

Online Advanced Course

NEW FEEDS AND FEEDING TECHNOLOGIES IN AQUACULTURE

14-23 June 2021

1. Objective of the course

Increased aquaculture production is one of the keys to ensure food security for a growing global population. Since fishmeal and fish oil are limited resources, the production of aquafeeds requires the use of new feed ingredients. Today, these ingredients are partly being replaced by other protein and fat-rich resources derived from plants and from industry by-products. Still, few commercial feeds are made with no fishmeal and fish oil. Hence, there is a need to develop industries to produce enough new and highly nutritious feed resources, such as insects, single cell proteins and algae, all of them being good replacements for fishmeal and fish oil.

The formulation of feeds is becoming more complex as the feed producers and farmers must accommodate both the changes in legal frameworks as well as customer requirements. In the near future, feeds will be produced from a greater variety of ingredients. At the same time the farmers need to secure that the nutritional requirements of the fish are met, and that the technical quality of the feed is optimal for the production system in use.

New technologies to better manage feeding timing and doses are being developed and used to optimize fish feeding performance in tanks and cages, especially during seasonal changes and stressful events.

This course aims to give an overview of both the existing and upcoming feed ingredients, what factors should affect the choices of feed and how feeding strategies and technologies are improving. The course emphasizes particular aspects of Mediterranean species and production conditions. At the end of the course the participants will be in a position to:

- Better understand the importance of the use of new ingredients and new formulations.
- Acknowledge the main challenges in feed production.
- Better use feeds, feeders and fish feeding monitoring.
- Recognize the impact of customers' preferences and the legal framework in feed production.
- Design feeding trials to better adapt feeds and feeding to the farm conditions and production systems.

2. Organisation

The course is jointly organized by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), through the Mediterranean Agronomic Institute of Zaragoza (CIHEAM

Zaragoza), and the EU H2020 funded project MedAID (Mediterranean Aquaculture Integrated Development. Grant agreement No 727315), with the collaboration of the EU H2020 projects PerformFISH (Integrating Innovative Approaches for Competitive and Sustainable Performance across the Mediterranean Aquaculture Value Chain) and NewTechAqua (New technologies Tools and Strategies for a Sustainable, Resilient and Innovative European Aquaculture).

MedAID is a project designed to increase the overall competitiveness and sustainability of the Mediterranean marine fish-farming sector, throughout the whole value chain, and aims to generate innovative knowledge and to develop tools to improve the performance of the production systems, create added value products, and draw up socially responsible business plans.

The course will be held online, with lectures and practical work delivered in live sessions by highly qualified lecturers from research centres, universities and private companies in different countries.

The course will be held from 14 to 23 March 2021. The 8 sessions will be held from 14 to 18 and 21 to 23 June, from 09:15 to 13:45 (Central European Time). The time slot could be reconsidered according to the countries of origin of participants finally selected.

3. Admission

The course is designed for 30 participants with a university degree, and is intended for professionals of the feed industry and fish farming, as well as for technical advisors and researchers in the field.

The number of admissions can be increased to attend lectures only and excludes the practical work sessions.

Given the diverse nationalities of the lecturers, knowledge of English, French or Spanish will be valued in the selection of candidates, since they will be the working languages of the course. The Organization will provide simultaneous interpretation of the lectures in these three languages.

4. Registration

Candidates must apply online at the following address:

<http://www.admission.iamz.ciheam.org/en/>

Applications must include the *curriculum vitae* and copy of the supporting documents most related to the subject of the course.

The deadline for the submission of applications is 26 April 2021.



Applications from those candidates requiring authorisation to attend the course, may be accepted provisionally.

All participants will be exempt from the payment of registration fees.

5. Teaching organisation

The course requires personal work and interaction among participants and with lecturers. The international characteristics of the course favour the exchange of experiences and points of view.

Lectures will be complemented with examples, debates and practical exercises. The objectives of the exercises are to learn how ingredients affect feed formulation and to be able to design trials under different scenarios.

6. Programme

1. How to select the best feed for the fish farm (3 hours)

- 1.1. Biological considerations and nutritional requirements
 - 1.1.1. Species produced: background on nutritional requirements
 - 1.1.2. Production cycle
 - 1.1.3. Fish size
 - 1.1.4. Genetics and breeding programmes
 - 1.1.5. Final product for sale
- 1.2. Production system
 - 1.2.1. Cages or ponds
 - 1.2.2. RAS
 - 1.2.3. Density
 - 1.2.4. Initial and final fish weight
- 1.3. Environmental conditions
 - 1.3.1. Water temperature
 - 1.3.2. Oxygen availability
 - 1.3.3. Water supply
 - 1.3.4. Natural food availability
 - 1.3.5. Water current
 - 1.3.6. Light

2. How to evaluate a feed (9 hours)

- 2.1. Protein content
 - 2.1.1. Essential amino acids
 - 2.1.2. Protein raw materials: composition and origin
 - 2.1.3. New and potential sources of proteins
- 2.2. Fat content
 - 2.2.1. Essential fatty acids
 - 2.2.2. Oils used: composition and origin
 - 2.2.3. New and potential sources of lipids
- 2.3. Starch content
 - 2.3.1. Nitrogen free extract level
 - 2.3.2. Starch level and origin
- 2.4. Energy content
 - 2.4.1. Digestible energy (DE) content
 - 2.4.2. Methods to evaluate DE in a feed
- 2.5. Additives
 - 2.5.1. Balancing nutritional requirements (vitamins, minerals, amino acids, etc.)
 - 2.5.2. Improving health status (pre- and probiotics and nutraceuticals)
 - 2.5.3. Technological additives (preservation, binders, antioxidants, etc.)

2.6. Feed technology and physical properties of the feed

- 2.6.1. Extrusion and other technologies
- 2.6.2. Pellet size (diameter and length): availability
- 2.6.3. Floating or sinking pellets
- 2.6.4. Pellet quality and ingredient effects

2.7. Practical group work on how ingredients affect feed formulation

3. How to use the feed (7 hours)

- 3.1. Feeding schedules
 - 3.1.1. Selection of pellet size according to fish size
 - 3.1.2. Feeding ad libitum or with restriction (palatability and appetite)
 - 3.1.3. Seasonal changes and fish handling
 - 3.1.4. How to prepare a feeding schedule
- 3.2. Feeding methods
 - 3.2.1. Manual feeding
 - 3.2.2. Self-feeders
 - 3.2.3. Automatic feeders
 - 3.2.4. Feeding monitoring and control sensor systems
- 3.3. Feeding programmes
 - 3.3.1. Indexes to measure feed efficiency
 - 3.3.2. Strategies to get the best growth
 - 3.3.3. Combining different feed formulations to achieve the best economic results
- 3.4. Artificial intelligence. Future use of multi-data sets to predict feeding
- 3.5. Open debate

4. Customers' requirements and aquaculture feed legislation (5 hours)

- 4.1. Adapting to customer requirements and challenges when doing so
 - 4.1.1. Increasing safety concerns
 - 4.1.2. Sustainability
 - 4.1.3. Organic feeds
 - 4.1.4. Traceability and certifications
- 4.2. Legal framework
 - 4.2.1. EU catalogue of feed materials
 - 4.2.2. Additives
 - 4.2.2.1. EU Policy on additives
 - 4.2.2.2. Allowed and banned additives (ethoxyquin and others)
 - 4.2.3. The feed label
 - 4.2.3.1. Declaration and allowances
 - 4.2.3.2. Expiry date
 - 4.2.3.3. Information to declare
 - 4.2.3.4. Feed ingredient traceability
- 4.3. Open debate

5. Feed trials (6 hours)

- 5.1. Benchmarking and field trials
 - 5.1.1. Design of benchmarking and field trials
 - 5.1.2. Case study of MedAID project trial on seabream
- 5.2. Practical work to design a trial for different production system, fish species and conditions
- 5.3. How to design and perform a good feed trial
 - 5.3.1. Facilities
 - 5.3.2. Fish number and size
 - 5.3.3. Environmental features
 - 5.3.4. Duration
 - 5.3.5. Sampling and sample analysis
 - 5.3.6. Results analysis, evaluation and reporting

GUEST LECTURERS

A. BONALDO, Univ. Bologna (Italy)
A. ESTÈVEZ, IRTA Sant Carles de la Ràpita (Spain)
O. FRETHEIM, Bluegrove, Oslo (Norway)
E. GISBERT, IRTA Sant Carles de la Ràpita (Spain)
B. HATLEN, NOFIMA AS, Sunndalsøra (Norway)
M. HIDALGO, Seafoodmatter, Utrecht (the Netherlands)
M.S. IZQUIERDO, Univ. Las Palmas de Gran Canaria (Spain)

E. MESEGUER, Grupo Dibaq, Segovia (Spain)
M. MOREN, NOFIMA AS, Bergen (Norway)
N. PAPANDROULAKIS, HCMR, Heraklion (Greece)
L. PARMA, Univ. Bologna (Italy)
T.A. SAMUELSEN, NOFIMA AS, Bergen (Norway)
A. TIANA, Grupo Dibaq, Segovia (Spain)