

# Progress in fish larval nutrition

## IFREMER

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Real Time PCR for gene expression quantification

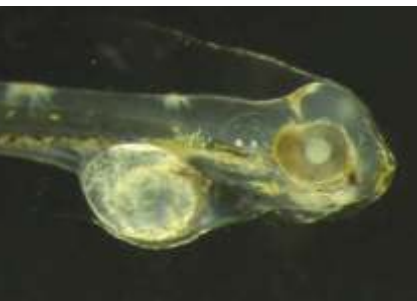
The IFREMER is the French Institute for Research and Exploitation of Sea Resources. The IFREMER Fish Nutrition Laboratory is a part of the joint research unit, Nuage (Nutrition, Genetics and Aquaculture) by three institutions (IFREMER, INRA, University of Bordeaux I). The laboratory has eighteen permanent staff and about 10 students or temporary scientists. It is located in Brest, in a large center hosting 600 people involved in marine sciences.

### Species and facilities

The fish nutrition lab conducts basic and applied research in marine fish nutrition for the past thirty years, on different species such as the European sea bass, sea bream, turbot, sole and more recently cod, red drum and pollack. The lab has 900m<sup>2</sup> experimental rearing facilities, including space for larval rearing, tanks for holding juveniles of different sizes and systems dedicated to digestibility studies. A large experimental feed manufacturing room is equipped with blenders, driers and sieves that produce experimental diets from size 60µm (larval diet) to 8 mm. The lab is equipped to do advanced biochemical and molecular analyses.

### History of research

The lab conducted research on major nutrient requirements (lipid, protein, etc.) in different species in the early 1980s. Gradually, it extended research towards more advanced areas such as the environmental aspects of fish nutrition, replacement of marine source materials by vegetable sources in fish diet and the effect on flesh quality, and the nutrition of fish larvae.



Sea bass larvae at 4 days after hatching, before mouth opening

### Larval feed development

One of the challenges in larval nutrition research is the formulation and manufacture of a compound diet which can replace live feeds in the feeding of marine fish larvae. Several experiments were conducted to understand the onset of the digestive capacity in fish larvae. Results showed that

digestion during larval stages is different from that of juveniles. The maturation of digestive functions occurred after a few weeks of development (day 25 post hatching in sea bass reared at 20°C). Before this maturation, the larvae are able to digest peptides (2 to 20 amino acids chain) and phospholipids. The findings led to the formulation of a patented diet (WO0064273) which is now used at large scale in hatcheries for sea bass, sea bream, turbot, cod, red drum, barramundi. This diet generally induces better survival and growth than the classical live feeds. The diet is now tested and adapted to new species such as halibut, wolffish and yellow croaker, in collaboration with Canadian and Chinese teams.



Sea bass larvae at 9 days after hatching, with gut full of diet

### Recent progress

Our present research aims to improve the quality of fish larvae produced in hatchery. Different environmental or nutritional parameters induce skeletal abnormalities and these are currently investigated in an EU funded program. A Ph.D. thesis research conducted by Laure Villeneuve at the lab showed the correlation between Vitamin A and the occurrence of specific skeletal deformities (see more detailed article by Zambonino *et al.*, this issue). The occurrence of these deformities was associated with an over-expression of some nuclear receptors. Other nutritional parameters will be investigated in order to understand how they interact with the molecular pathways controlling morphogenesis in fish. This will allow improvement of the diet formulation and consequently, the quality of hatchery reared larvae. ■

### From Lab to the World

Understanding of the digestion mechanisms and specific nutrient requirements in marine fish larvae led to the formulation of a compound diet by IFREMER. The diet includes hydrolysed protein and phospholipids, which correspond to the digestive enzymes in early developmental stages of fish larvae. It was patented in 1999 and the license was bought and exploited by Nutreco (Skretting). The diet is manufactured in France and sold as GEMMA Micro diet. It is available at different sizes, from 60µm to 400µm. The adaptation of this diet to commercial scale was undertaken by Dr. Armande Cuvier, after she completed her Ph.D. in the laboratory. It took two years to complete commercialization. Numerous tests were conducted to assure the quality of the diet produced in large scale manufacture and special feeders were developed for large tanks. This diet is currently used in European marine fish hatcheries in a large scale.



Dr Chantal Cahu (Ph.D., University of Paris VI) is at the present time head of department "Physiology of Marine Organisms" in IFREMER, French Institute for Research and Exploitation of Sea Resources. She conducted different activities of research and development in the field of shrimp and fish aquaculture. For the past 10 years, her main topic is marine fish larval nutrition, and her research has led to the formulation of a patented microdiet for fish larvae. She developed efficient research collaborations with scientists of several countries (Europe, Canada, Ecuador, China, Australia...).