MANUFACTURE OF "FRESH / WET" AQUACULTURE FEEDS BASED ON BY-CATCHES, FISH BY-PRODUCTS AND ALGAE

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Introduction

Context

- Focus on available bio resources transformation such as by-catches or fish by-products and marine plants (seaweeds and microalgae)
- Positioning on short supply chains fish feed processing or IMTA
- Wet feed may have benefits for aquaculture
- Natural gelling ability of fish muscle proteins allows texturing feeds

Challenges

- Incorporation of abundant resources readily available / reduction of discards
- Significant reduction of certain energy-consuming steps (such as drying)
- Adequacy with specifications of a nutritional efficient fish feed
- Production of fresh/wet feeds microbiologically safe
- Check and quantify nutritional effects of a wet diet

Wet and Fresh feeds

- Water content similar to live prey → Improvement of feed use
- Reduction (or removal) of the drying step → Energy saving
- Improvement of flavor spreading and palatability for fishes
- Neutral or positive effects on fish growth and survival
- Promotion of fish immunity and protective bacterial flora → Decrease in mortality
- No microbiological stabilization → Issues for storage and transportation
- Short supply chains → Length of storage and transportation limited
- Can be sticky and too soft → Complicating handling and feeding
- Risks of contamination by alteration or pathogenic flora.
- Fish has to consume more wet feed to match nutrient requirements
- Short term storage / Cooking step → Reduce of contamination

Pros

- Natural gelling ability of fish muscle proteins → Texture enhancement
- No microbial stability → Issues for storage and transportation
- Short supply chains → Length of storage and transportation limited
- Can be sticky and too soft → Complicating handling and feeding
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Cons

Raw Materials

Main raw materials potential availability (in France)

- By-catches : 17,000 tons/y
  - By-catches are unwanted / unsold marine organisms
  - Potentially available resource with the implementation of the landing obligation
  - Composition will depend on type, season and location of the fishery
  - Fish by-products : 350,000 tons/y

Main raw materials composition

- Chemical composition of raw materials is evaluated on the pulp part of batches, obtained by mechanical separation, related to dry matter
  - On a batch of by-catches received from a nephrops trawlers working in the Bay of Biscay
  - On a batch of by-products received from a salmon processing factory

Formulation

- Feed formulation is based on nutritional composition of main raw materials relevant to be incorporated - on a dry basis
- Target organism = European sea bass (Dicentrarchus labrax) or rainbow trout (Oncorhynchus mykiss)

Example of optimized formulation

- Carbohydrates source 22%
- Lipids 28%
- By-catches 45%
- Ashes 15%
- Proteins 28%
- Lipids 5%

Corresponding nutritional composition

- Carbohydrates 24%
- Lipids 26%
- Ashes 9%
- Proteins 49%

- Formulation simulations highlight the strong potential of fish raw materials to fit nutritional requirements
- In the example above, a carbohydrate source is needed to optimize the formulation to fit fish requirements. In this frame, seaweeds could be a good candidate as source of carbohydrates
- Some microalgae spp. could also be considered as a potential source of lipids and essential fatty acids in order to complete the diet

Process

Preprocessing step and mix

- Mechanical separation of fishes:
  - Removing bones or ossicles
  - Pretreatment of algae:
    - Decreasing ashes level
    - Improving digestibility
- Shearing along extruder allows denaturation and solubilization of myofibrillar proteins
- Cooking step allows the three-dimensional reorganization of proteins leading to gel formation
- Drying may be favorable for buoyancy, texture and homogenization of feed water content
- No storage for direct fresh feeding
- Short time cold storage will be studied

Perspectives

Several aspects of this project require extensive studies:

- Optimization of feed texture through extrusion, cooking and drying
- Impact of other materials such as seaweeds or microalgae on texture
- Impact of storage conditions on the texture of feeds
- Assessment of microorganisms in raw materials and feeds
- Study of the shelf life of feeds depending on storage conditions
- Evaluation of digestibility and palatability of developed feeds
- Assessment of the feed produced on fish culture (targeted organism) at a pilot scale

Main references


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