study was previously examined. There is however a need to address some issues on a level of the study as a whole. It could be argued that especially in qualitative research the validity of the research actually consists of the validity of the different parts of the research. It does not mean that it is possible to aggregate validity, but in the same way as there is a relationships between a theory as an outcome and certain procedures in the research (see especially Strauss and Corbin 1990), it can be thought that there is a relationship between the validity of a research project and the procedures that have been taken.

The study can be divided into two parts. Firstly, there is the key framework construction (foodweb) which is partly linked to deductive processes (e.g. from older models to new frameworks) partly to inductive processes (the researchers general knowledge) including also cause-and-effect relationships (e.g. from network operation to product creation)

which lead to frameworks considered as static designs. Secondly, there is the empirical part where cases are examined. In this part there is simultaneous shaping of factors and emerging designs. This means that the study is not purely qualitative in nature. It could be characterised of being of a quantitative-within-qualitative type. In these different parts the questions of validity have different emphases.

The framework consists of concepts and relationships between them. Internal validity of the framework itself, as far as causal relationships are concerned, relied very much on that provided by industrial networks. A related validity question could be asked: what kind of information would the application of industrial networks model provide? There were changes made because it seemed that the basic model was not satisfactory in this respect. Especially product development was explicitly added to the model. Taking into consideration the purpose of this study, this was expected to change the focus of the framework in a way that improved the validity. and it seemed to have done so. For operationalisations of the concepts, there were no final operationalisations but an open situation prevailed. This was due to the fact that that also an opposite direction was assumed: empirical findings could affect concept formation.

External validity was dependent on the theoretical content of the network. It could have been possible for example to first modify industrial networks to general product based networks. However, this would have meant that a lot of more emphasis would have had to be given to general theory based product development. In this study, in order to increase external validity, such a step was not taken but initially the generalisability was restricted to a specific food context: health-functional foods.

As far as external validity is concerned it can be asked how well the study captures the different factors linked to the phenomena. Childs presented a nutraceutical business model (Childs 1999, 78). According to her model there are eight components with their respective drivers. These eight components were consumers, private and public agencies, the FDA, health care industry, food industry, pharmaceutical industry, international activity, and nutrition science. The model was obviously constructed to take into consideration the special features of the US context. It seems that there are similar types of development factors as found in this study that can be considered of importance. There is reason to assume that the study captured some of the key factors that are influential to this development.

What has to be pointed out is that the starting point of the empirical study was that all the product cases represented commercially successful products. This meant that in the development no such problems were encountered that would have been so critical that the foodweb would have disintegrated and product development ceased. However, even in these cases there were situations where that could have happened. It seems that the difference whether a development leading to successful or unsuccessful products can be very small.

The purpose of the study was to describe and to increase understanding of the development of health-promoting foods. It can be asked how well that aim was attained? The problem is that as such there is no end point for the purpose chosen. The description could always be more accurate and it could be improved using better analytical tools. Going deeper and deeper into the studied phenomena could also increase understanding. What is however obvious is that the overall aim was attained.

The scientific contribution of this study is especially based on small steps taken in many areas. Foods were given a new analytical framework which was however, not yet validated. The foodweb was derived from a model of industrial networks and it was given a hypothetical form. Some questions that have not been previously raised were also brought up.

7.2. Practical implications

In the following based on the results of the study some practical implications are presented concerning the development of health-functional foods. It was found that there are many factors that affect the development of these new products, but which for one reason or another have not been given very much attention. There are no right answers to many questions but it is important that they are first discussed and if needed appropriate actions are taken.

It is obvious that it will become more and more difficult to consider foods as a single product group. Even if it is assumed that for foods it is not the physical product but the service that matters, it is doubtful whether there is a single service to which all foods contribute. What was suggested in this study was that foods should be seen more in the context of what kind of service they are expected to deliver.

In the health context it can be asked what makes health-functional foods differ from other health products? Or is there any need to make such a separation? We could think of a situation where an individual daily uses a cocktail of traditional foods, separate nutrient products (e.g. vitamins), medicines (e.g. for cholesterol lowering) and other health products (e.g. toothpaste). It is in this context that any new products actually should be considered and not within a context such as the foods themselves.

There can be expectations that the science basis of functional foods will provide measures of how to define the value of foods in an absolute sense. The reality is probably quite the opposite. It is more probable that based on old customs and habits more stability will be achieved, as there is no need for change. Change is inevitable in science. As more knowledge is acquired old knowledge can lose its value even in a short period of time. There can also be single studies that point to in opposite directions to what is normally done. For those not familiar with science this can be quite stressful and may lead to a situation where consumers lose their interest in health questions. A major issue in the future will be how to find a proper balance where changes in foods are considered to be positive but that the consumer is not overloaded with information that they cannot cope with.

The food and health area has been very much health expert dominated. However, there are many questions that not only experts can answer but where a more general discussion is needed. As an example of such political elements linked to nutrition it can be assumed that there are two different elements in nutrition: public nutrition and private nutrition. Public nutrition is linked to that how we should behave especially when the national health interests are taken into consideration. Then there is private nutrition that is linked to what people actually eat or would like to eat. Private nutrition causes problems. There are too many foods that are difficult to control. Private nutrition causes many health

accidents and produces all kinds of harmful consequences to the social and natural environment.

From the nutrition policy perspective this is, however, a crucial distinction. There is a difference between whether attempts are made to change from the private nutrition to public nutrition than if attempts are made within the field of private nutrition. A change made to a single food within private nutrition is not necessarily very remarkable from the point of view of public nutrition. It can however be so from the point of an individual food user.

Development within health-functional foods shows that the old system has been very much tuned to support public nutrition. It has mostly operated on a very general level. Reality at the market product level has not been of much of a concern. The situation is now changing. Market products are being backed up with the same kinds of research efforts that used to be found in the domain of public nutrition. This is a very significant change. It means that health related changes will more and more take place in connection with different commercial products.

There are problems in this change. Traditionally, the food industry has been very much raw material oriented. This could mean that research might concentrate more and more only on those single raw materials sources. If this is combined with a situation where only minor changes in foods are permitted, this could mean that most of research resources are used in single food investigations and the significance of such research can be asked. Such research could be led based mainly marketing aspects.

There is the problem is that because health related information for most actors in foodwebs has simply been given, the related service structure is underdeveloped. There are no actors that would, for example, compare different products on markets for their health enhancing characteristics from a consumer perspective. The same problem exists in the business-to-business side. There are no actors that would compare ingredients in respect to their health-promoting characteristics and would then help food industry firms to make informed choices. Currently the situation is not yet very acute but it can be assumed that in the future the situation will be different as a single food can potentially contain hundreds of characteristics that are significant from a health point of view.

Traditional foodservice operators have not been very interested in health related subjects, even if they are closer to consumers and not so much dependant on specific raw materials or ingredients. On the other hand they know the power of food habits and probably therefore the old approach that is based on expectation that food habits should be changed first, has not been very appealing. Health-functional foods would offer possibilities also in this sector.

What can not be found in markets are operators whose key capabilities of are based on knowledge concerning the relationship between foods and the body. In the food industry the hardware (physical foods) has usually been more important than the software (know-how as a basis of service products). New health-functional food operators should base their operations more on the software. A modern food factory of health-functional foods could respectively be seen as a place where products are assembled from components provided by different subcontractors. Ingredients and substances with special characteristics could be acquired and marketed globally.

There is the question of health related recommendations. Current nutritional recommendations contain problematic aspects. Even though the health related properties in foods may not be organoleptically sensed, health related recommendations are very much linked to the sensed properties of foods. In the background there is an assumption that these properties of foods will be linked to a certain specific traditional appearance of foods. To what extent will this be true in the future? The more there are changes in the physical content of specific foods the less the appearance or even general raw material basis of foods can be used as an indicator of specific health related content.

How do these recommendations respond to expectations that more and more foods will in the future be more and more prepared and consist of different modified components? How can such new products be positioned in general health relevant scales? It is also probable that there will be need for different kinds of recommendations. For example, different kind of recommendations for those food specialists that are not nutritionists but who are in a key role as new service products are developed, for those who are consumers and have a basic knowledge of nutrition, and for those consumers who are unaware of even the basic facts.

There are research results that indicate that most consumers think that they eat healthily and that there is no need for them to make changes, What is the basis of this attitude? In many other product groups one would think that new products mean improvements. Why cannot new health-functional foods be better than traditional foods. Not in all respects, but for example when the requirements of the new living conditions are taken into consideration? There are few other product groups where history has validated the products to the same extent as in foods.

There is clearly a need to know food consumers better in order to make information-related decisions. Currently simplified claims and food labels are very much emphasised where food information is concerned. This is probably due to the assumption that food consumers are not very much interested in the health content of foods and that they make last minute decisions at the shop level. Is this also picture we have of a consumer choosing health-functional foods in the future?

Safety was not a direct concern of this study. Safety here means that the probability that user of a product will only be affected by the intended health effects of the product. In practise safety is a major issue. It can be asked what is the value of health-promoting effects if there is high probability that a food, before being used, contains negative health features that make the intended health value marginal. It is probable that in this product context sensitivity to health related matters in general is greater and threats that in a traditional food context would not be of concern will be emphasised. This means that development of health-functional foods has other implications that need to be taken into consideration in the whole physical distribution chain.

Whether it is wanted or not social markers will emerge that will indicate the value of these products to individual customers. One critical question here is to what extent these markers are based on scientific research and to what extent they are based on old beliefs and customs. It is obvious that in order for these products to be successful there is the need for different kinds of information. Knowledge concerning the physiological level is just a starting point.

7.3. Applicability of the foodweb in food contexts in general

Even though the purpose of the study was not primarily to be a methodological contribution, as foodwebs were in such a central role in the study, in the following an evaluation concerning the general applicability of the foodweb framework in food context is made.

Assumptions

There were general assumptions concerning foodwebs. One of those concerned rationality. Rationality was linked to the institutional basis. This is probably a valid level to examine rationality in foodwebs in general. This is due to the heterogeneity of the foodwebs. In the market context the situation is different as it is based on more homogeneous starting point. It would probably be too demanding to assume that all actors in foodwebs would be rational in a way that had no relations to their habits and customs.

In the food context it is also probable that rationality cannot only be based on individual based characteristics (like bounded rationality, see e.g. Simon 1957). Change in the social setting can bring out differences in rationality under ceteris paribus conditions. Even environmental change can alter rationality patterns. Rationality under a state of famine is probably different from that in an affluent society.

If rationality is considered in very specific context, namely as a consumer makes choices concerning food products, it is probable that there is a difference in how traditional foods and health-functional foods are chosen. In the case of health-functional foods, when the cognitive information is more emphasised, this could mean that also rationality in choice is different from the case of traditional foods. This does not mean that intellectual choice is necessarily more rational than emotional choice, but that they are different.

The scope of a foodweb that is ultimately based on revealed interactions is probably as valid in a health-functional context as in other food contexts. It emphasises the empirical links and also the relativity of foodwebs. Usually not all interactions are known which means that an attempt to capture the foodweb leads to a partial picture of the real foodweb. Foodwebs in all context have also similar problems like the question of importance of different interactions or which are the driving forces that unite foodwebs? For descriptive purposes it is simply sufficient to assume that products unite a web. There are though questions like what is the driving forces behind the development of products and whether some kind of network mechanism can be assumed to direct foodwebs.

Assessment of applicability

The generality of a foodweb means that in principle there are no reasons why it could not be applied to other than health-functional food contexts. It is probably flexibly applicable to very different food contexts. Then probably the basic structure can remain unchanged even though the elements will have variable content, as different factors will be of importance. The structure and processes make it possible to analyse very turbulent environments where a lot of changes are taking place. In fact the more turbulent environment is the better suited is foodwebs simple and flexible structure to analyse such a situation.

In this study the framework was used in an ex-post type of analysis. That meant that there were already certain products. This meant that the product formation was easier to analyse.

In a situation where the products are only on an idea level the emphasis will probably have to be more on the elements of a web and on the process of how a product emerges based on some initial characteristics. It seems that anticipation of future products is difficult based on foodweb alone. Future foodwebs are not necessary based on past foodwebs. Then other kinds of analyses, like in this study concerning body-centred foods, will be needed that will directly deal with the product environment.

Even though it was said that in a traditional food context product development did not alter traditional products very deeply in a materialistic sense, it does not mean that development is easier or simple. There are probably even same kinds of elements that can be identified in health-functional context. Research in traditional context is probably more oriented to social research, for example, in the form of marketing or consumer research, than biological and technological research. Developments takes place more in a consumer context whereas health-functional foods were characterised by an expert approach.

Even for traditional foods there is continuity in development even though some apparent product characteristics seemed to be unchanged. This could be explained by assuming that the stable core of the product is expanding, at least temporarily. The area of interest and the related characteristics in the development context are continuously changing. It is to a large extent a matter of sensitivity concerning development. An idea of a process where no development takes place could be borrowed from markets. Production in which all other factors but product volume remain unchanged would be closest to pure markets. In reality there are no production processes in which volume is the only variable.

The so-called free markets in the food context mean typically fewer restrictions between the nations trade and less technical barriers. It does not mean that producers and consumers can freely decide what type of products will be available. Even if the role of direct public regulation on national level decreases, it means that other regulation systems will become effective. It is more important to find out how a foodweb is actually regulated and how it regulates itself. The foodweb will probably be a valid analysis framework even if there is further movement towards free markets in the food systems.

It can be thought that the foodweb would be as a service product web. There are activities, actors and resources also in this context and service product is also the result of a development process that is not necessary only limited to a firm-customer dyad. Then a uniting link would not be a physical food product but a service idea linked to the needs that lie behind foods. In fact there is such a service idea even behind concrete food products. It could lead to very different physical product solutions if the starting point is, for example, in some physical needs of a body than in some physical substances.

The product of a foodweb could be located between a hierarchy product and a market product (Figure 29). It is not produced by a closed hierarchy and it is not only based on price valued market decisions, but it is a commercial product that is influenced by forces that can be considered to be both of hierarchical and market origin.

Figure 29. General product types

It seems that foodweb offers the potential to be used as an analytical, mainly descriptive, framework in many different food contexts. It can not replace other approaches because it has inherent problems but it offers a new flexible holistic approach to specially describe problems and questions that are of empirical origin.

7.4. Suggestions for further research

A most obvious area of research would be to try to validate the initial hypothetical foodweb that was constructed in this study. There are more and more health-functional products being developed for markets which means that there are actually foodwebs all over the world in which development work is being done. The empirical background is therefore becoming stronger. A key question would then be whether the hypothetical foodweb presented in this study will capture the most important features in the development process?

Foodweb could also be applied as a descriptive framework in different food context to what was discussed in the previous section. As a qualitative approach is very much dependent on the researcher, it would probably be beneficial if the foodweb approach were applied by researchers that have different backgrounds. It would mean that different aspects in the development process were emphasised.

For the foodweb approach in general an important theme that was not directly dealt with is competition between foodwebs. In this study foodwebs were either relatively independent from each other or one single foodweb was assumed (around health-functional foods). However, as products compete, there also will be foodwebs and respective development processes competing with each other. This mean, for example, that products that are meant to lower cholesterol will be considered as substitutes and respective foodwebs has to find ways how to survive in this competition.

The idea of competition leads to the question of what factors affect the competitiveness of a foodweb. Not all foodwebs are in the same position. Analogies could be drawn from market thinking, like the assumption that a foodweb could be in a monopoly position. What is realistic to assume is that actually it is not so much producers or consumers that are competing but coalitions (as foodwebs) that have a common interest the expression of which is a specific product. This would mean that a producer and a consumer of a health-functional food could be closer to each other than a producer and consumer of another type of food product.

It was simply assumed that foodwebs aim for development of commercial products. This is not necessarily so. There can well be differences in foodwebs in this respect, which could be examined along the market orientation of foodwebs (Grunert and all. 1996). Market orientation is the organisation-wide generation of market intelligence, pertaining to current and future customer needs, dissemination of the intelligence across departments and organisation-wide responsiveness to it (Kohli and Javorski.1990).

When we look at the internal structure and processes of a foodweb, there are many open questions. Some of them were already mentioned when the applicability of foodwebs in food context was evaluated. Other themes are, for example, the relationship between product development and the basic elements of a foodweb. How differences in these

elements affect product development and what kind of a causal direction there is from product development to the elements in a foodweb?

Foodwebs, like networks, have usually been used in descriptive sense. If the aim were more predictive, there would have to be a certain mechanism that explains the workings of a foodweb. When it comes to the general mechanisms within well industrial networks it has drawn mainly based from the transaction cost[23] based approaches (see e.g. Lundvall 1993; Johansson and Mattsson 1991 and Blois 1989). It is an open question what could be relevant mechanisms within foodwebs.

There are many structure and process related themes. For example the position of consumers in a foodweb needs more research. The consumer's relationship to a foodweb is probably more complexes than what buying behaviour can reveal. When it comes to processes an important theme that was not much treated in this study was the integration and disintegration of a foodweb. Does integration for example mean that formal ownership structures change and will there be changes on how communication within a foodweb takes place? What was also a weakness is that the psychological process linked to development was not of explicit interest even if it can be thought to be of major significance especially as it is matter of innovative products.

There is also need to study more deeply the essence of foods. It is surprisingly a little researched area taking into consideration its significance. Foods are still to large extent based on traditional products or to an implicit idea that there is no need for evaluations because we all know what foods are. However, as more and more new actors with different backgrounds are entering the field, more research is needed to lay a proper foundation.

There seems to be also a need for sociological research concerning health-functional foods as a research subject. Even older approaches might be applicable. An example of this is the semantic fields that were developed by Lévi-Strauss (1979). Adapting them to today's situation would probably show that many old questions are still valid. One dimension Lévi-Strauss (1979) was exploring was the rawness-preparedness of the foods linked to masculinity and femininity considerations. It could be thought that there are links to these considerations such as those concerning health-functional foods.

There are also other possibilities for the idea of a foodweb to be applied in a research. The conceptual foodweb construction was not explicit when the interviews were made and empirical material was collected for this study. An alternative would have been to involve the interviewees in such a way that they would have directly given content to the foodweb as a core concept (see e.g. Checkland and Scholes 1991, Checkland 1981). An advantage of this would be that one interpretation layer that was made by the researcher concerning the foodweb could have been avoided.

[23] see eg. Williamsson 1975, 1987,1991, 1993

Summary

The study has an empirical basis as there are new health promoting products that have emerged on the food markets. Their share of the food markets has been relatively low but it is expected that it would grow in the future. Relatively few scientific studies deal with this phenomena and those that have been made typically represent only partial views. A more holistic view of the subject area is missing. The main audience of the research was considered to consist of researchers interested in the area traditionally treated under the theme of markets of health-promoting foodstuffs.

The objectives of the study were: to position health-promoting foods within foods in general; to describe the empirical development process of health-promoting foods using a foodweb as a conceptual framework; to increase understanding of the underlying problems in the development process, specifically of those which are new in a food development context; and to make hypothesis concerning general properties of the foodweb in the context of health-promoting foods.

The key framework used in the study – the foodweb- was based on the model of industrial networks, specifically on the so-called Uppsala school of networks. As the model was adapted for the purposes of this study, a product within a network was given an explicit role in the model. The specific food context that was studied was given more emphasis than the general properties of a foodweb. The empirical part of the study was based mainly on five cases. The criteria for the cases were that they were commercially successful products that had already some history behind them. The following cases, identified by their respective trademarks, were selected: Benecol, Hyla, LGG, Xylitol, and Yosa. Besides information considering the cases also other data obtained specifically from the international context were utilised.

As health-promoting foods were positioned within foods it was found that new questions emerged that are not usually treated within a food context. This led to the development of a specific framework for foods – body-centred foods. It was assumed that there are different body related purposes under which foods can be functional. Health-functionality was one of the respective functionalities. It was also found that foods have no clear-cut boundaries towards other product groups.

Empirical development processes described using the foodweb as a conceptual framework showed the interdependency of the development process from many activities, actors, and resources that usually cannot be captured if the development is viewed from a single organisation point of view. It also seemed that development is empirically a multi-layered process of many concurrent and sequential interactions only part of which are being revealed.

Based on the empirical findings it seemed that in every case there are different critical questions that have to be answered in order to make the development of a commercially successful product possible. Even for successful products there are typically periods of uncertainty when the continuity of the development is at stake. This indicated that there is a thin line between whether a development process will either result in a commercially successful product or not. It seemed that success in that sense is not dependent on any specific resources as such but on the capabilities to use different kinds of resources along the development process. One key capability here is the capability of consumers to consume the new food products.

The study resulted in initial hypotheses concerning the development process of health-functional foods in general. These hypotheses were presented as extensions to the basic foodweb framework. It seems obvious that besides those factors that have been traditionally relevant in food development context, there are new factors that have to be taken into consideration. There are activities like research that are essential but which have not previously been emphasised in food development context. The specific activities are also not single events in the progress of development. For example research is usually a critical activity throughout the development process. There are also actors that are often critical in the context of health-functional foods even though they have not been significant in the traditional food context. Capabilities that are needed are more and more information related. This can be understood as the information content of health-functional foods become ever more important because the health-promoting characteristics of these foods can not usually be tasted or organoleptically assessed.

This increasing complexity of this development process also means new challenges. It seems that there are many obstacles within the food system, consisting of the food consumers, producers, regulators and research that hinder development processes of these specific foods. There are many unresolved questions and questions that have not yet explicitly been asked that have to be encountered before it is relevant to expect goal oriented smooth development processes for health-functional foods specifically in the European context.

References

Anchrol, R. S. 1997. Changes in the Theory of Interorganisational Relations in Marketing: Toward a Network Paradigm. Journal of Academy of Marketing Science 25(1): 56-71.

Araujo, L & Easton, G.1996. Networks in Socioeconomic Systems: A Critical Review. Pp 63-107. In: Iacobucci,D.(ed). 1996. Networks in Marketing. Sage Publications. Thousand Oaks. 442 p.

Axelsson, B. 1992. Network research – future issues. Pp 238-251. In: Axelsson, B. & Easton, G. (eds.). 1992. Industrial Networks: A New View of Reality. Routledge. London. 265 p.

Azzam, M.A. & Pagoulatos, E. 1999. Vertical Relationships: Economic Theory and Empirical Evidence. Pp:7-20. In: Galizzi, G & Venturini, L.(eds.).1999. Vertical Relationships and Coordination in the Food System. Physica-Verlag. Heidelberg. 641 p.

Backhaus, K & Büschken, J.1997. What do we know about Business-to-Business Interactions ? A Synopsis of Empirical Research on Buyer-seller Interactions. In: Gemünden, H.G., Ritter, T & Walter, A.1997. Relationships and Networks in International Markets. Pp 13-36. Pergamon. 460 p.

Bagozzi, R.P. 1975. Marketing as Exchange. Journal of Marketing 39(October): 32-39.

Bain, J.S. 1966. Industrial Organisation. John Wiley & Sons. New York. 631 p. [Originally published in 1959].

Berner, L., Childs, N., Geiger, C., Keen, C., King, J., McDonald, J., Miller, S., Murphy, S., Schmitz, H., Shaw, A., Tong, P., Weaver, C. 1999. Food Choices for the 21st Century. Journal of Nutraceuticals, Functional & Medical Foods. 1(4):89-95.

Blaxter, M. 1990. Health and Lifestyles. Tavistock/Routledge. London. 263 p.

Blois, K.J. 1989. Transaction Costs and Networks. Management Research Papers 89/1, Templeton College. Oxford. 11 p.

Booth, D.A.1994. Psychology of Nutrition. Burgess Science Press. Basingstoke. p.213.

Bourdieau, P. 1984. Distinction; a social critique of the judgement of taste. Routledge & Kegan Paul. London.p. 613.

Brower, V. 1998. Nutraceuticals: Poised for a healthy slice of the healthcare market? Nature Biotechnology. Vol 16. August: 728- 731.

Checkland, P. 1981. Systems Thinking, Systems Practise. John Wiley. Chichester. 330 p. ok

Checkland, P. & Scholes, J.1990. Soft systems methodology in action. John Wiley. Chichester. 329 p. ok

Childs, N.M.1999. Nutraceutical Industry Trends. Journal off Nutraceuticals, Functional & Medical Foods 2(1):73 – 85.

Clydesdale, F.M. 1998. Science, Education, and Technology: New Frontiers for Health. Critical Reviews in Food Science 38(5): 397-419.

Cook, K.S. & Emerson, R.M.1978. Power Equity and Commitment in Exchange Networks. American Sociological Review 43(5): 721-739.

Cook, K.S. & Emerson, R.M.1984. Exchange Networks and the Analysis of Complex Organisations. In: Bacharach, S.B. & Lawler, E.J (eds.). 1984. Research in the Sociology of Organisations 3: 1-30. Jai Press. Greenwich. 256 p. ok

Creswell, J.W. 1994. Research design; qualitative and quantitative approaches. Sage. Thousand Oaks (Calif.). p. 228.

Denzin, N.K & Lincoln, Y.S.(eds.). 1994 Handbook of Qualitative Research. Sage. Thousand Oaks. 643 p.

Easton, G. 1992. Industrial networks: a review. Pp 1-36. In: Axelsson, B. & Easton, G. (eds.). 1992. Industrial Networks: A New View of Reality. Routledge. London. 265 p.

Easton, G & Araujo, L. 1992. Non-economical Exchange in Industrial Networks. In: Axelsson, B. & Easton, G. (eds.). Industrial Networks. Pp. 62-84. Routledge. London. 265 p.

Easton, G & Araujo, L. 1994. Market Exchange, Social Structures and Time. European Journal of Marketing 28(3): 72-84.

Easton, G., Wilkinson, I., Georgieva, C. 1997. Towards Evolutionary Models of Industrial Networks – A Research Programme. Pp 273-293. In: Gemünden, H,G., Ritter, T. & Walter, A.1997. (eds.). Relationships and Networks in International Markets. Pergamon. Oxford. 458 p.

Ebers, M. 1997. Explaining Inter-Organisational Network Formation. In: Ebers, M (ed.). The Formation of Inter-Organisational Networks. Oxford University Press. London. 295 p.

Elias, N. 1978. The Civilizing Process Vol 1: the history of manners. Pantheon Books. New York. 310 p. [Originally published in 1939: Über den prozess der Zivilisation]

English Language Dictionary. 1987. Collins Cobuild. London. 1703 p.

Eriksson, K. 1976. Hälsan - en teoretisk och begreppsanalytisk studie om hälsan och dess natur som mål för hälsovårdsedukation. Licenciate thesis. Faculty of Pedagogics. University of Helsinki. Helsinki. p.119.

Falk, P. 1990. The Corporeality of Consumption. Helsinki University Printing House. Helsinki.

Falk, P. 1992. Consuming supplements: paradoxes of modern hedonism. Faculty of Political Sciences, Department of Sociology. University of Helsinki. Helsinki. 89 p.

Falk, P. 1994. The Consuming Body. Sage Publications. London. 235 p. ok

Fieldhouse, P. 1985. Food and nutrition: customs and culture. Croom Helm. London. p. 233.

Glaser, B.G & Strauss, A.L. 1967. The Discovery of Grounded Theory - Strategies for Qualitative Research. Aldine de Grueter. New York. 271 p.

Goldberg, I. (ed.). 1994. Functional Foods, Designer Foods, Pharmafoods, Nutraceuticals. Chapman & Hall. New York. p. 551.

Graf, E & Saguy, I.S. (eds.). 1991. Food product development; from concept to the marketplace. Chapman & Hall. New York. 441 p.

Grunert, K.G., Larsen, H.H., Madsen, T,K., Baadsgaard, A. 1996. Market Orientation in Food and Agriculture. Kluwer Academic Publishers. Boston. 272p.

Grönroos, C. 1990. Services Management and Marketing. Lexington Books. Lexington. 298 p.

Göransson, G & Kuiper, E. 1997. Skånemejerier: functional foods through research. In: Traill, B. & Grunert, K,G.(eds.) 1997. Product and Process Innovation in the Food Industry. Blackie Academic & Professional. London. 237 p.

Harkki, A & Miller, J,W. 1997. Novel ingredients - important components of future foods. In: Poutanen, K (ed.).1997. Biotechnology in the food chain - New tools and applications for future foods. Technical Research Centre of Finland. Espoo. p. 261.

Hasler, C.M. 1996. Functional Foods: The Western Perspective. Nutrition Reviews 54(11): 6-10.

Hilliam, M. 1999. Functional Foods-Ready to fly but far to go? The World of Ingredients. March/April:46-49.

Hilliam, M. 1998. Functional Foods in Europe. The World of Ingredients. March/April: 45- 47.

Horan, C,P., McLoughlin, D., & DeBurca, S. 1998. A Preliminary Assessment of the Impact of IMP Literature on Scholarly Research: A Citation Analysis. In: Halinen-Kaila, A. & Nummela, N. (eds). 1998. Interaction, Relationships and Networks: Visions for the Future. 14th IMP Annual Conference. Vol. 1: Competitive Papers. Turku School of Economics and Business Administration. Turku. 596 p.

Houston, F.S. & Gassenheimer, J.B. 1987. Marketing and Exchange. Journal of Mar keting. 51(October): 3-18.

Håkansson, H. (ed.). 1982. International Marketing and Purchasing of Industrial Goods - An Interaction Approach. John Wiley & Sons. Chichester. 409 p.

Håkansson, H. (ed.).1987. Industrial Technological Development – A Network Approach. Croom Helm. London. 234 p.

Håkansson, H. & Johanson, J. 1992. A Model of Industrial Networks. In: Axelsson, B. & Easton, G. (eds.). Industrial Networks. Pp. 28-34. Routledge. London. 265 p. ok

Håkansson, H & Johanson, J. 1993. The network as a governance structure – Interfirm Co-operation Beyond Markets and Hierarchies. In: Grabher, G (ed.). 1993. The embedded firm. Routledge. London. 306 p.

Håkansson, H. & Snehota, I. 1989. No Business is an Island: The Network Concept of Business Strategy. In Ford, D.(ed.).1990. Understanding Business Markets; Interaction, Relationships, Networks. Academic Press. Cambridge. 556 p. [Originally published in Scandinavian Journal of Management 4(3):187-200].

Håkansson, H. & Snehota, I. (eds.). 1995. Developing Relationships in Business Networks. Routledge. London. 418 p.

Ichikawa, T. 1994. Functional Foods in Japan. Pp. 453- 467. In: Goldberg, I. (ed.). 1994. Functional Foods, Designer Foods, Pharmafoods, Nutraceuticals. Chapman & Hall. New York. p. 551.

Jarillo, J,C. 1998. On Strategic Networks. Strategic Management Journal 9: 31-41.

Johannisson, B. & Mønsted, M. 1997. Contextualizing Entrepreunerial Networking: The Case of Scandinavia. International Studies of Management and Organisation 27(3): 109-136.

Johanson, J. & Mattsson, L-G. 1987. Interorganisational Relations in Industrial Systems: A Network Approach Compared with the Transactions-cost Approach. International Studies of Management and Organisation 17(1): 34-48.

Johanson, J. & Mattson, L-G. 1988. Internationalisation in Industrial Systems - A Network Approach.(In: Ford, D. (ed.).1990. Understanding Business Markets. Academic Press. Cambridge. p. 556.)

Johanson, J & Mattson, L-G. 1992. Network positions and strategic action – an analytical framework. Pp 205-217. In: Axelsson, B. & Easton, G. (eds.). 1992. Industrial Networks: A New View of Reality.. Routledge. London. 265 p.

Jonas, M.S. & Beckmann, S.C. 1998. Functional Foods: Consumer Perceptions in Den mark and England. Working Paper no 55. Centre for Market Surveillance, Research and Strategy for the Food Sector. Aarhus. 34 p.

Jones, C., Hesterly, W.S. & Borgatti, S.P. 1997. A General Theory of Network Governance: Exchange Conditions and Social Mechanisms. Academy of Management Review 22(4): 911-945.

Jones, T. 1997. New product development: an introduction to a multifunctional process. Butterworth-Heinemann. Oxford. 134 p.

Kearney, J..M. & McElhone, S. 1999. Perceived barriers in trying to eat healthier – results of a pan-EU consumer attitudinal survey. British Journal of Nutrition 81 (suppl. 2):133 -137

The Keystone National Policy Dialogue on Food, Nutrition, and Health. 1996. The Ke y stone Center, Keystone (Col.). 159 p.

King, R.P. & Phumpiu, P.P. 1996. Reengineering The Food Supply Chain: The ECR Initiative in the Grocery Industry. American Journal of Agricultural Economics 78(5): 1181-1187.

Knoke, D & Kuklinski, J.H. 1991. Network analysis: basic concepts. Pp 173- 181. In: Thompson, G., Frances, J., Levačić, R., Mitchell, J. 1991. Markets, Hierarchies and Networks – The Coordination of Social Life. Sage Publications. London. 306 p. [Originally published in Knoke, D. & Kuklinski, J.H. 1982. Network Analysis. Sage Publications. Pp 9-21.]

Kohli, A.K. & Jaworski, B.J. 1990. Market orientation: The construct, research positions, and managerial implications. Journal of Marketing 54(1): 1-20.

Kojima, K. 1996 The Eastern Consumer Viewpoint: The Experience in Japan. Nutrition Reviews 54(11): S 186-188.

Kujala, J. 1994. Variety seeking behavior in a food buying context. University of Helsinki. Department of Economics and Management. Serie: Publications. Helsinki. 29 p.

Labuza, T.P. 1994. Foreword. xii. In: Goldberg, I. (ed.).1994. Functional Foods – De signer Foods, Pharmafoods, Nutraceuticals. Chapman & Hall. New York. 551 p.

Lancaster, K.J. 1966. A New Approach to Consumer Choice. The Journal of Political Economy LXXIV: 132- 157.

Lévi-Strauss, C. 1979. The Origin of Table Manners. Introduction to a science of Mythology: 3. Harper & Row. New York. 551 p. [Originally published in 1968 : L'Origine des Manieres de Table].

Lindman, M. 1997. Managing industrial new products in the long run: a resource-based view on new product development and performance. Acta Wasaensia no 59. Dissertation. University of Vaasa. Vaasa. 336 p.

Lundvall, B-Å. 1993. Explaining interfirm co-operation and innovation: limits of the transaction-cost approach. Pp 36-64. In: Grabher, G. The Embedded Firm – On Socioeconomics of Industrial Networks. Routledge. London. 306 p.

Mattsson, L-G. 1997. "Relationship Marketing" in a Network Perspective. In: Gemünden, H.G., Ritter,T. & Walter, A.1997. Relationships and Networks in International Markets. Pp. 37-47. Pergamon. 460 p.

Mennell, S. 1986. All manners of food: eating and taste in England and France from the Middle Ages to present. Blackwell. Oxford. 380 p.

Mennell, S., Murcott, A. & van Otterloo, A.H. 1992. The Sociology of Food: Eating, Diet and Culture. SAGE Publications. Bristol. 150 p.

Miles, M.B. & Huberman, A.M. 1994. Qualitative Data Analysis. SAGE Publications. Thousand Oaks. California. 338 p.

Mitchell, J.C. 1969. The Concept and Use of Social Networks. Pp 1-50. In: Mitchell, J.C. 1969. Social Networks in Urban Situations. Manchester University Press. Manchester.

Morten, S.J. & Beckman, S.C. 1998. Functional Foods: Consumer Perceptions in Denmark and England. Working Paper no 55. Centre for Market Surveillance, Research and Strategy for the Food Sector. Aarhus. 34 p.

Murthy, M. 1997. Nutraceuticals, Functional Foods and Medical Foods: Commentary and Caveats. Journal of Nutraceuticals, Functional & Medical Foods 1(3):73-99.

Mäki, U.1993. Economics with Institutions: agenda for methodological enquiry. In: Mäki, U., Gustafsson, B. & Knudsen, C. (eds.).1993. Rationality, Institutions and Economic Methodology. Pp 3 - 42 . Routledge. London. 312 p.

Möller, K. & Wilson, D. 1995. Interaction and network approach to business marketing: a review and evaluation. In: Möller, K & Wilson, D.1995. Business Marketing: An Interaction and Network Perspective. Pp. 587-608. Kluwer Academic Publishers. Norwell. 635 p.

Oliver, A.L. & Ebers, M. 1998. Networking Network Studies: An Analysis of Conceptual Configurations in the Study of Inter-organisational Relationships. Organisation Studies 19(4): 549-583.

Olkkonen, R. 1998. Splitting Hairs: Notes on the Nature of the Exchange Concept. In: Halinen-Kaila, A. & Nummela, N. (eds.). Interaction, Relationships and Networks: Visions for the Future. 14th IMP Annual Conference. Vol. 1: Competitive Papers. Turku School of Economics and Business Administration. Turku. 596 p.

Osborn, R.N. & Hagedoorn, J. 1997. The Institutionalization and Evolutionary Dynamics of Interorganisational Networks. Academy of Management Journal 40(2): 261-278.

Patton, M.Q. 1990. Qualitative evaluation and research methods. Sage. Newbury Park (Cal.). 532 p.

Popper, K.R. 1968. Conjectures and Refutations. Harper & Row. New York. 417 p. [Originally published in 1962].

Porter, M.E. 1988. Clusters and the New Economics of Competition. Harvard Business Review. Nov-Dec. 14 p.

Poulsen, J. B. 1999. Danish Consumers' Attitudes Towards Functional Foods. Working Paper no 62. Centre for Market Surveillance, Research and Strategy for the Food Sector. Aarhus. 44 p.

Powell, W.W. 1990. Neither Market nor Hierarchy: Network Forms of Organisation. Research in Organisational Behaviour 12: 295-336.

Rayner, M. 1998. Systematic Review as a Method for Assessing the Validity of Health Claims. In: Sadler, M,J. & Saltmarsh, M. (eds.)1998. Functional Foods: The Consumer, the Products and the Evidence. The Royal Society of Chemistry. Cambridge. 215 p.

Roberfroid, M.1998. Concepts and Strategy – Functional Food Science. The World of Ingredients. Marc/April: 34- 38.

Rona, Z. The Real Nutraceutical Agenda. NNC News. http://www.nnoc.com/what.html. 4/1/99

Samuelsson, P.1989. Economics. McGraw-Hill. Singapore. p. 1013. [Originally published in 1948].

Scientific Concepts of Functional Foods in Europe.1999. Consensus document. British Journal of Nutrition 81: S1-S27.

Simon, H.A. 1957. Models of Man. John Wiley & Sons. New York.

Sloan, A,E. 1998. Food Industry Forecast: Consumer Trends to 2020 and Beyond. Food Technology 52(1): 37-44.

Sloan, A.E. 1999. The New Market: Foods for the Not-So-Healthy. Food Technology 53(2): 54-60.

Spedding, C.R.W. (ed.). 1989. The Human Food Chain. Elsevier Applied Science. London. 319 p.

Stake, R.E. 1994. Case Studies. 236-245 pp. In: Denzin, N, K & Lincoln, Y,S. (eds.). 1994. Handbook of Qualitative Research. Sage. Thousand Oaks. 643 p.

Strauss, A.L & Corbin, J. 1990. Basics of qualitative research: grounded theory procedures and techniques. Sage. Newbury Park (Cal.). 270 p.

Street, P.R. 1990. A systems View of Commercial Supply and Marketing Links. 159-203. In: Jones, J.G.W. & Street, P.R (eds.). 1990. Systems theory applied to agriculture and the food chain. Elsevier. London. 365 p.

Tansey, G & Worsley, T. 1995. The food system; a guide. Earthscan. London. 259 p.

Thorelli, H,B. 1986. Networks: Between Markets and Hierarchies. Strategic Management Journal 7: 37-71.

Tikkanen, H. 1997. A Network Approach to Industrial Business Processes - A Theoretical and Empirical Analysis. Series A-7. Dissertation. Turku School of Economics and Business Administration. Turku. 227 p.

Tirole, J. 1989. The Theory of Industrial Organisation. MIT Press. Cambridge, Massachusetts. 479 p. [Originally published in 1988].

Urban, G,L., Hauser, J,R. & Dholakia, N. 1987. Essentials of new product development. Prentice-Hall. Englewood Cliffs. 340 p.

Utterback, J.M. 1996. Mastering the Dynamics of Innovation. Harvard Business School Press. Boston. 253 p.

Utterback, J.M. & Abernathy, W.J. 1975. A Dynamic Model of Product and Process Innovation. Omega 3(6): 639-656.

Warde, A. 1997. Consumption, Food & Taste. Sage Publications. Wiltshire. 231 p.

Welsh, S. 1996. Nutrient Standards, Dietary Guidelines, and Food Guides. In: Ziegler, E.E. & Filer(Jr), L.J. 1996. Present Knowledge in Nutrition. ILSI Press. Washington, DC. p. 652.

Weng, W & Chen, J. 1996. The Eastern Perspective on Functional Foods based on Traditional Chinese Medicine. Nutrition Reviews 54(11): S11-16.

Wick, K.L. 1995. Consumer Issues and Expectations for Functional Foods. Critical Reviews in Food Science and Nutrition. 35(1&2): 167-173.

Williamson, O.E. 1975. Markets and Hierarchies: analysis and antitrust implications. The Free Press. New York. 286 p.

Williamson, O.E. 1987. The Economic Institutions of Capitalism. Free Press. New York. 450 p. [Originally published in 1985].

Williamson, O.E. 1991. The Logic of Economic Organisation. In: Williamson, O.E. & Winter, S.G.1991. The Nature of the Firm; origins, evolution, and development. Oxford University Press. New York. 244 p.

Williamson, O.E. 1993. The Evolving Science of Organisation. Journal of Institutional and Theoretical Economics 149(1): 36- 63.

Winkler, J.T. 1998. The Future of Functional Foods. In: Sadler, M.J. & Saltmarsh, M. (eds.). 1998. Functional Foods: The Consumer, the Products and the Evidence. The Royal Society of Chemistry. Cambridge. 215 p.

Wrick, K.L. 1995. Consumer Issues and Expectations for Functional Foods. Critical Reviews in Food Science and Nutrition 35(1&2):167-173.

Yin, R.K. 1989. Case study research; design and methods. Sage. Newbury Park (Cal.). 166 p.

Ziegler, E.E. & Filer, L.J. (eds.). 1996. Present Knowledge in Nutrition. ILSI Press. New York. 655 p.

Appendix 1

Interviewed persons

Case Xylitol

Name	Position	Date
Lindholm, Bengt	Production Director, Cultor Group	10.12.1997
Mäkinen, Kauko K.	Professor, University of Turku	22.10.1997
Taskinen, Sakari	Development Director, Leaf-Hellas Oy	29.10.1997

Case Hyla

Name	Position	Date
Leporanta, Kalle	Product Development Manager,Valio	7.10.1997
Luoma, Laura	Product Manager, Valio Group	8.10.1997

Case LGG

Name	Position	Date
Luoma, Laura	Product Manager, Valio Group	8.10.1997
Salminen, Kari	Research Director, Valio Group	20.1.1998
Saxelin, Maija	Researcher, Valio Group	13.10.1997

Case Yosa

Name	Position	Date
Salovaara, Hannu	Professor, University of Helsinki	26.9.1997
Scharlin, Merja	Managing Director, Bioferme Oy	5.11.1997

Case Benecol

Name	Position	Date
Miettinen, Tatu A.	Professor emer., University Central Hospital Helsinki	21.10.1997
Palmu, Tapio	Development Manager, Raisio Group	29.10.1997

Appendix 2

Interviews

Before the interviews were carried out, a letter was sent to each person to be interviewed. In that letter the purpose of the study was explained, and the themes and questions that were going to be discussed were presented. These themes and questions varied to some extent depending on the role the person had had in the development process. In some cases information concerning the case was received even prior to the interview, which made it easier for the researcher to become orientated to the case and also prepare detailed questions. Interviews lasted an average of 1.5 hours.

In the following the interview themes and some of the respective questions are presented:

1. The background of the product:
e.g.
* Which are the main factors behind the emergence of the product idea?
* Who are the main persons or organisations that have contributed to this idea?
* Are there some previous developments that are especially important from the product point of view?

2. Research concerning the product
e.g.
* What is the background of the functionality of the product
* What kind of research is being done concerning the product?
* Who have been partners in the research?

3. Commercialisation of the product
e.g.
* How was research involved in the commercialisation?
* What partners wee involved and what kind of resources were needed?
* What were the biggest problem areas in the commercialisation?

4. Influence of public authorities
e.g.
* How did public authorities influence the development process?
* How and at what stage were the authorities contacted?
* Would the product be different without the influence of the public authorities?

5. General questions:
e.g.
* What have been the most critical phases in the overall development of the product?
* What is the current dependency of the product on research?
* Are there changes expected to take place that would affect the position of the product?

6. What other factors not yet treated during the interview are of significance as the product was developed from a product idea to a commercial product?

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