

INTRODUCTION

ABOUT THIS BOOKLET

This booklet is the final in a series of three technical booklets on the nutrition and feeding of fish farmed in Europe, and has been produced under the framework of the **European Union FP7 funded ARRAINA project (Advanced Research Initiatives for Nutrition & Aquaculture)**. The aim is to make these booklets widely available both to targeted stakeholders and society in general, in order to raise awareness of the science-based knowledge supporting the development of high-quality, safe, and environmentally sustainable aquaculture feeds.

This booklet is specifically aimed at **scientists and feed producers**, but it also targets other industrial segments (e.g. fish farmers, feed additives companies, retailers) and individuals interested in gaining further knowledge of the physiological consequences of the raw materials that are currently used in the feeds of farmed fish. The species focussed on by the **ARRAINA** project are: Atlantic salmon, rainbow trout, common carp, European sea bass and gilthead sea bream.

The objective of this booklet is to provide a reliable set of biomarkers and associated methodologies to assess the nutritionally mediated effects on growth performance, metabolic homeostasis, stress responsiveness and health condition of fish which are fed

new diet formulations from early life stages to completion of production cycle and sexual maturation. Of particular value are predictive and non-invasive biomarkers available at a relatively low cost, although the combination of **conventional and omics approaches** is emerging as a user-friendly option.

The first two **ARRAINA** technical booklets were focused on **feed ingredients** and **nutrient requirements**, and are available at www.rraina.eu.

ABOUT AQUACULTURE FEEDS IN EUROPE

Fish feeds are produced using a large variety of feed ingredients that have different nutritional and physical properties. They are formulated on the basis of solid scientific knowledge, contributing to the development of an environmentally-friendly aquaculture sector and to produce high quality nutritious food for humans¹⁻³.

The production of environmentally sustainable aquaculture feeds starts with the selection of high-quality raw materials that may need to be supplemented with specific nutrients (amino acids, phospholipids, vitamins, macro and micro minerals) to support maximum growth, health and well-being of fish. Given that the nutrient profiles of marine feedstuffs and plant protein-sources can vary greatly, one of the aims of the **ARRAINA** project was to identify which

micronutrients, and in which form, need to be supplemented to plant-based diets to support maximum growth and production of farmed fish from early life stages to completion of sexual maturation.

The **ARRAINA** project brings together different competences for developing tools and methodologies based on targeted and non-targeted biomarker approaches in the five species of interest for the assessment of nutrient requirements or status of fish, going further than just identifying differences in growth parameters.

Additionally, the project considers the potential presence and prevalence of contaminants associated with plant-based feedstuffs on fish fillets for human consumption, developing targeted and broad screening methods for fast and sensitive analyses.

ABOUT THE ARRAINA PROJECT

It is well recognised that the sustainability and competitiveness of aquaculture depend strongly on the replacement of capture fishery-derived fish meals and oils with alternative feedstuffs of plant origin. **ARRAINA** has been responding to this need by measuring the long-term effects that these changes in diet composition will have on the full life cycle of fish for which presently little is known.