Tailorzyme

Valorisation of side streams

Marine raw materials and products

Products and side streams from fish processing

Potential high-value products from side streams:

Skin:
- 70% water
- 25% protein
- 3% fat

→ COLLAGEN PEPTIDES

Backbone:
- 7% water
- 22% protein
- 3.5% fat
- Remainder; minerals

→ COLLAGEN PEPTIDES

Cut-offs → PROTEIN HYDROLYSATE

Viscera, liver, head → PROTEIN HYDROLYSATE AND FISH OIL

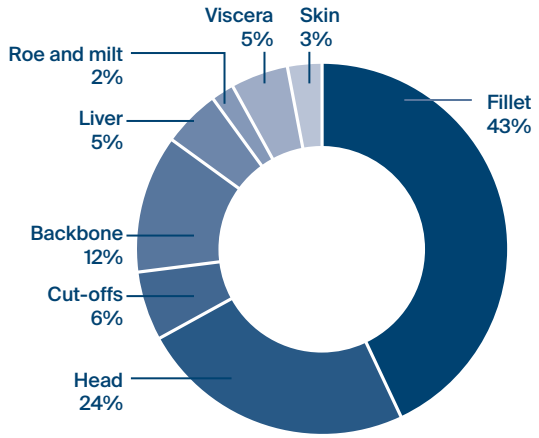

Figure 1. Products and side streams from shore processed cod (adapted from Arason at al. , 2009).

Collagen, gelatin and collagen peptide products

Collagen is a structural triple-helix protein that accounts for approximately **30% of the total protein content in the human body.**

Upon denaturation, the triple-helix dissociates, resulting in the formation of gelatin. This gelatin is a versatile **multifunctional protein**, utilised in various industries, such as food, pharmaceuticals and personal care.

Gelatin can be further hydrolysed into collagen peptides. Compared to gelatine, collagen peptides offer several advantages: Due to their **lower molecular weight (3kDa)**, they reduce solution viscosity and exhibit enhanced solubility, **improving digestibility and bioavailability**. These properties can also **assist production and formulation processes**.

Additional products & processes

- **Protein hydrolysates** typically contain approximately 90% protein and less than 5% fat. They are rich in essential amino acids, contributing to their **bioactivity and functional properties**. Fish protein hydrolysates can be utilised as nutritional supplements, as well as functional ingredients such as emulsifiers and can also exhibit **antioxidant activities**.
- **Fish oil** is a natural source of **omega-3 polyunsaturated fatty acids (PUFAs)**. These fatty acids are not produced by the human body and are associated with **various health benefits,** including the reduction of inflammation and the lowering of blood pressure.
- **Fish meal** processes benefit from proteases by **reducing viscosity** and **lowering energy consumption**.

Valorisation of side streams
Process overview

Cleaning the raw material and other pre-treatments

Skins and backbones may contain residual meat, which can be removed using gentle enzymatic hydrolysis. This process ensures that all residual meat is separated from the skin and bones and provides a protein hydrolysate plus meat free skin and bone.

Due to having differing compositions, skin and bone require tailored treatments designed to expose the collagen material.

SKIN

1. Caustic maceration: This step removes non-collagenous substances and partially disrupts the triple-helix structure of collagen, facilitating gelatin.
2. Acid extraction: Applied to swell the gelatin from the pretreated collagen matrix, giving easier gelatin extraction.
3. Sieve, wash and filtration.

BACKBONE

1. Acid treatment: The acid reacts with the calcium in the bone, causing it to precipitate as salt. This process softens and opens the bone matrix, making the collagen more accessible to proteolytic enzymes.
2. Sieve and wash.

Enzymatic hydrolysis

Once the collagen has been exposed, it can be hydrolyzed by specific enzymes. This enzymatic hydrolysis step cleaves the extracted gelatine, reducing the molecular size and viscosity, and increasing the solubility of the collagen peptides.

- **Enzymes:** The choice of the enzymes depends on the requirements for the final product. Examples of enzymes used in this application are: TailorFood Endocut-09L®, TailorFood Endocut-07L®, TailorFood Endocut-05L®, TailorFood Exocut-TR L®
- **Hydrolysis control parameters:** Enzyme concentration, pH, temperature, stirring, substrate:water ratio, hydrolysis time
- **Enzyme inactivation**

Downstream and final processes

To obtain the final product the following separation processes are normally required. The product can then be concentrated and dried.

1. Decanter/Centrifugation
2. Filtration steps
3. Concentration: Evaporator, spray-dryer, etc.

Yields

Steps	Description	Skin	Backbone
Total yield	Collagen obtained (dry) / Raw material (dry)	19%	16%
Enzymatic hydrolysis step	Collagen obtained (dry) / Pre-treated material (dry)	87%	98%
Pre-treatment step	Pre-treated material (dry) / Raw material (dry)	22%	17%

The yields are based on experimental data from Tailorzyme's laboratory.

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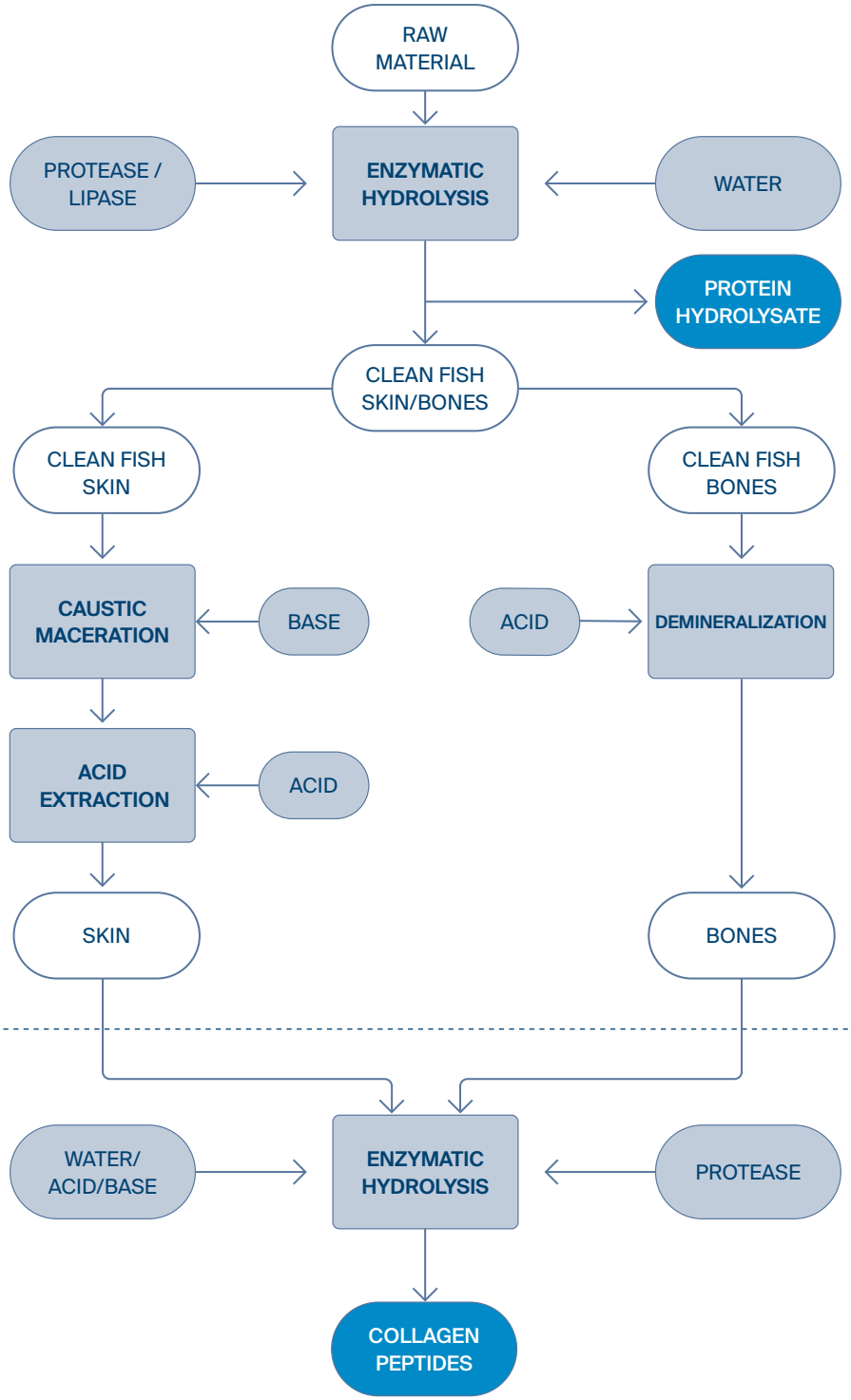
Process overview

Cleaning the raw material & pre-treatment



Enzymatic hydrolysis & downstream processes

Tailorzyme
CUSTOMIZED ENZYME SOLUTIONS

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