



OUTLINE IMPLEMENTATION PLAN FOR THE FULL DURATION OF THE INTEGRATED PROJECT SEAFOODPLUS 2004-2008

The core research area of the SEAFOODplus programme is organised in five Research and Technology Development (RTD) areas, designated RTD Pillars, and one horizontal activity spanning all RTD pillars. Each of the RTD pillars addresses their specific discipline oriented research areas, but there is a strong interdependence, thus integrating the various components to a coherent overall project concept.

RTD Pillar 1 Seafood and human nutrition

The major causes of premature morbidity and mortality in Europe are cardiovascular disease (approx. 40%) and cancer (approx. 25%). Epidemiological studies provide convincing evidence that seafood consumption is related to improved health and reduced risk of chronic diseases. Increasing evidence supports an important role for long chain n-3 polyunsaturated fatty acids from seafood. There is increasing concern that the ratio of the n-6/n-3 fatty acids in the diet in some European populations is too high, in the region of 12:1 where a desirable level is estimated to be nearer to 6:1, and by some scientists' suggestion even lower. By consuming more seafood this imbalance could be rectified.

The research in this pillar addresses the question: 'What is essentially the importance of seafood consumption for the health of the consumer?' On the basis of mainly epidemiological research there are strong indications that regular seafood consumption could help to reduce gastrointestinal diseases, e.g. colon cancer and inflammatory bowel disease, and other diseases with an inflammatory component, e.g. diabetes type 2 and osteoporosis. Seafood consumption may play a significant role in weight management, and help in the prevention of obesity among young adults. There is good evidence that regular seafood consumption reduces cardiovascular mortality. These beneficial effects should be verified and the underlying mechanism elucidated, before health claims for functionality could be attached to seafood consumption. This has to be done particularly by intervention studies in humans. Therefore in this pillar the attention is focused on the physiological effects of seafood protein and seafood fatty acids addressed within three projects. These projects include intervention studies in humans to explore effects and elucidate their mechanisms. There are also indications for an important preventive role of seafood against postpartum depression, a disease affecting 5-20% of childbearing women. Therefore epidemiological research, in important areas as colon cancer and postpartum depression, are included in the projects. An effort will be made to distinguish between effects from seafood protein versus seafood lipids, for the best of development of good seafood products for the consumer. In a later stage of SEAFOODplus, the links to other pillars, especially to pillar 4, will be developed with the efficacy testing of seafood based functional foods.

RTD Pillar 2 Seafood and consumer behaviour and well-being

It is generally agreed that seafood is a valuable resource of human nutrition. Epidemiological studies indicate that seafood contributes to a healthy diet, and populations that eat seafood regularly have a lower risk of coronary heart diseases, hypertension and cancer. Seafood may thus play an important role in a healthy diet – and in securing consumer health and well-being in Europe. It is also a fact that the overall level of seafood consumption differs substantially, and that seafood consumption seems to be declining in several European countries. However no detailed overview is available explaining this due to lack of valid and comparable data on the European level. Thus, from a European health policy perspective, knowledge on what determines the consumption levels across Europe from a cross-cultural consumer perspective will be crucial for attempts to change or increase seafood consumption. Attempts to do so may either aim at

adapting seafood products more to consumer demands or aim at changing consumers attitudes or perceptions of seafood; the first implying tailor-made product development activities, the latter communication efforts directed at consumers. Both require a better understanding of what determines seafood consumption in Europe.

In general studies of factors determining food acceptance or choice distinguished between three types of factors: (1) properties of the food product, (2) factors related to the person engaged in food consumption, and (3) environmental factors. Most research on food and seafood choice has only concerned the effects of a single type of determinant in isolation, while it had been argued that future research should take a more comprehensive and integrated approach. In this pillar 2 four unique consumer projects supplement each other, and together they will reach new scientific insights and provide methodological innovations in relation to consumer research. At the core, a consumer survey will provide the basis for describing and predicting consumer preferences and attitudes towards seafood on an aggregate level, and this project provides results to the other three projects as well as to other pillars in SEAFOODplus. The three other projects all extend this knowledge in relation to three crucial areas on seafood product level: on eating quality of seafood, on consumer perception of new seafood products, and on consumer perception of seafood communication. All four project and their key achievements are described below.

RTD Pillar 3 Seafood safety

Although seafood is, in general, regarded as a wholesome safe and nutritious food it may, on occasion, pose consumer risks. This pillar addresses research towards identifying and reducing the risks posed by seafood and thus improving the health and well being of the seafood consumer. From reviews of the international epidemiological data it is clear that among seafoods the most clearly identified consumer risks are from human enteric viruses contaminating bivalve molluscs, pathogenic bacteria e.g. *Vibrio* species, the formation of biogenic amines (histamine poisoning) in certain fishery products and marine biotoxins. In addition to these clearly demonstrable risks other potential risks have been described including bioaccumulation through the food chain of persistent organic pollutants and heavy metals through environmental or aquaculture food contamination and residues of veterinary medicines used in aquaculture. Management of the consumer risks from seafood in the European Union is either through direct legislation requiring monitoring and control to prescribed standards for specific risks or through generic controls using Hazard Analysis Critical Control Point (HACCP) procedures. Such risk management options are usually underpinned by risk assessment however this approach is currently underdeveloped in the seafood safety area. It is however clear from the illness statistics and from continuing EU Rapid Alerts relating to seafood, that, despite the controls in place, the risks persist and seafood consumers continue to suffer illness. Partners within the SEAFOODplus consortium have extensive and long-term experience with seafood safety risks and, collectively, constitute a unique pool of expertise within Europe. Following extensive consultation among these key European Fisheries Institutes SEAFOODplus has developed an integrated package of proposals which address some of the key research needs within the seafood safety area. The projects build on existing knowledge and experience and aim to make very practical contributions towards improving consumer protection within the European Union. Projects address the key strategic areas of development of improved test methods for both viral and bacterial contaminants of seafood (projects 3.1 and 3.3). The development of HACCP procedures for better control of viral pollution risk in shellfish harvesting areas (project 3.2). A better understanding of why EU consumers still continue to experience histamine food poisoning leading to predicative models and, potentially, improved industrial processing measures (project 3.4). These projects are underpinned by a comprehensive risk assessment, which will provide risk managers, and consumers with targeted, and in context, information on risks associated with seafood (project 3.5).

Overall these projects comprise a balanced and integrated package addressing key issues that should facilitate the development of better controls for seafood production and lead to less consumer illness.

RTD Pillar 4 Seafood from source to consumer product

Consumers are concerned about the limitation of fish stocks. There is an increasing amount of byproducts from the seafood production chain due to a growing aquaculture sector in various

European countries. Although the major quantity of by-products is used for feed production, manufacturing byproducts into food with beneficial health effects represents a larger and a more challenging potential. This full utilization approach will also contribute to a positive consumer image of the fishery chain. Seafood byproducts are an important source for protein hydrolysates (bioactive peptides), n-3 lipids, nucleotides, collagen, gelatin, chitosan and mucopolysaccharides etc. with proven and potential positive health beneficial effects. However the recovery and utilization of byproducts from wild fisheries and aquaculture can be improved and the potential health benefits of new components from seafood by products need to be tested for the efficacy.

The market for convenience food is growing and in case of seafood this may help to overcome some barriers for seafood consumption such as the presence of bones, inexperience of consumers in preparation seafood. The convenience seafood products are in particular lightly (semi) preserved. However consumers' safety issues are of great importance for those products due the contamination with pathogens. Different methods including ionisation or chemical preservatives have been tested for killing or inhibiting the growth of unwanted micro-organisms in food but they all affect flavour or texture and are not compatible with the 'fresh' image of these foods. The synergistic combination of subtle preservation factors or advanced technologies including the use of protective bacterial culture (biopreservation), anti-microbial active food-packaging and non-thermal processes (e.g. pulse light) in order to control, destruct or inactivate undesirable micro-organisms may help to overcome these problems.

One of the problems with respect to the acceptance of seafood by consumers is the rancidity and texture softening of seafood. Oxidation reduces the already limited amount of n-3 lipids in diets, and renders the use of these fatty acids as bioactive functional food ingredients difficult. During oxidation the fatty acids are converted into radicals and hydroperoxides which are further transformed into a wide array of (non)-volatile end products. Both radicals, hydroxyalkenals and aldehydes are found to be highly reactive and can affect colour, protein functionality and enzyme activity. Enzymatic degradation of proteins in seafood after slaughter affects the texture. Until recently softening primarily was ascribed to two groups of proteases, namely the cathepsins and the calpains and lately there has been a growing interest in the protease, 20S proteasome. However the mechanisms and kinetics of these processes leading to deterioration of sensory properties and nutritional quality are not understood. This knowledge will ensure high nutritional and sensory quality of seafood.

As mentioned above the current interest in the role of seafood in human health is due to the n-3 lipids which are highly susceptible for oxidation. The prevention of the oxidation by a natural anti-oxidant from marine origin, which also has a beneficial health effect as a dietary fibre, and other functional components is one of the options to develop seafood products as functional food beyond the existing intrinsic nutritional value of seafood. Dietary modulation of the farmed seafood is another option. Compounds like Se-(alkyl)cysteines present in e.g. alliums are of significant importance combating cancer as shown already by human intervention studies. However feed modulation using this vegetable selenium source to affect the selenium content and bioavailability of selenium in farmed fish has not been investigated. The concept development of functional seafood products beyond the state of the existing intrinsic nutritional value is an unexploited area so far. The research addressed will also be consumer driven in order to ensure that the products fulfil the needs and demands of the (target) consumers groups with respect to healthiness and convenience.

RTD Pillar 5 Seafood from aquaculture

Provision of seafood from capture fish is limited and partly not sustainable. Future demand of seafood will thus have to be met from aquaculture sources. There are three major consumer concerns about seafood from aquaculture. Firstly, farmed fish may have poor taste and texture compared to the wild fish and consumers fear about contamination from fish feed. Secondly, consumers have ethical concerns over intensive production and slaughter of farmed fish. Thirdly, consumers are concerned about sustainability of marine fish feed sources, and the adverse environmental impacts associated with pollution and interaction with wild stocks. Projects in pillar 5 directly address these concerns helping to overcome consumer resistance to aquaculture

products. In order to address these factors contributing to seafood quality and consumer preferences, some key elements need to be better understood. Seafood from aquaculture can potentially overcome the problem of the over exploitation of scarce wild resources. It can potentially deliver a product of defined quality and composition to the market in all seasons of the year enabling a greater penetration of 'healthy foods' in the diet of Europeans. With increasing intensification also comes the ability to determine the quality of the product in several ways, in order to tailor-made seafood products. In addition, a high seafood quality should be linked to ethically acceptable husbandry practices and aquaculture systems, in reality and as perceived by the consumers. Furthermore, it is important to diversify farming away from salmon to various white fish species, such as cod and carp. These 'new species' are likely to be more susceptible to quality problems. Research on how genetic background, growth and husbandry affect the biological properties of the muscle and hence eating and processing quality traits are therefore particularly timely.

Unless these quality problems are resolved there will be a declining consumption of healthy seafood. The research in pillar 5 focuses on major deficiencies in scientific understanding, which must be addressed to realise the above benefits. The relevance of the research proposed is shown by the participation of SMEs in the WPs.

RTD 6 Horizontal activity Seafood traceability to ensure consumer confidence

The seafood sector is facing a considerable challenge in the next few years regarding the full introduction of traceability in the EU community. To do this right, a whole new set of concepts has to be introduced to the sector. At the same time it is an outstanding opportunity to introduce traceability not only as a defensive system, but also as an offensive tool that can be used to secure the credibility of new seafood products, such as the ones that are developed, tested and brought to the marketplace in SEAFOODplus. On this background the RTD Activity 6 is created as a horizontal activity that supports and develops the traceability tool for the whole project, and in particular for RTD pillars 3, 4 and 5. On the other hand the RTD Activity 6 is dependent of the reaction of the consumer or end user of the traceable data. This information will be delivered by RTD pillar 2 and the achievements will be built into the construction of the validated traceability systems.

The overall objective is to develop validated traceability systems for general use for seafood and seafood products from consumer/retailer to fishermen. This is a multi-scientific and multi-technological task ranging from methodology over implementation to validation. Electronic solutions are the only real option to make practical and feasible traceability solutions. But a long range of scientific and technological problems must be solved before validated traceability systems can function in general in an open EU marketplace. Until now the only general definitions in the traceability area for fish and fish products have been the outcome from EU project QLK-2000-00164 'Tracefish'. The RTD 6 Horizontal activity will take its offset from the results obtained in this project, and use the experience the partners developed in this area. The approaches and the outcome are general, but testing and validation is done in different seafood sectors and countries to cover the whole complex seafood area. Developing a uniform methodology, consisting of a well-defined vocabulary and guidelines for operating traceability will be the S&T approach. Therefore an extensive study of data capture equipment, data flow, development of management models, validation methods and analysis of selected seafood chains has to be done.

The technology transfer and dissemination of the outcome of this horizontal activity will be important as new EU legislation will require implementation of traceability systems from the 1st of January 2005 for all players in the seafood production chain. These systems do not have to be validated systems, but if they are not, the credibility of the systems have a limited value.