

# Enriched Convenience Seafood Products





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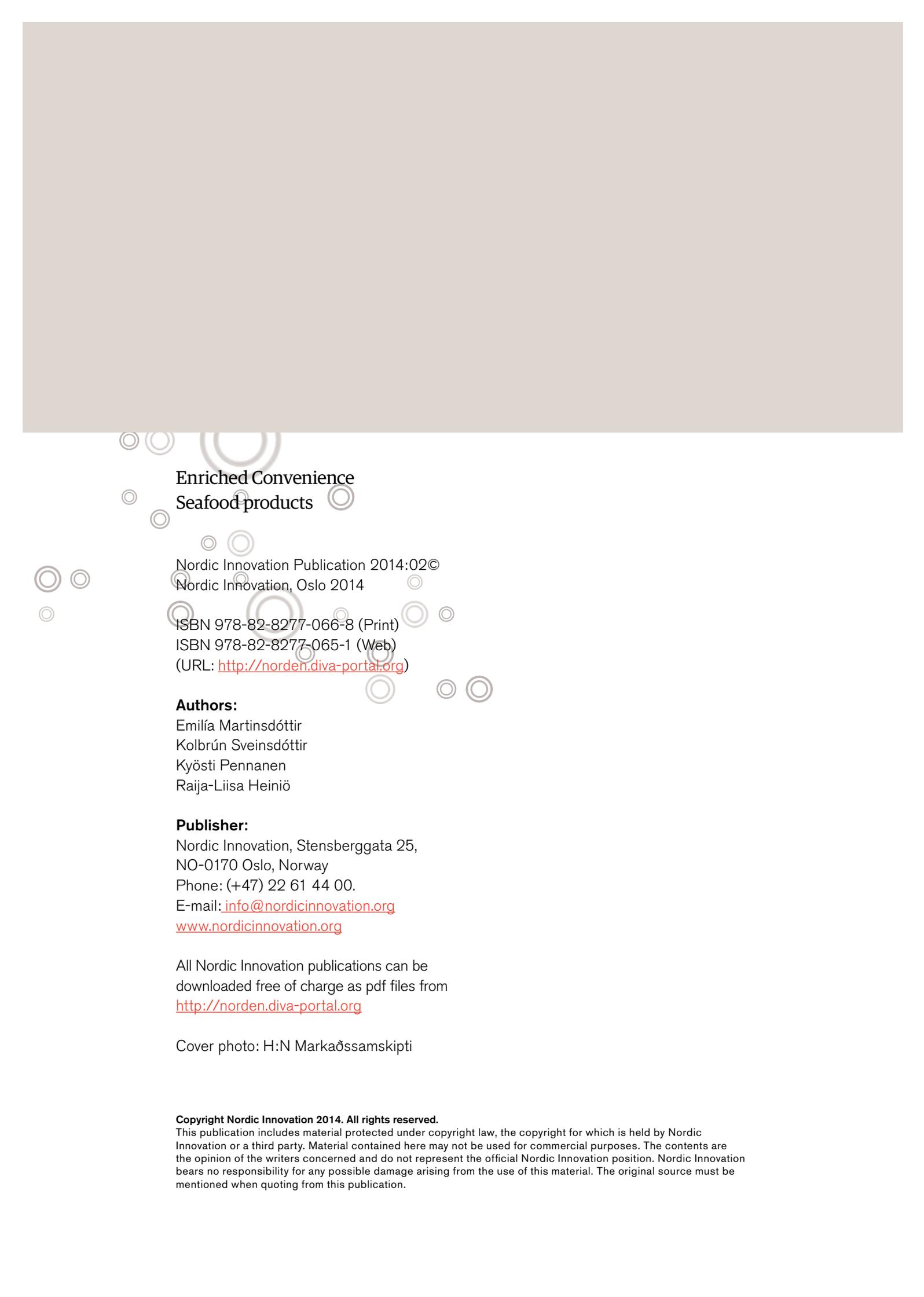


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# Executive Summary

Consumers can choose from a variety of food supplements for their diet. The food supplement market of vitamins, minerals and proteins has been steadily growing as functional foods. Consumers increasingly search for food products with known bioactivity either natural or added ingredients as means to improve their health or prevent diseases. The market for these types of products is one of the fastest growing markets in the world today. Few companies in the Nordic countries are producing seaweed powders, fish protein powders and omega fish oil powders ready for seafood consumer dishes. There are no seafood products on the market in Europe with added natural seaweed powders. Seafood proteins are finding their way into seafood products with good success due to very recent advances in processing technologies. By adding the fatty acids to lean fish products, the lean fish products will acquire the requested properties of fatty fish. There is a tremendous potential for the Nordic countries for better utilization of marine raw materials and conversion of these materials to high value ingredients in a production of high value enriched seafood dishes. The concept of the project was shown increasing interest both from industries and consumers during the project period.

The aim was to increase the value of ocean based raw materials, reach new seafood consumer groups and increase market share of the companies involved as a step forward for production of enriched seafood dishes for targeted consumer groups. Seafood dishes enriched with bioactive compounds from the ocean, such as seaweed, fish proteins and fish oil were developed to meet market demand. The developed products will become an option for consumers to choose enriched food instead of food supplements which will be of benefit and appeal certain consumer groups.

A web questionnaire designed around concepts of enriched convenience seafood products in Finland and Iceland was used to study consumer perception of different concepts and different levels of information about enrichment with omega-3, seaweed extract and fish proteins. The results show that product development with the seaweed is a very interesting option for both seafood producers for enrichment of convenience seafood products, and could be used for both fat and lean fish species. The positive outcome in both concept tests for the relatively unknown food ingredient seaweed showed various possibilities for future product development of enriched convenience seafood products. The omega-3 could be an interesting option for lean fish species, and the fish protein for products aimed at more specific consumer groups, such as groups more interested in functional foods. When all considered, enrichment of convenience seafood products with marine based ingredients is a realistic option for the seafood producers, but it is very important to consider labelling and information provided to the consumers.

Various prototypes of enriched seafood were developed in Finland. The consumer study results revealed that in blind evaluation the commercial products were deemed best. However, consumers do not operate blind-folded in the market place but they expose to different kind of information on the products such as product information or marketing messages. For that reason, it was considered as important to provide consumers some information on the evaluated products as such results would probably more reflect the reality in the market place which consumer face and also provide evidence whether Finnish consumers appreciate reduced salt content and/or seaweed in salmon products. The results showed that product information had significant effect on consumers' evaluations and opinions on the product. In all experimental products consumers' evaluation of taste pleasantness and willingness to buy was increased significantly and in almost, all cases the willingness to try the product was enhanced. Consumers also evaluated the suitable price of experimental products significantly higher once they received information on the product. To conclude, the results are promising from experimental product perspective. Based on the results, it seems that Finnish consumers appreciate salmon products with reduced salt. This is natural as salt reduction and its effect on heart diseases has been in past widely debated issue in Finland. Moreover, inclusion of seaweed into products to reduce salt content seems to interest consumers. The study results indicate also that consumers are willing to pay for such products. However, such products still require further product development as in general those performed worst among the six studied products. The seaweed powder producer succeeded in developing his product ready for enrichment of food during the product period and will stabilise the production within one year.

In Iceland various experiments in developing seafood dishes with addition of omega-3 were conducted and resulted in six different prototypes (four types of fish dishes with sauce, fish cakes and vegetables cakes) with and without the omega-3/6 oil from BioActive Foods developed in cooperation between Grimur Kokkur and Matis. A consumer study was conducted with the aim of studying consumer liking of six ready meals developed, enriched with omega-3 in comparison to conventional meals, after repeated consumption for four weeks. The study was conducted parallel to dietary intervention (described here below) using the same meals to collect information on bioavailability of omega 3/6 oil. Altogether 77 consumers, 50 years and older received six meals every week over a four week period, thereof 27 consumers received regular meals and 50 consumers received comparable meals but enriched with omega-3/6 oil. As an important part of the product development of the fish dishes the participants were asked various questions at the start and end of the intervention on liking of the dishes, experience of cooking and on purchase habits and fish consumption. The participants answered detailed questions regarding feelings before, during and after consumption and liking of the meals. Generally, the meals were well liked, both the enriched and conventional meals. Some liking differences were noticed between the conventional and enriched meals, depending on the type of meals. The liking of the meals was not reduced with repeated consumption with the exception of one type of meal. After consumption, the participants consuming the enriched meals felt more satiety. Desire to consume the meals was similar in week one and four, especially when the participants were asked to consider consumption after extended period of time. The results indicated that enrichment with omega-3/6 is a realistic option, but the enrichment is more appropriate in some meals, depending on other ingredients in the recipe.

The fatty acid profiles of the blood of a certain group of consumers using enriched seafood dishes for period of time were measured to estimate individual protection of persons against lifestyle diseases. This was done via intervention study in collaboration with the Unit for Nutrition Research, Landspítali University Hospital and Faculty of Food Science and Nutrition, University of Iceland. The intervention was conducted in May - October 2013 using three groups of people. One group consumed seafood dishes and a placebo powder. A second group consumed seafood dishes enriched with the omega-3 oil and a third group consumed seafood dishes and omega powder from BioActive Foods. The participants consumed the meals and powders six times a week for four weeks. The results showed that after four weeks of regular consumption of n-3 powder or meals enriched with a blend of cod liver/olive oil, the EPA, DHA, n-3/n-6 ratio and omega-3 index changed in agreement with the intake of n-3 fatty acids. The study also indicated that the bioavailability of n-3 fatty acids in encapsulated powder form was very similar to bioavailability of n3- fatty acids from meals enriched with liquid cod liver/olive oil. It was of very high importance for BioActive Foods and the seafood producer to be able to verify the effect and bioavailability of the n-3 fatty acids both in consuming enriched dishes and the powder.

A communication and marketing strategy for the enriched seafood dishes was planned for the seafood processors. The company Grimur kokkur ehf is an innovative Icelandic SME which operates mainly in convenience seafood markets. Based on the discussion with the company, the aim of the work was to enhance GK's marketing understanding. In order to fulfil the task, the following analyses were performed: identification of company objective; SWOT-analysis to analyse GK's internal strengths, weaknesses, opportunities and threats; competitor analysis to identify the main competitors and their offerings; customer analysis to identify different consumer segments of interest for Grimur kokkur ehf and analysis on distribution channels. The results of the different analyses were tailored and a strategy was developed for Grimur kokkur ehf to reach their objective. Grimur kokkur ehf has now at least six prototype nearly ready to the market. The plan now is a new healthy product line with various products in the Icelandic market within 6-months to one year from now. The company is now in their first real steps to exporting their products. They have capacity in their new production facilities to produce more than for the inland market.

Main interest for Hätäälä Oy was in relation to consumer understanding as important and useful for his further marketing activities. Thus, the work within marketing strategy task was directed to gain deep knowledge on Finnish consumers' fish consumption related behaviour. The topics covered in the study were: Intensity of fish consumption with the focus of buying, preparing and eating fish and fish products at home; preferences and expectations for the grocery shop as an environment for buying fish; evaluation of the quality of fish and processed fish products at the grocery shop and perceptions of fish as a raw material and as a meal. A general notion was that buying, preparing and eating fish correlates positively with age. The information that consumers considered as important was the freshness of the fish. Consumers answered generally that they like fish as food. The results show that respondents had a relatively positive attitude towards fish in general but that opinions of those who eat fish regularly differ strongly of the opinions of those who consume fish irregularly. Price was the most frequently stated and important factor diminishing fish consumption and second most important obstacle was weak availability or assortment of fish.

The composition of the consortium consisting of two different research companies with expertise in product development, consumer research and marketing, two seafood processors and three companies producing various bioactive ingredients made the outcome of the project very successful. Also collaboration with the Unit for Nutrition Research, Landspítali University Hospital and Faculty of Food Science and Nutrition, University of Iceland contributed to successful outcome of the intervention studies and supervision of students. The project resulted in four oral and five poster presentations at international conference and. Also two scientific articles have been submitted for review in scientific journals.

The successful outcome of the project has opened up new possibilities in local and foreign markets for producers of innovative bioactive marine based products, fish protein, seaweed and fish oil products as ingredients in functional (sea)foods. The results of the project will increase variety of seafood products with functional properties for consumers and value of ocean based raw material, especially by-products and un-utilised resources. The ingredients companies Marinox and BioActive Foods, the seafood processor Grímur kokkur and both research institutes will continue their collaboration in a newly funded EU project with the aim to increase the value of convenience foods by adding functional ingredients with confirmed bioavailability.

## Background

Nordic seafood industries are largely placed far back in the value chain and the marketing has been through a few exporters. At the same time this creates distance to the market and contributes to the lack of market expertise. In recent years marine based biochemicals extracted from by-product fractions from the fish processing industry are being introduced into commercial products. These materials are especially rich in proteins and lipids, which can be further processed into highly valuable and bioactive ingredients, e.g. peptides and long chain fatty acids. Ready-to-eat seafood products enriched with bioactive ingredients are unknown on the Nordic market. Other products with functional ingredients, especially milk products have an established position in the market.

Competing products may be considered both domestic and imported sources of protein, protein-rich products such as fish and meat in addition to other protein-fortified products such protein drinks. Bodybuilders consume a large amount of these products to meet the protein requirements; also every-day eating of chicken is common.

Adding FPH into seafood products is a natural first step in developing new markets for FPH enriched products. The main competitive products of such products are other types of supplements like vitamins, protein powders, whey protein, mainly as a by-product of the dairy industry, or plant based antioxidants. Seafood proteins are finding their way into seafood products with good success due to very recent advances in processing technologies.

Seaweed polyphenols have very high antioxidant activity and could compete for example with rosemary extracts which are marketed as natural antioxidants. Seaweed extracts from certain brown algae species, e.g. *Fucus vesiculosus*, have found to have superior antioxidant activities in addition to other unique properties (e.g. anti-inflammatory and anti-diabetic activities) which make them highly attractive for use in various food systems. Due to the strong market demand and positive preliminary tests it is believed that seaweed extracts can be highly competitive on the market and various uses in food can be found. There are no seafood products on the market in Europe with added natural seaweed powders. Seaweed polyphenols may have several advantages in seafood products, including bioactivity, increased oxidation stability of food products and more appropriate flavour profile with flavour enhancing effects with the possibility of salt-reduction in foods.

Omega-3 enriched products are well known and can be found in functional foods and drinks, dietary supplements and clinical nutrition all over the world. The unique novel omega-3 powder (1 LifeActive) is now on the market with the ability to both regulate

and maintain the omega-6/omega-3 fatty acid balance in the body while simultaneously safeguarding the daily need for omega-3 from fish and protective biological antioxidants from olives (flavonoids). BioActive Foods supplies a blood test that measures the profile of 11 fatty acids (99 %) in the blood to calculate the fatty acid balance in red blood cell membranes, as well as the risk factors of Omega-3 level and Omega-6 share in the blood. By adding the omega powder to lean fish products, the lean fish products will adopt the favourable properties of fatty fish.

Consumers increasingly search for food products with known bioactivity either natural or added ingredients as means to improve their health or prevent diseases. The market for these types of products is one of the fastest growing markets in the world today.

The idea was to develop convenience seafood products enriched with marine-based ingredients such as seaweed powder and powder of fish oil or fish proteins, either using one ingredients or a combination of ingredients, which may positively enhance positive health effect, salt reduction, flavour and stability of the products. Production and incorporation of seafood based ingredients has been problematic in the past, particularly due to quality problems of the ingredients and their carry over effect in the final product. Recent research has now resulted in processes where highly functional bioactive hydrolysates with a good flavour profile can be produced from fish by-products. Recent process improvements have created new possibilities for the use of marine based ingredients in functional foods. These developments open the door to a large range of innovative (sea)food products enriched marine bioactive ingredients and give consumers greater choices when seeking to enrich their diet with compounds with nutritional benefits.

The aim was to increase the value of ocean based raw materials, reach new seafood consumer groups and increase market share of the companies involved as a step forward for production of enriched seafood dishes for targeted consumer groups. Seafood dishes enriched with bioactive compounds from the ocean, such as seaweed, fish proteins and fish oil were developed to meet market demand. In the project the stability and bioactivity of ingredients for use in consumer products were studied and the effect of enrichment on stability and quality of the seafood products. Acceptance of the concepts and the prototypes in consumer studies in the Nordic market were studied. A communication and marketing strategy for the enriched seafood dishes was planned for the seafood processors. The fatty acid profiles of the blood of a certain group of consumers using enriched seafood dishes for period of time were measured to be able to use to calculate individual protection of persons against lifestyle diseases. This innovative seafood development project based on collaboration between a fish processing company, ingredient companies and food research institutes with emphasis on consumer oriented product development, consumer testing and marketing.

### **Stability of ingredients**

The stability of the bioactive compounds were studied in the project revealing the needed information for the producers for use as ingredients in food products. Enrichment of food bioactive compounds could lead to changes in functional properties and sensory attributes. The sensory attributes are of top priority for consumers and one that cannot be compromised. The stability and quality of the ingredients has to be verified before use in food. The stability and quality of both seaweed and omega powder was studied.

**Seaweed raw material and extractions**

The brown algae *Fucus vesiculosus* (Linnaeus) was collected in Reykjanes peninsula. The algae were washed with clean seawater. Small pieces were cut and then freeze-dried, pulverized into fine powder, and stored in tightly sealed polystyrene containers at  $-20^{\circ}\text{C}$  prior to extraction. Two seaweed extracts from different seasons (extract I and extract II) were prepared and stored for 64 weeks at  $4^{\circ}\text{C}$  and  $-18^{\circ}\text{C}$ . Ascorbic acid was added to two samples (1000 mg/kg extract) and stored at  $-18^{\circ}\text{C}$  with the aim to increase the storage stability. Samples were taken every 8-10 weeks and subjected to following in-vitro bioactive tests: Total polyphenol content (TPC), ORAC (Oxygen Radical Absorbance Capacity), DPPH radical scavenging, reducing power.

The total polyphenol content of seaweed extract II was higher compared to seaweed extract I, indicating seasonal variations. Seaweed extract II has a higher antioxidant power, measured as ORAC values and reducing power, compared to seaweed extract I. Neither temperature nor storage time did affect the antioxidant power except seaweed extract II, kept at room temperature, which had lower ORAC and reducing power after 64 weeks compared to samples kept at  $4^{\circ}\text{C}$  or  $-18^{\circ}\text{C}$ . The antioxidant power was similar at the initial stage of the study and after 64 weeks. No significant effect of adding ascorbic acid to increase storage stability was seen in samples kept at  $-18^{\circ}\text{C}$ .

**Omega-powder**

Lipid oxidation is the most important factor limiting the shelf life of seafood products. Long-chain PUFAs, contained in high concentrations in seafood lipids, are characterized by a high aptitude to oxidation, leading to several volatile compounds with a negative impact on the sensory features of fish products. These compounds, produced as secondary oxidation products from lipid hydroperoxides decomposition, are characterized by a low olfactory threshold and have unpleasant sensory properties, commonly described as rancid odor and flavor.

The unique novel omega-3 powder (1 LifeActive) is now on the market with the ability to both regulate and maintain the omega-6/omega-3 fatty acid balance in the body while simultaneously safeguarding the daily need for omega-3 from fish and protective biological antioxidants from olives (flavonoids). The aim of this study was to evaluate the stability of the omega-6/omega-3 oil powder regarding sensory quality during storage.

The omega-3 powder (1 LifeActive), a confidential blend of microencapsulated cod liver oil and olive oil from BioActive Foods, Norway, was kept at refrigerated ( $4^{\circ}\text{C}$ ) and room ( $22^{\circ}\text{C}$ ) temperatures from production (June 2013) for six months (to December 2013). The powder was evaluated by the sensory panel at Matís. Minor differences were detected between samples stored at different temperatures. The powder had not reached the end of shelf life after six months storage.

# Consumer perception of enriched seafood in Iceland and Finland

The food industry is essentially faced with challenges to keep health-oriented consumers seeking for intake of enriched convenience instead of supplementary pills. A major problem in the successful development and market launch of innovative healthy products is the lack of knowledge of consumer perception and its translation into product attributes for use in customised product development. An approach that uses a combination of both technological and sensory and consumer research should result in enriched convenience food with sensory characteristics accepted by the targeted consumer groups with high consumer acceptance. The European market for enriched food products is the less developed among developed countries. European consumers generally seem to be rather suspicious in enrichment of food and though health claims in food products communicate the health effect, it does not necessarily make the product more appealing. Therefore, development of enriched foods requires understanding of consumers' demands.

## **Concept test in Iceland**

Previous work related to the ideas of seafood processors to establish a production line of oven-ready seafood products with added health-value, was conducted before the start of the project "Enriched Convenience Seafood Products". The work was related to consumer focus groups, consisting of a broad spectrum of seafood consumers in two sessions. The focus group work showed that bioactive compounds were not known to the participants, but generally they sounded positive rather than negative to them. Antioxidants, seaweed and omega-3 were usually experienced as positive, and omega-3 was associated with healthy fish oil and protection against diseases. Proteins as such and proteins used to increase the protein content of seafood were both experienced as positive and negative. Partly based on the results from the focus group, an online questionnaire was designed within "Enriched Convenience Seafood Products", to test concepts of enriched seafood products that could fit in an oven-ready seafood product line. A random sample of 4000 people aged 18-80 years was obtained from the National Registry via marketing company. Introductory letters were sent out in end of January 2012 in which participants were asked to participate by going to a URL provided in the email, and sign in via password and respond to the survey.

### **Methods**

A web-based questionnaire was designed to study the effects of information about the enrichment with omega-3, fish proteins and seaweed extract and possible health effects/functional properties on how consumers experienced the products.

The set-up of the questionnaire was that first information about seafood purchase and use of food supplements was requested. Then questions regarding the different concepts were asked, and then attitudes related to healthy eating, new foods, functional foods and convenience regarding meals. At the end of the questionnaire, information related to physical activity and demographic factors were collected.

Questions regarding purchase and consumption: I buy a) fish or other seafood at least once a month and b) I buy fish dishes (such as fish cakes) at least once a month (yes/no); c) How often do you eat fish as main course (frequency on 9-point scale: never-daily); d) How often do you take vitamins, fish oil or minerals and e) How frequently do you take other supplements, such as glutamine, creatine or protein (powder, bars, drinks) (frequency on 9-point scale: never-more than 1 time per day). Do you look at content information on food packaging (frequency on 5-point scale: never-always).

Statements about concepts/products: A photo of a common convenience seafood product (fish cakes) was chosen to show with the different information given in relation to the enriched convenience seafood concepts. The information varied according to ingredients and function of bioactive compounds, and participants were asked to rate statements on a 7-point scale (disagree/agree) regarding if they considered the product to be attractive, healthy, to contribute to good health, to contribute to improved performance in sports, fulfil nutritional needs, to reduce the risk of cardiovascular diseases, natural, and tasty. Then they were asked how unlikely or likely they were to buy the product on a 7-point scale. The statements were 13 in total. First, four statements appeared with information about if the fish cakes were traditional or had been enriched with fish protein, omega-3 or seaweed in random order and with no other information. Following, statements containing information about the enrichment and different levels of information about the effects of consuming the functional ingredients.

Questions regarding interest in healthy eating, openness to try new foods attitudes towards functional foods and the importance of convenience around meals, were asked on a 7-point scale

To estimate attitudes towards different ingredients in convenience seafood meals (fish cakes), a 7-point scale (Very negative/very positive) was used for a) antioxidants, b) added fish protein, c) salt, d) omega-3, e) seaweed, f) D-vitamin, g) kelp.

To estimate the participant's physical activity level they were asked about the frequency of a) difficult, b) light/average and c) very light physical activity.

Finally, questions were asked about gender, age, education last completed, the number of household members and children in the household under 18 years of age, zip code and total income of the household.

**Main results**

Interest in healthy eating is important when considering interest in buying enriched seafood products. Of 460 participants completing the survey, slightly more than 50% were estimated to place high emphasis on the healthiness of food according to their attitudes towards healthy eating. This group was more likely to use information provided on packaging, consume more fish, and take vitamins, minerals, fish oil and other food supplements. This group had a more positive attitude towards functional foods but placed less emphasis on convenience around meals. The average age was higher, more females and higher education level was within this group. One-third of the participants were very positive towards functional foods which included relatively many in the age group 55-64 and were almost three times more likely to consume food supplements (other than vitamins and minerals).

Information about enrichment of convenience seafood products affects how consumers experience the product. Generally, enrichment had rather negative effects on expected taste. However, the information about the substances used for enrichment (omega-3, seaweed and fish proteins) and their function positively influenced how the participants perceived the healthiness of the products and effects of consumption (better health, performance in sports, fulfilment of nutritional needs, lower likelihood of heart related diseases). Additionally, more information increased the likelihood of buying the product. Fish cakes with information about omega-3 enrichment and information about function were the most positively evaluated with the highest probability of purchase. The importance of omega-3 is generally well known which could contribute to the more positive evaluation. However, the information about the function of omega-3 had similar effect to a more positive outcome as information about ingredients of/ and function of seaweed and fish protein, though the advantages of seaweed and fish protein are probably less known among Icelandic consumers.

The consumers placing higher emphasis on the healthiness of food and consumers that had a general positive attitude towards functional foods were more positively affected by information about omega-3, seaweed and fish protein enrichment. Similarly, these groups had more positive attitudes towards these ingredients in fish cakes. However, the difference in buying intention was more noticeable between groups with different attitudes towards functional foods.

The results indicate that consumers are positive towards enrichment if known substances like omega-3 are used, but it is better to provide information about the function in the body, even though the substance is well known, as it increases the positive experience of consuming the product. Enrichment with seaweed appears also to be a realistic option when information about effects was provided and similar conclusion was found for the fish protein. These products appealed in general to people placing emphasis on the healthiness of food, which is a rather big portion of consumers according to these results.

Generally it can be concluded from these results that the enrichment of convenience seafood is a realistic option, but it is important to consider labelling and information provided to the consumers.

**Concept test in Finland**

The aim of the Finnish study was to gather information on consumers' perception of salmon product concepts enriched with fish protein powder, omega-3 powder

and seaweed extract. As fish products with such ingredients are relatively uncommon for Finnish consumers it was found that the basic information was necessary to obtain at this stage of the project to enable further consideration of potential products to be developed in later stages. The product, salmon cake, was chosen as the seafood producer mainly produces salmon products, and adding different ingredients to salmon cakes for a successful production.

### **Methods**

To achieve the study aim, a quantitative method was applied. Altogether eight different, verbally described product concepts were developed (three fish protein concepts, three omega-3 powder concepts and two seaweed concepts). The difference between the concepts was the depth of information provided to consumers, that is, the amount of information related to the considered added value of ingredient such as health benefit, salt reduction or maintenance of muscle mass in salmon cakes. The reason for this was 1) to gain understanding if the consumers associate the ingredients' benefits with the products without further education/marketing, 2) if the information of added value makes concepts more appealing and 3) to consider if the information provided can be useful in marketing if some product concept turns into actual product. In addition to product concepts enriched with different ingredients, consumers also evaluated traditional salmon cakes as a reference concept to find out if adding the ingredients had effect on consumers' evaluations.

The questionnaire used in the study followed the same logic as the one used in Iceland. Thus, the following dimensions of product concepts were studied (in a scale 1 = completely disagree...7 = completely agree):

- 1) Attractiveness
- 2) Healthiness
- 3) Contribution to health
- 4) Contribution to improved performance in sports
- 5) Fulfilment of nutritional needs
- 6) Ability to reduce the risk of cardiovascular diseases
- 7) Naturalness
- 8) Tastiness
- 9) Buying intention

Through the previous dimensions it was considered to capture the most relevant issues regarding each individual product concept and use the information as basis for decisions related to further development of the concept into actual product.

The concept descriptions used in Finland were slightly different compared to the Icelandic concepts. This was mainly due to the fact that the Finnish companies need to follow EFSA regulations in their marketing and communication towards consumers.

Data was collected during October 2012 via Internet panel of an external service provider. As the nature of the study is practical and it aims at directing further Rand D –work in the project, it was decided to use different recruitment criteria to reach such consumers who consume fish products and do not hold negative attitude towards ingredients in general. In the end, all the consumers participating in the study met all the following criteria (reason for each criterion is presented in brackets):

- 1) buy fish or other seafood at least once a month (it was decided that all participant need to buy fish or other seafood regularly)
- 2) buy fresh convenience fish dishes (such as fish cakes or fish balls, smoked salmon, raw spiced salmon, fish salad etc.) at least once a month (it was decided that all participants need to buy fresh convenience fish dishes regularly)
- 3) eat fish 2– times a month or more frequently (it was decided that all participants need to eat fish regularly)
- 4) consume vitamins, fish oil or minerals once a month or more frequently (it was decided that all participants need to have experience in ingredients ensuring that such consumers are reached who do not have hostile attitude towards ingredients).

### **Main results**

The aim of the Finnish concept study was to gather information on consumers' perceptions on salmon product concepts enriched with fish protein powder, omega-3 powder and seaweed extract. The results of the study are somewhat mixed. On one hand, the fish protein and omega-3 concepts did not perform that well (as perhaps expected). On the other hand, the most unfamiliar ingredient, seaweed did relatively well especially when the ingredient was attached to salt reduction information.

One explaining factor for the previous might be that a salmon cake was used as the product for the study purposes. Salmon is one of the most consumed fish in Finland and the high omega-3 and protein content of it are well known among Finnish consumers. This might have alleviated the perceived value of omega-3 powder (health) and protein powder (maintenance of muscle mass) to consumers while the seaweed extract with its salt reducing capability offered such benefit which does not naturally exist in salmon. Thus, the study results related to omega-3 and protein powder might have been different in some lean fish products such as pike cake.

The results related to seaweed extract can be considered promising. First of all, the image of the seaweed can be considered negative among Finnish consumers as it is mainly associated with summer and the appearance of toxic cyanobacterium in the Baltic Sea meaning that the usage of it in food can easily cause concerns among consumers. However, the seaweed concept with the salt reduction information still received relatively good scores among consumers. One explanation for this result might be the wide public discussion about the importance of salt reduction so the benefit of seaweed extract is somewhat easy to recognise by consumers and it probably makes sense from consumers' perspective to integrate seaweed to salmon products and thus reach the benefits of both omega-3 and salt reduction at the same time.

From further Rand D perspective, one reasonable avenue within this project might be convenience foods enriched with seaweed extract. The promising results of the concept study tailored with the fact that the consumers had no knowledge on the origin of the ingredient (Atlantic Ocean) which left more room for the association of the ingredient with toxic image provides ground for such decision related to further product development. Another point is that Hätälä Oy mainly produces salmon products so the omega-3 and protein enriched products might be out of question as a salmon product probably is not the ideal for those ingredients (though those might be good ingredients in some other fish products).

***Conclusions of consumer concept test for seafood producers***

The web questionnaire designed around concepts of enriched convenience seafood products in Iceland showed that possibilities for seafood products enriched with seaweed and fish protein, but especially omega-3 is a realistic option. More than 50% of the participants in the survey were estimated to place high emphasis on the healthiness of food, and over 30% were positive towards functional foods.

The results showed that it is very important to consider labelling and information provided to the consumers. The information about enrichment of convenience seafood products affects how consumers experience the product. Generally, enrichment had rather negative effects on the expected taste. However, the information about the substances used for enrichment (omega-3, seaweed and fish proteins) and their function positively influenced how the participants perceived the healthiness of the products and more information increased the likelihood of buying the product. Fish cakes with information about omega-3 enrichment and information about function were the most positively evaluated with the highest probability of purchase.

The results of the concept test for Finnish consumers were somewhat unexpected as concepts including the unfamiliar ingredient, seaweed, did relatively well especially when the ingredient was attached to salt reduction information. The concept including omega-3 and fish protein did not perform that well, which could be related to the high omega-3 and protein content of the salmon that is well known among Finnish consumers. Thus, the study results related to omega-3 and protein powder might have been different in some lean fish products such as pike cake.

From further Rand D perspective, one reasonable avenue within this project might be convenience foods enriched with seaweed extract. The promising results of the concept study tailored with the fact that the consumers had no knowledge on the origin of the ingredient (Atlantic Ocean) which left more room for the association of the ingredient with toxic image provides ground for such decision related to further product development. Another point is that the producer mainly produces salmon products so the omega-3 and protein enriched products might be out of question as a salmon product probably is not the ideal for those ingredient (though those might be good ingredients in some other fish products).

The results show that product development with the seaweed is a very interesting option for both seafood producers for enrichment of convenience seafood products, and could be used for both fat and lean fish species. The positive outcome in both concept tests for this relatively unknown food ingredient seaweed shows various possibilities for future product development of enriched convenience seafood products. The omega-3 could be an interesting option for lean fish species, and the fish protein for products aimed at more specific consumer groups, such as groups more interested in functional foods.

When all considered, enrichment of convenience seafood products with marine based ingredients is a realistic option for the seafood producers, but it is very important to consider labelling and information provided to the consumers.

# Product Development of Seafood Processors

Enrichment of bioactive compounds in processed foods while realising a comparable taste, aroma and texture is a technological challenge. For successful product development, detailed scientific knowledge is hence a prerequisite. Using seaweed ingredients and omega-3 powder may negatively affect the flavour and texture of the food products. The sensory attributes are the top priority for consumers and one that cannot be compromised. Indeed, it is a challenge to incorporate function and nutrition without negatively affecting sensory characteristics.

A proven flexible, consumer driven product development is the Stage-Gate® model (Cooper RG, 2001). Nevertheless, the applicability and budget demands of this strategy are questionable when it comes to SMEs with a small budget and a limited time-frame. Despite the extensive theoretical knowledge available on NPD, it is well known that many new products fail in the market. Studies have shown that several variables can distinguish between success and failure of new products, mainly depending on processes, resources and strategies. Speed to market, quality management, multifunctional teamwork, sense of commitment and a systems approach are said to be key requirements for success in NPD (Huang X, and other (2001), March-Chorda and others (2002). These studies show an importance of focus on the customer-consumer market. Some NPD activities were regarded as more important such as market study, product development and commercialisation. Asking for feedback from consumers during the development process even if the product is not yet finalized (concept testing) is recommended and to perform market analyses (purchase behaviour, pricing and trends).

A number of research tools for consumer driven product development are available. Qualitative tests, such as focus group and in-depth interviews provide insights to consumer needs, initial responses to product concepts or prototype and to product usage (Meilgaard and others, 2007) Analysing the information that is provided by the consumers can lead to a better understanding of the current market situation (Søndergaard 2005, Søndergaard and Harmsen (2007). Questionnaires about attitudes and personality traits have been commonly used in consumer research and product development for many years. This method can generate extensive, quantifiable insights regarding e.g. food neophobia (Pliner and Hobden, 1992), interest in healthy eating (Roininen and others, 1999), attitudes towards functional foods and health claims (Urala and Lähteenmäki, 2007; Grunert and others, 2009) convenience orientation, perceived convenience of seafood (Olsen and others, 2007).

To obtain added product knowledge, trained sensory panels can be very valuable. By using methods such as descriptive sensory analysis, the product characteristics can be described in a short time<sup>70</sup>. Descriptive sensory analysis has been used e.g. to describe the sensory aspects of various seafood products, such as sensory differences due to various factors, such as origin, storage time and storage method of cod fillets (Sveinsdottir 2009, 2010). However, information about actual consumer overall liking has to be obtained by a consumer test. Central location tests (CLT) are the most common types of consumer tests, Lawless and Heymann (1999). CLT can be conducted at relatively low cost, in a short time and are easily controlled compared to home-use tests (HUT). HUT provides testing in a more realistic setting in line with the consumers' usual habits, e.g. with regard to preparation, serving size, consumption time, social settings and environment. In addition, HUT offers the opportunity to study the effects of different types of product related information on the consumer perception of products (Kole and others, 2009).

In this project the product development was guided by online concept testing, sensory evaluation, consumer liking in central location and in home.

### **Product development, sensory evaluation and consumer tests in Iceland**

Before making prototypes various studies were performed both in laboratory scale or/and in the processing plant.

At start the already existing products of the company were used for enrichment. The products chosen were chosen as most feasible based on how and where in the process they could be added. This information was used at later stages to develop new products. Fish oil could be added into some of the products without affecting the flavour. Also the seaweed extract enrichment was successful regarding flavour. Then, prototypes of seafood dishes enriched with bioactive compounds from the ocean, such as seaweed, fish proteins and fish oil to increase omega-3 fatty acids were developed. The results showed that it is possible to increase the content of omega-3 fatty acids in fishcakes without negatively affecting the flavour. Also the enrichment of seaweed and fish proteins to increase protein content was successful.

All samples were evaluated by a trained sensory panel at Matís. The sensory panel consists of 18 members, all selected and trained according to international standards (ISO 8586, 1993); including detection and recognition of tastes and odours, use of scales and in the development and use of descriptors.

### **Quality of ingredients**

In the first product development experiments of the company Grimur kokkur used salmon protein powders to increase the protein content of fish cakes. The aim was to higher the protein content up to 18 to 20% with the aim of being suitable for athletes, body-builders to become a variant in their food choice. Fish cakes was used for all the experiments. The protein content of fish cakes could be increased up to 18%. The fish extracts showed to have too high salt content to be used directly into the production. The results showed that it was of uttermost importance that the raw-material used for the powder production is of high a quality and cannot contain too much salt. At the beginning of the project,

only omega powder containing vanilla flavour was available, which is not at all acceptable in seafood. This was discovered after the sensory panel started to taste various prototypes. The vanilla flavour evolves especially at heating. Vanilla flavour was not added to the powder, but there is vanilla flavour in the oil used in the powder. Along with the powder, fish oil (cod liver oil) was used in the product development with very good results so the fish dishes contained omega-3 as planned. The dishes enriched with seaweed powder showed to be very promising.

### **Heat treatments**

A study was done on lipid oxidation of Omega-3 enriched seafood products during processing and storage using seaweed extracts showed interesting results. Marine lipids are known to provide high contents of long chain omega-3 polyunsaturated fatty acids (PUFA) that have health-beneficial effects. However, fish lipids are very susceptible to oxidation. Under conditions when microbial growth is delayed, lipid oxidation is the most important factor limiting shelf life. Our previous studies have shown that brown seaweed (*Fucus vesiculosus*) extracts were excellent antioxidants in food models. The aim of the experiments to study the stability of seafood products, with added omega-3 rich fish oil and /or seaweed powder before, during and after heat treatment. In addition, the aim was to study if *F. vesiculosus* extracts could delay or inhibit the onset of lipid oxidation.

Fish dough was enriched with cod liver oil (1000 mg omega-3 per 150 g fish dough portion) and/or either type of seaweed extract prepared by aqueous or ethanol extraction (set to 300 mg phloroglucinol equivalents (PGE) per kg of dough). The fish dough was formed into fish cakes and fried in oil. Samples were taken after 4, 7, 14 and 28 days of storage at 2-4°C and kept at -24°C until analysis. Chemical (peroxide value and TBARS), physical (NIR, fluorescence and color) and sensorial analysis were used to estimate the level of lipid oxidation.

No differences were detected between sample groups with regard to rancid odor or flavor until after 28 days of storage, when rancid flavor was detected in the sample containing cod liver oil and aqueous seaweed extract. The chemical and physical measurements showed that the level of oxidation was different between the sample groups. Cod liver oil significantly increased the level of oxidation after cooking. Ethanol extract showed better performance than the aqueous seaweed extract in prevention of oxidation.

The results of the study indicate the potential of using extracts of *F. vesiculosus* as an antioxidant in seafood products. Regarding the seaweed powder we have very interesting results backing up the hypothesis of the flavour enhancing effect.

### **Product development and consumer studies as a part of the intervention study**

The concept testing indicated that more interest was in seaweed and omega as ingredients and therefore the emphasis in this project turned into use those ingredients. Within the main project one of the main emphasis in the product development was to produce enriched seafood dishes with omega oil to use in the intervention study. In the later stage of the project the emphasis of the seafood producer was product development of omega enriched products in a new production line for health oriented consumers and to evaluate the quality and shelf life of the products. In addition, the aim was to collect information on bioavailability of omega3/6 oil to support statements to use in product information via food intervention. Products resulting from the product development were used in the

intervention and at the same time the acceptance of the products during the intervention was studied. The first step in the product development was to decide how much omega-3 oil could be added to the product which was done in an experiment with fish cakes.

Sensory evaluation showed acceptable results using up to 8% of omega-3. Next, several other types of dishes were developed with the amount of the omega-3/6 oil needed to fulfil the recommended daily dosage of omega-3. Evaluation of the dishes showed satisfactory results and then six different prototypes (four types of fish dishes with sauce, fish cakes and vegetables cakes) with and without the omega-3/6 oil were developed. Sensory evaluation and chemical analysis were used to test the quality of the prototypes after 0, 3 and 6 months of frozen storage. The results from the chemical measurements showed that enriched dishes had higher fat content compared to the conventional dishes due to the enrichment with the omega-3/6 oil. Sensory evaluation of most of the dishes showed that the products had a shelf life of at least six months. Cold storage odor and flavor was barely detected and similar results were found for rancidity which is a critical factor in shelf life of sensitive omega 3 fatty acids. Neither fish oil odor nor flavor was detected. However olive oil odour and flavour was detected in some enriched dishes. Overall, it can be concluded that ready to heat convenience fish meals can be enriched with omega- 3/6 oil, but the flavour of the dishes is differently affected by the oil and some recipes appear to more suitable than others.

Consumer liking of the prototypes of enriched convenience dishes in comparison to conventional dishes was performed to study liking and experience after repeated consumption over four weeks. The study was conducted parallel to dietary intervention using the same meals to collect information on bioavailability of omega 3/6 oil (described in more details in the chapter Intervention study here below). Altogether 77 consumers, 50 years and older received six meals every week over a four week period, thereof 27 consumers received regular meals and 50 consumers received comparable meals but enriched with omega-3/6 oil. Before the start of the intervention, the participants answered a questionnaire about general fish consumption, purchase habits regarding to fish, intake of supplements and if they looked at the labelling of food. In the first and fourth week of the intervention, the participants answered questionnaire about liking of the convenience dishes in the intervention that participants answered at home parallel to consuming the meals in the intervention.

The participants in both groups were buying fish on averages ones a week and convenience dishes 5-8 times per year. Generally, the meals were well liked, both the enriched and conventional meals. Some liking differences were noticed between the conventional and enriched meals, depending on the type of meals. The liking of the meals was not reduced with repeated consumption with the exception of one type of meal. After consumption, the participants consuming the enriched meals felt more satiety. Desire to consume the meals was similar in week one and four, especially when the participants were asked to consider consumption after extended period of time. The results indicated that enrichment with omega-3/6 is a realistic option, but the enrichment is more appropriate in some meals, depending on other ingredients in the recipe.

### **Product development, sensory evaluation and consumer tests in Finland**

From the bioactive, enriching components studied in the project (protein, oil, seaweed) the Finnish producer became most interested in product development with seaweed. The company is using mainly salmon as their raw material, and protein and omega-3 addition to salmon does not give any additional value. Further, concept test conducted indicated that Finnish consumers show interest in seaweed combined with salmon products.

The seaweed powder is expected to reduce the amount of salt needed in the products, to act as enhancer of the perceived flavour, and to have antioxidative effect and thus increasing the shelf life of the product. Salmon products are especially sensitive to rancidity due to its high fat content. Thus, the expected antioxidative effect of seaweed would have a positive impact on the stability of the salmon products. The interest of the seafood producer in the project was mainly to use existing products for enrichment. The two products chosen have a common recipe but differ from each other regarding the process of preparation. One is produced by deep-frying but the other is produced by more mild and gentle procedure frying on a teflon band.

### **Methods**

A study was performed covering adjusting the commercial recipes of the producer for two seafood dishes enriched with a bioactive compound (seaweed), creating the sensory profiles to these products, and measuring consumer liking on the products with and without given information on the added bioactive

The central location test was about Finnish consumers' evaluations on salmon products. The study results revealed that in blind evaluation the commercial products were deemed best. However, consumers do not operate blind-folded in the market place but they expose to different kind of information on the products such as product information or marketing messages. So, information on the actual product features was presented. The results showed that product information had significant positive effect on consumers' evaluations and opinions on the product. Based on the results, it seems that Finnish consumers appreciate salmon products with reduced salt. This is natural as salt reduction has been in past widely debated issue in Finland. Moreover, inclusion of seaweed into products to reduce salt content seems to interest consumers.

The results of the sensory profiling evaluated by the trained panel and of CLT evaluated by consumers showed that for consumer liking of fish balls and fish cakes the taste attributes – saltiness, spiciness and flavour intensity were most dominant and texture attributes less relevant, except juiciness for fish balls. The commercial reference samples showed to be most liked when no information of the products was given. However, the given information significantly increased the liking of all products, especially of the fish balls but also that of the fish cakes. Seaweed seemed to cause a different flavour deviating from the reference and low-salt product modifications giving a novel note to the products. In the seaweed fish cake also soft and juicy texture was appreciated when information about the product was given.

**Main results**

The consumer study results revealed that in blind evaluation the commercial products were deemed best. This result can be considered logical as the commercial product has gone through a long product development process and it has also succeeded in the market for a long time. In other words, it is a product which consumers like. On the other hand, the worse performance of the experimental products in blind evaluation can be explained by the fact that the taste of the product might be something what consumers are not familiar with. Especially, consumers might have considered the decreased salt content in the products as odd which has been reflected in the evaluations.

However, consumers do not operate blind-folded in the market place but they expose to different kind of information on the products such as product information or marketing messages. For that reason, it was considered as important to provide consumers some information on the evaluated products as such results would probably more reflect the reality in the market place which consumer face and also provide evidence whether Finnish consumers appreciate reduced salt content and/or seaweed in salmon products. So, information on the actual product features was presented. The results showed that product information had significant effect on consumers' evaluations and opinions on the product. In all experimental products consumers' evaluation of taste pleasantness and willingness to buy was increased significantly and in almost all the willingness to try the product was enhanced. Consumers also evaluated the suitable price of experimental products significantly higher once they received information on the product. It is also noteworthy that the information elevated the evaluations over or close to the commercial product. For instance, in case of the taste pleasantness (which is one of the main factors affecting consumers' food choice) a salmon product with 50% reduced salt combined with information received even higher scores than the commercial product (with or without information). On the other hand, the willingness to try seaweed salmon product was highest once the products were evaluated with information.

To conclude, the results are promising from experimental product perspective. Based on the results, it seems that Finnish consumers appreciate salmon products with reduced salt. This is natural as salt reduction and its effect on heart diseases has been in past widely debated issue in Finland. Moreover, inclusion of seaweed into products to reduce salt content seems to interest consumers. The study results indicate also that consumers are willing to pay for such products. However, such products still require further product development as in general those performed worst among the six studied products.

**Intervention Study - Physiological effect of consuming enriched seafood dishes****Introduction**

Oily seafood is the main source of LC n-3 PUFA. The Nordic Nutrition Recommendations recommend that n-3 fatty acids should at least contribute 1% of total energy intake (E%) for adults and children from 2 years of age (NNR. 2012). That corresponds to 2,2g of n-3 fatty acids in 2000kcal consumption. Despite recommendations and awareness of the benefits from fish consumption, food habits have changed over the years and less people meet the recommendations of fish consumption; two fish meals per week with a focus on oily fish (NNR. 2004). This is possibly the leading reason for such a low intake of LC n-3 PUFA (Kris-Etherton, Harris, Appel and Committee 2003). This is also the case in

Iceland. About half of the population reached the goal on fish consumption (300 g per week) in the 2011 national survey and is that similar to the findings of the national survey from 2002 (Hólmfríður Þorgeirsdóttir and others. 2011; Laufey Steingrimsdóttir, Hólmfríður Þorgeirsdóttir og Anna Sigríður Ólafsdóttir 2002). According to these studies older people usually consume more fish than younger people. According to the last dietary survey, only 13% of the fish consumption comes from oily fish, which has a considerably amount of LC n-3 PUFA in contrast to lean fish (Hólmfríður Þorgeirsdóttir and others, 2011). The Icelandic population gets LC n-3 PUFA mostly from cod liver oil (51%) and from fish and fish products (34%).

Considering the low consumption of fish and seafood in large parts of the population, attempts have been made to fortify food with LC n-3 PUFA. It has been shown that enriched foods with LC n-3 PUFA result in higher plasma phospholipid DHA and EPA content (Dalton et al. 2009; Metcalf, James, Mantzioris, and Cleland, 2003; McCowen and others. 2010; Wallace and others, 2000). The problem is that it can be problematic to fortify foods with cod fish oil, because it has a strong odour and taste that can be hard to hide. Therefore it is a challenge to find the right amount of LC n-3 PUFA for fortification in order to get both the health benefits as well as still a satisfactory flavour.

As an alternative, fish liver oil in powder form has been suggested for fortification of foods. In this context it is important to consider bioavailability of LC n-3 FA in this new form, because bioavailability of LC n-3 FA has been reported to depend on their chemical form (Neubronner and others, 2010). Few studies that have been conducted in this area have though indicated mostly comparable bioavailability of microencapsulated fish oil compared to fish oil gelatine capsules (Wallace and others. 2000; Higgins and others, 1999). However, according to our best knowledge there have not been any human studies comparing bioavailability of LC n-3 FA in powder form (microencapsulated fish oil) in comparison to meals enriched with omega-3. The bioavailability of LC n-3 FA in microencapsulated form in general also has to be studied further (Schuchardt and Hahn 2013).

Given these considerations, the bioavailability of LC n-3 FA; 1) consumed in the form of prepared meals enriched with LC n-3 FA (a blend of cod liver oil and olive oil) and 2) consumed as LC n-3 FA powder dissolved in water. This was done in a four week intervention with 99 participants. Inclusion criteria for participation was to be 50 years and older and regular consumption of fish or fish meals. The amount of LC n-3 FA that participants consumed where in accordance with daily nutritional recommendations and did not exceed that limit.

### **Methods**

All participants (N = 99), all living in the capital area of Iceland, were recruited via advertisements on the internet, email lists at the University of Iceland and through advertisements published in regional health care facilities. Inclusion criteria were age 50 years or over and regular consumption of fish or fish meals. The study was approved by the National Bioethics Committee (VSNb201302008/03.07) and was notified by the Data Protection Authority (S6241/2013). All persons gave their informed consent prior to their inclusion in the study.

Subjects were given six ready-to-eat meals and six powder sachets each week, which contained different amounts of EPA and DHA dependent on group. The meals were four different fish dishes with sauce, fish cakes, and vegetables cakes. The meals were produced by the Icelandic Seafood producer all the dishes were frozen and kept frozen until cooking or heating. The omega-3 powder was a blend of cod liver oil and olive oil provided by BioActive Foods, Norway and protein powder with vanilla flavor was used as placebo powder

The subjects were randomized into three groups. Group 1 (n = 38) was provided daily with 1.75 g EPA and DHA in the form of ready-to-eat meals enriched with omega-3 oil, group 2 (n = 30) was provided with 1.75 g EPA and DHA in the form of microencapsulated omega-3 oil powder and group 3 (n = 31) was a control group. The meals and powder sachets were handed out weekly to the participants. Subjects had to exclude all other LC n-3 FA than those provided from their diet for at least two weeks prior to and during the intervention.

Blood samples from fingertip were collected at baseline and endpoint using a test kit and then sent to an accredited research laboratory in Norway for analysis on fatty acids. Also the ratio between n-6 and n-3 fatty acids was evaluated based on the methods published by Saga and others. (2012). The anonymous tests were gathered and processed by the accredited laboratory. The omega-3 index was calculated from whole blood using following formula  $EPA + DPA + DHA (\%) \times 0.95 + 0.35$  which was presented by Harris and Von Schacky (2004).

Before the start of the study each subject answered an extensive questionnaire. Each participant was asked questions about socioeconomic status health related behavior, health status (food allergy or intolerance), about physical activity and questions about general purchases and consumption of fish and fish meals. Participants also answered another extensive questionnaire during the intervention, about liking of the products during consumption, how much they consumed and their experience of cooking the meal etc.

### **Main results**

The results show that after four weeks of regular consumption, the amount of EPA in blood approximately doubled in both groups who received n-3 fatty acids but did not change in the control group. The changes in DHA were less pronounced, however, in the same direction as changes in EPA. The n-3 index as well as the n-3/n-6 ratio improved dramatically in the two n-3 groups but neither did change in the control group.

The study also shows that the bioavailability of n-3 fatty acids in encapsulated powder form is very similar to bioavailability of n-3 fatty acids from ready-to-eat meals enriched with liquid omega-3 oil. Therefore it can be assumed that both ways may contribute equally to positive health effects attributed to n-3 fatty acid.

It is a strength of the present study that it is doubly blinded and randomized and there is a control group of participants that did not get LC n-3 FA over the intervention period. However the study period was only for four weeks so the increments in blood values presumably had been higher if the study had been for a longer period, despite that the

blood values of omega-3 increased significantly. The data of consumption is self-reported so it is not entirely known how much of the courses and powder was ingested. The omega-3 measurements were done from whole blood but not from RBC membrane which is preferable when measuring long term omega-3 status and cardio protective abilities but with a simple equation the measurements are comparable to the omega-3 index (Harris and Von Schacky 2004).

The results show that after four weeks of regular consumption of n-3 powder or meals enriched with omega-3 oil EPA, DHA, n-3/n-6 ratio and omega-3 index change in agreement with the intake of n-3 fatty acids. The study also shows that the bioavailability of n-3 fatty acids in encapsulated powder form is very similar to bioavailability of n-3 fatty acids from meals enriched with liquid omega-3 oil and therefore it can be assumed that both ways may contribute equally to positive health effects attributed to n-3 fatty acids.

No significant difference was between women and men. According to the questionnaires more than 97% of the meals were eaten during the intervention. It seems that the n-3 fatty acid powder and the enriched meals were well tolerated and not disliked.

# Marketing Strategy

## Introduction

Understanding and adopting market oriented approach to business can be considered as important for companies. As Narver and Slater (1990) state, market orientation is the key philosophy that should drive company's marketing management and strategy. The concept is defined: "Market orientation is the organization wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organization wide responsiveness to it." (Kohli and Jaworski, 1990, p. 6). In a nutshell, market orientation means establishing business based on the target market and customer needs and embedding this philosophy throughout the organization to generate superior value to customers (cf. Blankson and Cheng, 2005). In the end, creation of value for – and with – the customers is of crucial importance for the success of a company operating in business-to-consumer (B2C) market (Ravald and Grönroos, 1996; Slater, 1997; Lusch and Vargo, 2006).

In 2012, small and medium sized enterprises (SMEs) represented over 99 per cent of the non-financial organizations in EU, provided over 67 per cent of work places and accounted for 58 per cent of gross value added thus forming the backbone of EU economy (Wymenga and others., 2012). However, market oriented approach to business is not very common among SMEs (Stokes and Blackburn, 1999; Blankson and Stokes, 2002). The owners (and quite often at the same time the managers) of the SMEs might not either understand or care about marketing and related operations - such as being aware of market environment or market research (Blankson and Stokes, 2002) - but mainly focus on daily routines in management and planning, mostly of which are based on intuition and energy of the owner-manager. This might be due to the lack of resources (time, money, personnel), competence or owner-manager's decision (cf. Keskin, 2008). Anyway, exceeding these barriers to market orientation and willingness to learn and become more market oriented have proven to be beneficial for SMEs; studies have shown that market and learning orientation have significant effects on SMEs' business performance related to new product development, number of new product launches and developing new products to enter new market segments, just to mention few (e.g. Chaston and others., 2001). Moreover, there is evidence that the more holistically SMEs consider market orientation the better they perform compared to their less market oriented competitors (Lindman and others., 2012).

The aim of Task 2.5 – Marketing strategy was to collect market (e.g. competitors, consumers) and companies' internal information and combine those into a holistic marketing strategy. This work was deemed to benefit the participating fish producers Grimur kokkur ehf and Hätälä Oy in their marketing communication and planning related to both enriched and traditional convenience seafood products.

# Marketing strategy

## – conceptual underpinnings

### ***Definition of marketing strategy***

Marketing strategy is defined as “an organization’s integrated pattern of decisions that specify its crucial choices concerning products, markets, marketing activities and marketing resources in the creation, communication and/or delivery of products that offer value to customers in exchanges with the organization and thereby enables the organization to achieve specific objectives” (Varadarajan, 2010).

If the definition of marketing strategy is scrutinized, six main components can be identified. Those are: 1) company objective, 2) customers, 3) competitors, 4) products, 5) marketing activities/communication (later promotion) and 6) resources (see, figure 1). As Varadarajan (2010) states, the company needs to consider all components holistically so that each action related to any of the individual component are integrated to other components in order to reach the company objective.



**Figure 1. Components of marketing strategy**

Marketing strategy encompasses the decisions and activities that enable an organization to concentrate its limited resources on the greatest opportunities to maintain or improve its performance and to achieve and sustain a competitive advantage (Varadarajan and Jayachandran, 1999). It also aims to understand and fulfil better the basic needs, wants and motivations of customers/consumers (typically considered the most critical), stakeholders, business partners, and society, as well as the organization itself (Ferrell and Hartline, 2011).

Strategic marketing decisions are also different than day-to-day operative activities. Varadarajan (2010, p. 123) characterises strategic decisions as following:

- 1) They entail resource commitments that are either irreversible or relatively difficult to reverse;
- 2) They entail resource commitments that are relatively large in magnitude;
- 3) They entail resource commitments that are made with a relatively long term outlook;
- 4) They entail resource commitments that are spread over a relatively longer time period;
- 5) They entail resource commitments that are made with a relatively greater emphasis on the achievement of a competitive cost and/or differentiation advantage;
- 6) Those are made in the context of other strategic decisions, in light of inter-dependencies between them and
- 7) Those are made at higher levels in an organization (e.g. top management or CEO).

While considering marketing strategy (in comparison to managing the company based on intuition or daily-based routines), everything begins with the specific objective which the company aims to fulfil through the strategy. The objective can be, for example, new position in the market, differentiation from competitors, or penetration to some new market segment or even to completely new market. Once the objective is set, all the further strategic considerations should be considered in the light of the objective. For instance, if the objective is to penetrate to some new market, the company should study what type of customers and competitors there are, whether to offer high-end or bulk products or whether the company possess sufficient resources to reach the objective. Or, if the company's objective is to posit itself differently they need to figure out whether there is sufficient customer-base that reflects the new position, how to approach them and would position change generate new competitors or how easily old competitors could respond to company's new strategy. In a nutshell, all strategic operations related to any marketing strategy components needs to be in line with the company objective and changes in objective should be reflected in all individual components of marketing strategy.

### **Market – customers and competitors**

The principle of market orientation is to adapt the conditions in markets to company's behaviour (e.g. Narver and Slater, 1990; Blankson and Cheng, 2005). This means that the company needs to understand the actors in market, that is, customers and competitors. Their needs, wants and behaviour should also be reflected in company's marketing strategy.

Based on the current service dominant logic of marketing, customers are the one to decide whether, and what kind of, value some product or service offer to them (e.g. Woodruff, 1997; Lusch and Vargo, 2006). So, to compete in the market and to offer superior value means that understanding of customers is of special importance to the company (Ravald and Greenrooms, 1996; Slater, 1997; Lusch and Vargo, 2006).

Customers (or consumers) in B2C market evaluate the product based on what value they associate with it. According to the theory of perceived value, different attributes the individual evaluates could be grouped under four different aspects. Two of these are utilitarian in nature, namely 1) cost/sacrifice and 2) functional/instrumental value while two are hedonic ones, namely 3) experiential/hedonic and 4) symbolic/expressive values (e.g. Sheth and others., 1991; Babin and others., 1994; Jones and others., 2006; Smith and Colgate, 2007).

To find out what type of value consumers perceive in products and to figure out what type of consumer segments there exist and what they value in products, a customer analysis can be performed. Customer analysis concept is about questions such as why customers buy and what value they seek, when and where they buy and who is involved in the purchase decision. Central to a customer analysis is the concept of market segmentation. This is the process of dividing a market into smaller groups of customers with similar needs and wants or responsiveness to market offerings which are, or may become, significant for planning a separate target marketing strategy.

Analysing and understanding different customer segments provides company several benefits. First of all, company can focus its marketing operations on such segments which company is able to serve reasonably and which appreciate its offering (e.g. it might not be wise for SME to consider too large segment as SME might not have sufficient resources to deal with it). Secondly, company can tailor its value proposition (product, promotion) to fit with the segment expectations. Thirdly, company can identify such segments which are not yet fiercely competed and posit itself according to it.

The other important actors in the market are competitors. For instance, there might be no reason for SME to serve such markets in which competition is fierce (or at least the value proposition should be different than the competing ones). So, understanding what kind of competition is expected in the markets and in which customer segments is of importance. To figure this out, company can perform competitor analysis.

Competitor analysis is a strategic technique used to evaluate outside competitors. A primary objective is to understand and predict the competition behaviour between firms in their mission for a competitive position in an industry (Chen, 1996). Competitor identification, a necessary first step for competitor analysis and strategy, is based on scanning organisation's competitive field and identify weaknesses and strengths that a company's competitors may have (Chen, 1996, Clark and Montgomery, 1999; Bergen and Peteraf, 2002). As a result, competitor analysis should support the analysis of pricing policies, product design, development and positioning, communications strategy, and channels of distribution. For example, if there are similarities among resources and technology for production then companies may be considered competitors based on the supply-side substitutability. Instead, if two companies produce goods addressing similar needs of the consumers then they may be considered competitors based on

demand-side substitutability. Another step in this analysis is to evaluate and use that information to improve efforts within the company (Bergen and Peteraf, 2002).

### **Company – resources, products and promotion**

Once the company has analysed the market environment, it can focus on analysing its internal characteristics such as products, resources and promotion activities and how those reflect company objective and market realms. In terms of internal analysis, company should pay attention to its resources (both tangible and intangible) and products, that is, what and how they are going to offer to the market. Tailoring company's internal characteristics to fit the external environment is crucial from marketing strategy perspective. For example, to successfully enter into the market, it is worthwhile to understand the needs and wants of potential customers (and type, i.e. B2C or B2B) in the target market, make evaluation of the price of the products and find balance between customers' expectations and company's offering, how the product/service offering should be communicated to market and what type of competitors the company is competing with and how those are positioned in the market.

Resources refer to company's ability to produce the products and promote those to the chosen market. Resources can be divided into 1) tangible and 2) intangible resources. Tangible resources consist of machinery and facilities the company possess while the intangible resources mean the intellectual resources such as skills and competences of the personnel. Analysing company's resources in the light of the company objective, customer and competitor analysis could be fruitful. If the market analysis reveals some unsatisfied market segment with some unique product preferences (which is in line with company's objective), then the company could analyse whether its tangible resources are suitable to serve the segment and/or whether there is a need to change something, the cost of change, and finally calculations on the profitability to enter/reject the market. The same applies to intangible resources. Based on the resource analysis, the company could consider whether the current intellectual resources are suitable or whether there is a need for some additional resources, where to find such resources and whether the expenses of such resources would be obstacle for entering the market.

The company's offering to the market is in a key role while proposing value to the customers. Thus, this offering should reflect the market needs. In terms of products, the value of market oriented and strategic approach to target market is that it reduces the trial and error activities and assists company to increase the odds of delivering products which the chosen market value. Especially in the case of SMEs, this could be considered critical when company is operating with limited resources. As discussed earlier, consumers evaluate the products based on what value they expect to be included in them. So, when a chosen market segment expects the product, for example, to deliver functional value (e.g. food is filling), then the strategically wise activity for a company is to produce such products without putting emphasis on product features which emphasise some other perceived value dimension.

Also promotion should reflect company's objective and it should be tailored with the market needs. Integrated marketing communications (IMC) is a concept of "marketing communications planning that recognizes the added value of a comprehensive plan that evaluates the strategic roles of a variety of communications disciplines (for example, general advertising, direct response, sales promotion, and public relations) and combines

these disciplines to provide clarity, consistency, and maximum communications impact" (Schultz, 1993). The primary goal of IMC is to affect the perception of value and behaviour through directed communication. Mohr and Nevin (1990) describe the term communication strategy as a particular combination of the facets (frequency, direction, modality, and content) of communication. When a communication strategy matches the channel conditions (structure, climate, and power), the channel outcomes (coordination, satisfaction, commitment, and performance) will be enhanced in comparison with the outcomes when a communication strategy mismatches channel conditions.

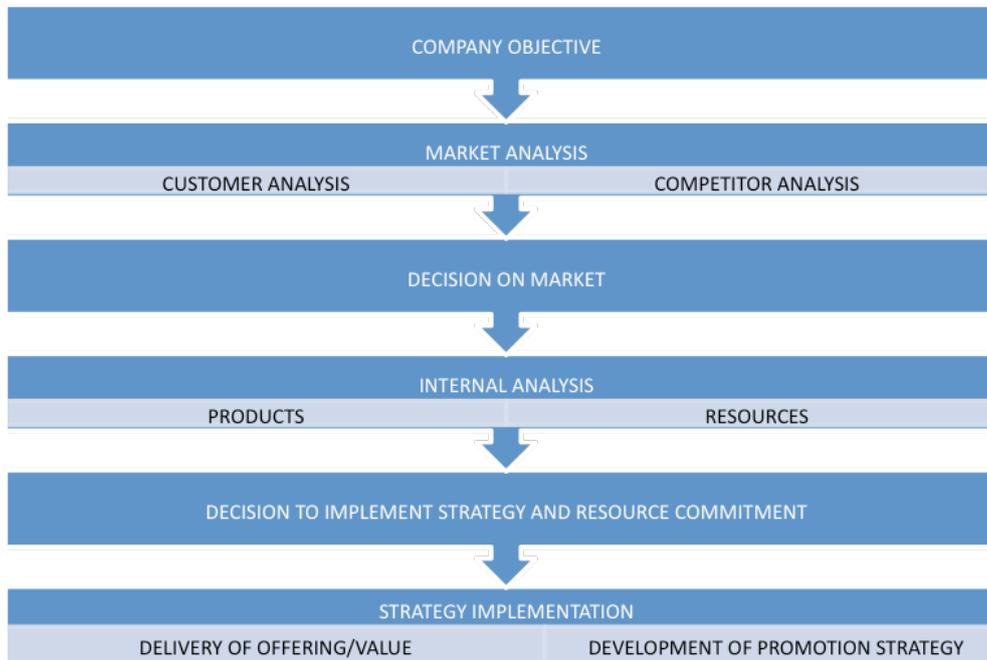
Kitchen and Schultz (2000) have identified four stages of IMC: Tactical coordination of promotional elements, redefining the scope of marketing communications, application of information technology, as well as financial and strategic integration. In other words, marketing communication should reflect the earlier strategic decisions, that is, market needs, differentiation of competitors and product features.

### **Strategy development**

Traditionally, the research on marketing strategy formulation has emphasized assessment of firms' strengths, weaknesses, and external opportunities and threats (Menon and others., 1999). Marketing strategies only result in superior returns for an organization when they are implemented successfully (Bonoma, 1984). On the other hand, marketing strategy implementation can be defined as the communication, interpretation, adoption, and enactment of a marketing strategy or strategic market initiative (Noble and Mokwa, 1999).

The process of marketing strategy development is illustrated in figure 2 below. The first step of the process is to set objective for the company. This is followed by market analysis (customer and competitor analysis). Based on the market analysis, the company should make decision on market based on customer needs and competitive situation (customer segment and its characteristics, position in market in comparison to competitors). This decision should also be in line with the company's objective or the objective should be modified. The process continues with internal analysis, that is, analyzing company's resources and products in a light of market needs. This stage of process should reveal whether company's resources are sufficient and how products should be developed to respond the market needs.

Based on the market and internal analysis, the company should decide whether the strategy is reasonable and whether it has sufficient resources to implement it. The decision to implement the strategy should also involve the commitment of the resources. After the decision, the final step of the process is strategy implementation. During the implementation, the company needs to decide how the offering/value is delivered to target market (i.e. decisions on logistics within the value chain, supply chain, price of offering) and also the development of promotion strategy (i.e. how the target market is reached).



**Figure 2. The process of marketing strategy development**

# Cases: Grimur kokkur ehf and Hätälä Oy

Two marketing strategy cases were performed during the project. The content and depth of the work varied based on the participating food producers needs and wants. In case of Grimur kokkur ehf, the content of the work was broad including both company's internal analysis and external market analyses. In case of Hätälä Oy, the scope of marketing strategy work was directed to understanding consumers. The more deep analysis on consumers was deemed the most useful approach as this was identified as the main lack in company's knowledge.

## **Grimur kokkur ehf**

The company Grimur kokkur ehf is an innovative Icelandic SME which operates mainly in B2C convenience seafood markets. Based on the discussion with the company, the aim of the work was to enhance GK's marketing understanding. In order to fulfil the task, the following analyses were performed:

- 1) Identification of company objective;
- 2) SWOT-analysis to analyse GK's internal strengths, weaknesses, opportunities and threats;
- 3) competitor analysis to identify the main competitors and their offerings;
- 4) customer analysis to identify different consumer segments of interest for Grimur kokkur and
- 5) analysis on distribution channels.

The next step in the project was to tailor the results of the different analyses. Based on this work a strategy was developed for Grimur kokkur ehf to reach their objective. As a result, it was suggested following:

- 1) CUSTOMERS – Focus on specific consumer segment, not in many segments. It is anticipated that there is some segment which appreciate more Grimur kokkur's offering and are willing to pay for those.
- 2) PRODUCTS – Consider the type of products offered based on the segment needs. This is what the target segment most probably is looking for and is willing to pay for.
- 3) PROMOTION – Make selection on the way you promote the product. Take care that the promotion and value proposition is in line with the position in the market. Be always coherent in all promotion to avoid confusion among consumers.
- 4) COMPETITORS – Make sure that the value proposition is different than the competing ones. For SME's it might not be wise to engage in fight for market. It is easier and less expensive to serve niche market.

- 5) RESOURCES – Consider the intangible resources. Do you have what it takes to reach the objective or do you need something more? If you do, consider, what is the most feasible manner to reach the resources. In terms of tangible resources, focusing first on smaller segment could be reasonable for SMEs to ensure that the capacity is feasible to serve both existing and new market. Uncontrolled growth might become expensive.

### **Hätälä Oy**

As mentioned, the main interest for Hätälä Oy was in relation to consumer understanding. Thus, the work within marketing strategy task was directed to gain deep knowledge on Finnish consumers' fish consumption related behaviour. More specifically, the aim was to study consumers' practices of buying, preparing and eating fish and fish products in the home environment. This kind of information was deemed very important and useful for Hätälä Oy further marketing activities.

The topics covered in the study were following:

1. Intensity of fish consumption with the focus of buying, preparing and eating fish and fish products at home;
2. Preferences and expectations for the grocery shop as an environment for buying fish;
3. Evaluation of the quality of fish and processed fish products at the grocery shop
4. Perceptions of fish as a raw material and as a meal.

### **Methods**

The research began with an internet panel –discussion. The purpose of this pre-study was to assist in developing the questionnaire used in main study. The tool applied was VTT's own internet panel platform Owela. Altogether 60 active consumers participated the discussions.

Development of the questionnaire: The questionnaire was developed based on the pre-study data, consultation with Hätälä Oy and previous research on fish consumption. The questionnaire were further tested with 15 consumers. The feedback received from tests were analysed in detail and utilised to adjust the questionnaire items.

Data collection: The main data was collected via internet panel of independent market research company. The method was chosen because of its strengths – the possibility to gain data from a large number of consumers and the reach of a wide array of consumers of different ages and backgrounds in a cost effective and timely way.

The questionnaire was available to the internet panel members between 13.9. – 24.9.2013 with two reminder letters sent in 17th and 20th of September. The cover letter to the informants stated that the study was about consumers' opinions and experiences of buying, preparing and/or eating fish.

2600 invitations were sent. The distribution was 1300 male and 1300 female informants. In the end, 641 responses were received.

### **Main results and conclusions**

#### ***Buying, preparing and eating fish and fish products at home***

A general notion was that buying, preparing and eating fish correlates positively with age. The only exception being here that older persons did not differ from the younger when the question concerned buying (processed) fish products. Another and logical notion was that household usable net income correlated with fish consumption.

Difference between eating fish as a main dish or a side dish: 16% of respondents reported eating fish as a main course in the home-environment on average twice a week or more frequently. Fish was eaten much less as a side dish. The equivalent share here was 8%. It could be of interest to consider the opportunities to develop fish products eaten as a side dish. Besides the potential to increase the eating of fish and fish products, this could be a way to introduce the taste of fish to those who rarely use fish. A specific target group to consider for these types of products could be children and young adults.

Age and preparing and serving fish: An important difference between informants of age 50 years and above and 18-49 years were found. Older consumers were more eager to prepare and serve fish. The difference merits attention in future research. It does not look like it could be explained through a change in the persons learning to prepare fish. Is it possible that between the age groups of 40-49 years and 50-59 years the respondents life circumstances change, do their ability to use time for cooking increases? Or is it a question of differing generations?

Difference between buying fresh fish and fish products: Frequencies in buying fish products were much lower than was the case in buying fresh fish. This may be explained by fresh fish being consumed quickly after being bought, but it may also signal the possibilities for product development. Of interest is that significant differences between types of households were found. Results suggest that one adult household buy much less fresh fish than the other types of household. Fish being quick to prepare it could have potential to be a more frequently bought food item also in one adult household.

#### ***Quality evaluations of fresh fish and processed fish products***

The majority of informants considered that making quality evaluations themselves at the shop is quite or very important (92% for evaluating fresh fish and 84% for evaluating fish products). The information that consumers considered as important was the freshness of the fish. Use-by-date was the first in importance for both categories. It was followed by the capture date and the appearance of the fresh fish and appearance and type of fish for the fish products. Further, of particular interest is that quality certificate, producer and brand were amongst those which gained lowest mean values in both categories. They were not unimportant, but their importance was low.

#### ***Buying fish and fish products either at the service counter or self-service shelf***

The results suggest that non-buying and unwillingness or neutral attitudes towards buying fish products at the service counter seem important in some groups – amongst men (62%) and in the lowest income group (<20',67%). The results show that respondents like buying fresh fish packed at the self-service shelf. 53% of all respondents answering to this question reported that they 'very willingly' buy fresh fish packed at the service counter. The option of buying fresh fish ready-packed fish from the self-service shelf was much less liked (equivalent share was 17%).

Along the results, processed fish products are bought more frequently at the self-service than service counter. The share of persons, who have not bought processed fish products packed at the service counter was important (28% of all respondents) while equivalent share for self-service was significantly less (17%). Yet, the distribution of answers suggests that people like buying at the service counter somewhat more.

#### ***Boneless fresh salmon fillet in food preparation***

The respondents considered boneless fresh salmon fillet generally as a likable, good and pleasant raw material, which is effortless, quick and easy to prepare. To somewhat lesser extent it was characterized as interesting, relaxing, fun and refreshing. Furthermore, it was considered as a somewhat expensive the mean value of answers being 3,3 on a scale 1 (expensive) - 7 (inexpensive).

When the irregular and regular users' opinions were studied, the clearest and statistically significant differences were in the aspects that reflect effort. In the hedonic or cognitive aspects the two groups differed much less and at statistically almost significant level or non-significant level.

The results differed to some extent along age groups. Of interest is that there seems to be an almost linear positive relation between the respondents' age and the perception of effortlessness. Also, of interest is that all age groups considered fresh salmon fillet as expensive rather than inexpensive. The youngest considered fish more expensive than others.

#### ***Perceptions of fish as food***

Consumers answered generally that they 'like' fish as food, consider it generally as 'good' and 'delicious'. The results show that respondents had a relatively positive attitude towards fish in general. Fish was also considered frequently as pleasant and interesting.

It would be of interest to know more of why the items 'troublesome-effortless' and 'demanding-easy' gained mean values that were only little above the neutral value. This result signals that fish is only vaguely if not at all described as easy and effortless food. Furthermore, the results suggest that fish is considered frequently as somewhat expensive food.

The results of this study suggest that opinions of those who eat fish regularly differ strongly of the opinions of those who consume fish irregularly. Understandably, those who regularly eat fish gave fish significantly higher values for all variables.

Statistically significant differences between age groups were found in all but one studied variables. The only variable, with no statistically significant differences was 'boring-refreshing'. The two older age groups showed in most items clearly more positive answers than the other age groups.

#### ***Obstacles and hindrances for eating fish***

Five potential obstacles for eating fish were studied: (1) price, (2) availability, (3) difficulty to prepare, (4) someone in the household disliking fish and (5) health reasons.

'Price' was the most frequently stated and important factor diminishing fish consumption. The second most important obstacle was 'weak availability or assortment of fish'.

The result seems to show that the 'difficulty of preparation' is an obstacle only to a minority of persons. However, for the respondents in 1 adult household perceived 'fish being difficult to prepare' as affecting the amount of fish consumed more often than others. For the participants in this enquiry, 'disliking fish' was not often affecting the eating of fish. Of interest is, however, that it was in households with children more important than for others. 'Someone disliking fish' was considered fairly often a factor of importance. Finally, there was a small minority of respondents who report 'health related obstacles' to eating fish (4% agreed some and 2% agreed completely). We may, however, assume that many of those who have strong allergies or other problems inhibiting fish consumption, were likely not to have participated into the inquiry.

***Availability and assortment of fish and the choice of a grocery shop***

The last question discussed the meaning of availability and assortment of fish to the grocery shop choice. Only 23% of all respondents considered that it was of very small or quite small importance. The majority (44%) of respondents considered it to be of quite big or very big importance. The result correlated with the age of respondents. Of those who bought fish about 1 day a week (n=196) 67% said that it was of quite big or big importance. For the more frequent buyers the share was 89%.

# Experience of the project and how it will affect the participation in the future work

The project period was only two years and the project consortium consisted of ingredients producers and seafood producers with the relationship of supplier-buyer status. The ingredients companies were developing and producing ingredients to use in ready seafood meals. At the start of the project the ingredients were not fully developed for starting the technical development of enriching seafood dishes. Only a few tons of flavoured omega powder was produced during the first period. The unique novel omega-3 powder (1 Life-Active) is now on the market with the ability to both regulate and maintain the omega-6/omega-3 fatty acid balance in the body while simultaneously safeguarding the daily need for omega-3 from fish and protective biological antioxidants from olives (flavonoids). The powder had to be produced without flavour to be able to use in the seafood. To speed up the development process the seafood company Grimur kokkur used the oil mixture which is the basis for the powder for his product development with very successful outcome.

In Iceland various experiments in developing seafood dishes with addition of omega-3 were conducted and resulted in six different prototypes (four types of fish dishes with sauce, fish cakes and vegetables cakes) with and without the omega-3/6 oil from BioActive Foods developed in cooperation between Grimur Kokkur and Matis. These dishes were tested by 100 consumers for four weeks at their homes. The company is using the results from the consumer testing and the marketing strategy from the project to prepare and plan the final marketing. The plan now is a new healthy product line with various products in the Icelandic market within 6-months to one year from now. The company is now in their first real steps to exporting their products. They have capacity in their new production facilities to produce more than for the inland market. The seaweed powder was also under development most of the project period. However Marinox was able to supply the seafood producers with the enough ingredients for trials during the last phase of the project. The production is now stabilising and the plan is to produce 26 tons next year. For both the ingredients companies this project was extremely important to open up the technical possibilities to use their ingredients in food but not only as food supplement.

The Finnish company is now in collaboration with VTT actively working with the product development with enriched seafood dishes with seaweed using sensory evaluation and consumer tests. The Finnish seafood producer has expressed a high interest in the seaweed powder after making various prototypes. However his prototypes are further from the market than the products of the Icelandic producer.

The added value of the cooperation between Iceland, Norway and Finland in seafood product development where the Icelandic and Finnish seafood processor companies will use ingredients from Iceland and Norway is substantial, and will open up many possibilities for all the companies. There is a tremendous potential for the Nordic countries for better utilization of marine raw materials and conversion of these materials to high value ingredients in a production of high value enriched seafood dishes. In Finland functional foods have been on the market for a longer period, and more knowledge about the relation and communication with the consumers in the marketing area exist. More variety of consumer seafood with health effect will be beneficial for the Nordic consumers. This Nordic collaboration have now led to European possibilities both regarding further funding for research, innovation and marketing.

Consumers can choose from a variety of food supplements for their diet. The food supplement market of vitamins, minerals and proteins has been steadily growing as functional foods. The option for consumers to choose enriched food instead of food supplements will be of benefit and appeal certain consumer groups. The products developed within the project will be appreciated by consumers seeking salt-reduced products and products that deliver potential health improving properties as well as a high protein diet like athletes. Protein added ready-meals might also be important contribution to the diet of the elderly people and some patient groups. The ingredient companies will use the results as opportunities for their further marketing and sales within food enrichments. They will use the outcomes of the stability and bioactivity tests to inform buyers, advertise, and control their production and to improve their products. The seafood processors will have increased market share and further possibilities for marketing and sale inland and abroad. All the companies will use the consumer knowledge and experience gained in the project for further consumer-driven innovation and development and marketing of their products. For the interest at conference and workshops there was shown during the project period an increasing interest in the possibility for giving consumers more choice in healthy food than of supplementary pills both by industries and consumers. There is great interest for diet for elderly people in Europe in the near future and the concept of this project is highly interesting for further work in that area.

The R&D companies have added to their knowledge in consumer driven product development, insight into consumer attitudes and marketing strategies of enriched seafood.

The results of the Nordic project led to increasing interest of the small companies and the R&D to continue the research already started and funded by Nordic Innovation. Some of the partners collaborated in preparing and submitting a proposal to the programme Research on the Benefits of the SME under the EU FP7. The proposal was granted in 2013 and the new project will be funded for two years and started January 1st. 2014. The new consortium involves the partners of this project the RTD Matis (leading the new project) and VTT, the ingredients companies Marinox and BioActive Foods and the seafood processor Grimur kokkur. The project idea has now attracted other food industries in trying these ingredients. In the new consortium are also a cereal and dairy producers and TNO an independent research organization in the Netherlands and University of Milan. The aim of the new project (EnRichMar) is to increase the value of convenience foods by adding functional ingredients, produced from underutilised marine based raw materials and by-products from fish

processing, with confirmed bioavailability, to them. Two new food-categories will now be added to the testing cereal and dairy products which will open up more possibilities for the ingredient companies.

The focus will be placed on ingredients such as fish oil powder of fish oil and seaweed extracts which may induce positive health effects, enhance flavour and enable salt reduction in food products, and improve the stability of the products, enhance positive health effects and stability, enhance flavour and consequently contribute to salt reduction to meet market demand. The functional properties of the enriched products will be studied via dietary intervention.

The development of convenience food enriched with bioactive compounds will have impact on various sectors of the European food industry. The SME's will gain research input and knowledge from the RTDs to strengthen their market position. New markets for bioactive marine based products, seaweed and fish oil as ingredients in functional (sea) foods, cereal and dairy products will open. The competitiveness of the SME's will increase for the growing markets of food with bioactive compounds. The verification of physiological health effect of consumption of enriched food is of high importance to the food ingredients and the food producing companies. In this project it was succeeded in showing positive health effect of consuming enriched seafood dishes and omega powder. The fatty acid profiles of the blood of a certain group of consumers using enriched seafood dishes for period of time were measured to estimate individual protection of persons against lifestyle diseases. This was done via intervention study in collaboration with the Unit for Nutrition Research, Landspítali University Hospital and Faculty of Food Science and Nutrition, University of Iceland. The results showed that after four weeks of regular consumption of n-3 powder or meals enriched with a blend of cod liver/olive oil, the EPA, DHA, n-3/n-6 ratio and omega-3 index changed in agreement with the intake of n-3 fatty acids. The study also indicated that the bioavailability of n-3 fatty acids in encapsulated powder form was very similar to bioavailability of n3- fatty acids from meals enriched with liquid cod liver/olive oil.

The consortium of the project consisting of two different research companies with expertise in product development, consumer research and marketing, two seafood processors and three companies producing various bioactive ingredients formed a well-balanced team with great possibility of successful outcome of the project.

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# Table of abstract

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| <b>Enriched Convenience Seafood Products</b>  |  |
| <b>Abstract:</b><br>The aim was to increase the value of ocean based raw materials, reach new seafood consumer groups and increase market share of the companies involved as a step forward for production of enriched seafood dishes for targeted consumer groups. Seafood dishes enriched with bioactive compounds from the ocean, such as seaweed, fish proteins and fish oil were developed to meet market demand. In the project the stability and bioactivity of ingredients for use in consumer products were studied and the effect of enrichment on stability and quality of the seafood products. Acceptance of the concepts and the prototypes in consumer studies in the Nordic market were studied. A communication and marketing strategy for the enriched seafood dishes was planned for the seafood processors. The fatty acid profiles of the blood of a certain group of consumers using enriched seafood dishes for period of time were measured to be able to use to calculate individual protection of persons against lifestyle diseases. This innovative seafood development project based on collaboration between a fish processing company, ingredient companies and food research institutes with emphasis on consumer oriented product development, consumer testing and marketing. |  |
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