RTD Synopsis: TA 4 – Sustainable Feed Production

Research towards sustainable feeds for aquaculture has been funded and supported by the European Commission since 1998, with the start of the fifth framework program (FP 5). In FP 5 research projects on sustainable feeds development were funded under key action 5 (sustainable agriculture, fisheries and forestry) of the Quality of Life programme. Under FP 6 sustainable feeds were addressed mainly within "Food Quality and Safety".

Numerous studies have investigated and recommended potential alternatives to fish oil and fish meal in fish feeds within FP 5, most notably the RAFOA and PEPPA projects. The RAFOA project established that fish oil in fish feeds containing fish meal could be very largely replaced with vegetable oils; the PEPPA project established that fish meal in fish feeds containing fish oil could be largely replaced with vegetable meals. However, the extent to which fish oil and fish meal can both be replaced, simultaneously, in fish feeds is far from clear. Moreover, it is paramount that such replacement must not prejudice the health and welfare of the farmed fish; it must retain the health benefits of the product and its acceptability and quality to the consumer and, above all, its safety to the consumer.

Projects such as Aquamax and FeedFatSafety within FP 6 addressed these challenges.

For FP 7, research towards sustainable feeds for aquaculture has been mainly addressed within the Food, Agriculture, Fisheries and Biotechnology Research Theme. The primary aim in funding food, agriculture, fisheries and biotechnology research under FP7 is to build a European Knowledge Based Bio-Economy (KBBE) (food, feed, forest, fisheries, agriculture, aquaculture, chemistry, etc.) by bringing together all industries and economic sectors that produce, manage and exploit biological resources and related services, supply or consumer industries, such as food, fisheries, forestry, agriculture, etc.

This synopsis provides an overview of the main outputs of EU projects financed under FP 6 and FP 7.

EU research projects on sustainable feeds for aquaculture

- **AQUAMAX (FP 6) - Sustainable Aquafeeds to Maximise the Health Benefits of Farmed Fish for Consumers**

This extensive project comprised 4 major research programs:

Objective 1: **to develop feeds based on sustainable alternatives to fish meal and fish oil to produce healthy and minimally contaminated fish that are highly nutritious and acceptable to consumers**

Research program one has surveyed and analysed a wide range of alternative ingredients considering fully their nutritional suitability for fish, their economic viability, their sustainability and their safety. A comprehensive database of potential alternatives has been put in place and validated by Life Cycle Analysis.

AquaMax has developed novel aquafeeds with both fish oil and fish meal largely replaced with sustainable, mainly vegetable materials and tested these new feeds successfully in feeding trials and farm-level demonstrations with salmon, rainbow trout, sea bream and carps.

Objective 2: to assess health benefits of fish produced on new feeds

Within research program 2 the health benefits of fish produced on the new feeds were validated through a nutritional intervention study on oily fish consumption in pregnancy. This study was made possible thanks to the development of tailor-made salmon with minimal levels of contaminants and a high content of omega 3 fatty acids. Results showed that when pregnant women eat two portions of salmon per week, the intake of long chain Ω-3 fatty acids is significantly increased, as well as the levels of selenium and vitamin D. Moreover, they have a higher amount of long chain Ω-3 fatty acids in their bloodstream and in their breastmilk. This dietary change can thus enable the mother to supply more optimally these nutrients to the developing baby before and after birth. The intervention study has been supported by data from a parallel cross-sectional study in China.

Objective 3: to assess the safety of fish farmed on the new feeds

Research program 3 focused on the analysis of direct toxic effect of contaminants and the modulating effects of beneficial nutrients in fish in order to assess the safety of the fish farmed on the new feeds developed within the project. Within this program innovative food safety toxicity tests were developed by identifying and characterising signature effects of key toxicants in fish. Moreover, actions of key toxicants and their amelioration by fish nutrients were assessed in developing animals and cultured cells and food safety tests were conducted in animals fed fish farmed on traditional and new feeds.

Objective 4: to assess perceptions regarding farmed fish and to devise a framework to communicate the risk and benefits of consuming farmed fish to the public and other Stakeholders

Within Research program 4, an assessment of public perception regarding farmed fish was conducted through an analysis of the media coverage and through interviews with sectoral experts and focus groups. A framework to communicate the risks and benefits of consuming farmed fish was devised and proactive strategies so as to communicate to the public and other stake holders were developed.

- **PROSPARE (FP 7) - Progress in saving proteins and recovering energy**

The animal by-products (AB-P) industry has always been a vital part of the world food production chain, providing valuable new products and reducing pollution loads.
PROSPARE aims at developing a technological platform for multi-purpose processing of AB-P, in particular poultry ones, flexible enough to be tailored to different industrial sector needs. Using a novel bio-catalytic approach unmarketable poultry secondary resources (feather, bones and meat) will be converted into value added peptide hydrolysates of high food and feed value leading to marketable end-products, with programmable nutritional properties, and bio-diesel. Innovative techniques will be used for the molecular characterization of the hydrolyzates.
Safety issues associated with new technologies will be properly addressed and novel methods to assess the healthiness of intermediate and end-products will be developed and compared to standard ones.

EU research projects on food safety, traceability and contaminants within aquaculture

- **FeedFatsSafety (FP 6) - Quality and safety of feeding fats obtained from co-products or by-products of the food chain**

The primary aim of 'FEEDFATSAFETY' was to ensure that meeting animal nutrition requirements also matched the safety and quality standards required for certain types of meat production. This is particularly relevant to the use of fats originating from by-products or co-products of the food chain. Within the project new knowledge has been generated on the transfer of main contaminants from feed to meat, plasma and to other target animal tissues and on how the relevance of the fatty acid composition of feed fats can help meat producers to achieve a particular and desirable fatty acid profile in meat and meat products.

Moreover, new data identified the need to improve fish oil safety especially oil analysis when PCB and dioxins of environmental origin are of concern.

Conclusions from the research indicate also that some co-products obtained from acid oils from chemical refining, acid oils from physical refining and animal fats are economically viable alternatives for feed and meat producers when compared with conventional oils such as soybean, rape, sunflower and palm oil.
Among the main outputs of the project there is a system of classification of fats in feedstocks (raw materials) from co-products and by-products (Gasperini et al. European Journal Lipid Science and Technology 109, 673-681, 2007) and a "Handbook of analytical methods for fat control" collating the procedures recommended for the control parameters assessed in fats.

- **CONFFIDENCE (FP 7) - Contaminants in food and feed: inexpensive detection for control of exposure**

The CONffIDENCE project aims to further improve food safety in Europe by the development of faster and more cost-efficient methods for the detection of a wide range of chemical contaminants in different food and feed commodities. These methods will not only save precious time in ever faster production cycles, but will also permit more food/ feed samples to be monitored due to the lower cost per test.
Within the project rapid and cost-efficient tests will be developed and validated for detecting chemical contaminants in meat, eggs, fish and fish feed, cereal based food/feed and vegetables. Moreover, long term solutions will be provided for the monitoring of persistent organic pollutants, perifluorinated compounds, pesticides, veterinary pharmaceuticals, heavy metals and biotoxins.

Other EU funded projects relevant to TA 4

- **ALFA PROJECT (FP 6) - Development of an Automated Innovative System for the Continuous Live Feed Production in Aquaculture Hatchery Units**

The project aimed at developing an innovative fully automated system for the continuous production of phytoplankton (algae) as live feed in aquaculture hatcheries. This system guarantees optimal microclimatic and nutritional conditions for the stable growth of algae by using both natural and artificial illumination and controlling the temperature, the nutrient content, the pH and the CO2 concentration of the water.

- **MYCORED (FP 7) - Novel integrated strategies for worldwide mycotoxin reduction in food and feed chains**

Mycotoxins are secondary metabolites produced by fungi that are toxic to humans and animals consuming the products. MycoRed aims at developing strategic solutions to reduce contamination by mycotoxins of major concern in economically important food and feed chains, through mycotoxins research joint actions. Some of the main objectives of the project are:

• to develop novel solution driven methodologies and handling procedures to reduce both pre- and post-harvest contamination in selected feed and food chains

• to generate and disseminate information and education strategies to reduce mycotoxin risks at a global level.

Future RTD Needs:

The following are some of the most urgent research needs identified within the **Aquamax** and the **FeedFatsSafety** Project:

- Optimise formulations of aqua feed ratios for the different farmed species
- Investigate simultaneous supplementation with micro-nutrients (e.g. trace elements, vitamins, essential amminoacids…)
- Investigate long term effects of changes in diet formulations on cultured fish species
- Investigate environmental impacts of long term effects of changes in aquaculture feeds formulations
- Develop novel methods to estimate nutritional requirements for nutrients and to evaluate the nutritional value of alternative feeds
- Develop innovative delivery vectors for nutrients and supplements
- Develop methodologies for the "risk benefit analysis" of consuming fish, whether wild or farmed
- Further elucidate the mechanisms of toxicants (e.g. mercury toxicity) and interaction with nutrients
- Generate toxicity data on persistent organic pollutants for which tolerable weekly intakes (TWIs) have yet to be established
- Develop new systems of purification for some fat categories to increase quality and safety of their use
- Study relationships between the regulated feed maximum levels of dioxins and DL-PCBs and the regulated meat maximum levels
- Develop new technologies to transform fat by-products to obtain fats with altered animal nutritional properties
- Improve knowledge transfer

A full list of the projects undertaken in Thematic Area 4 – Sustainable Feed Production can be found in the Annex. More detailed information is provided in the Technical Leaflet (TL) describing the main outputs and deliverables of each project.

Thematic Area 4: Sustainable feeds

F.P.	Acronym	Project Title
6	AQUAMAX	Sustainable aquafeeds to maximise the health benefits of farmed fish for consumers
6	ALFA	Development of an Automated Innovative System for the Continuous Live Feed Production in Aquaculture Hatchery Units
7	CONFFIDENCE	Contaminants in food and feed: inexpensive detection for control of exposure
6	FeedFatsSafety	Quality and safety of feeding fats obtained from co-products or by-products of the food chain
7	PROSPARE	Novel methods of treatment of animal by-products for the production of substances with biologically valuable functional properties
7	MYCORED	Novel integrated strategies for worldwide mycotoxin reduction in food and feed chains