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

1 Wet and Fresh feeds

Pros

- Water content similar to live prey → Improvement of feed use[1]
- Reduction (or removal) of the drying step → Energy saving
- Positive effect on fish behavior (more active, less aggressive)[2,4]
- Improvement of flavor spreading and palatability for fishes [1-3]
- Neutral or positive effects on fish growth and survival[2-5]
- Promotion of fish immunity and protective bacterial flora → Decrease in mortality[4]

Cons

- No microbiological stabilization → Issues for storage and transportation
- 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

Solutions

- Natural gelling ability of fish muscle proteins → Texture enhancement
- Short supply chains → Length of storage and transportation limited
- Adjustment of feeding strategy → Quick adaptation of fishes[5]
- Short term storage / Cooking step → Reduce of contamination

2 Raw Materials

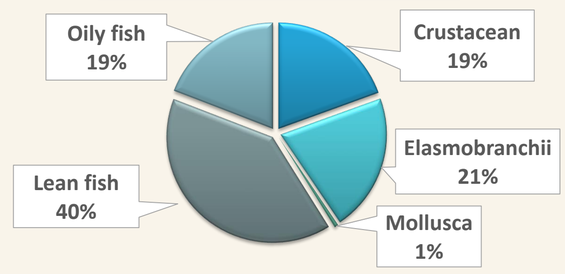
Main raw materials potential availability (in France)

→ 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 : 150,000 tons/y

Composition of by-catches[6]

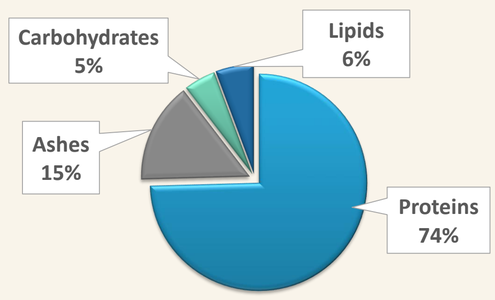


Main raw materials composition

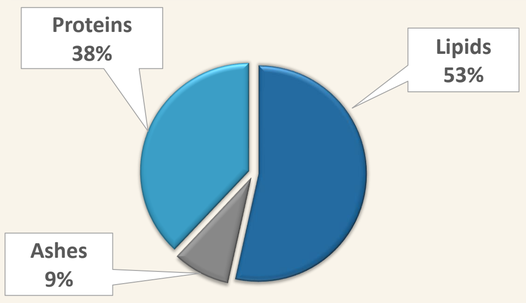
→ Chemical composition of raw materials is evaluated on the pulp part of batches, obtained by mechanical separation, related to dry matter

- 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

Pulp composition of by-catches



Pulp composition of salmon by-products

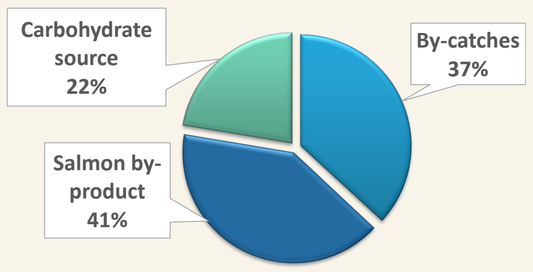


3 Formulation

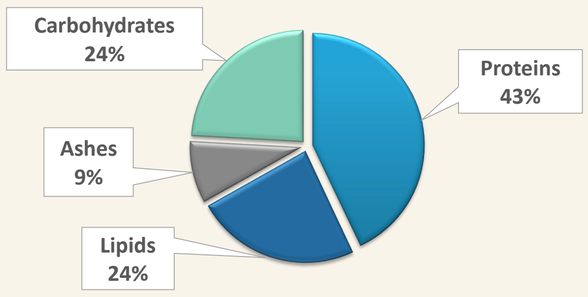
→ Feed formulation is based on nutritional composition of main raw materials relevant to be incorporated - on a dry basis

→ Target organism = European sea bass (*Dicentrarchus labrax*) or rainbow trout (*Oncorhynchus mykiss*)

Exemple of optimized formulation



Corresponding nutritional composition



→ 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

4 Process

Preprocessing step and mix

- Mechanical separation of fishes:
  - Removing bones or exoskeletons
- Pretreatment of algae:
  - Decreasing ashes level
  - Improving digestibility

Extrusion

- Shearing along extruder allows denaturation and solubilization of myofibrillar proteins

Cooking

- Cooking step allows the three-dimensional reorganization of proteins leading to gel formation

Light drying

- Drying may be favorable for buoyancy, texture and homogenization of feed water content

Storage

- No storage for direct fresh feeding
- Short time cold storage will be studied

Perspectives

→ Several aspects of this project require extensive studies.

Raw materials availability and potential

> Evaluate by-catches (and by-products) composition depending on type, season and localization of fisheries (or factories)

> Formulation will be adapted according to changes in the composition of raw materials

> Focus on seaweeds and microalgae as carbohydrates and lipids sources

Process

> 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

Final product

> 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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