DiscardLess

Strategies for the gradual elimination of discards in European fisheries

“Using discards in the value chain”

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Aim and objectives

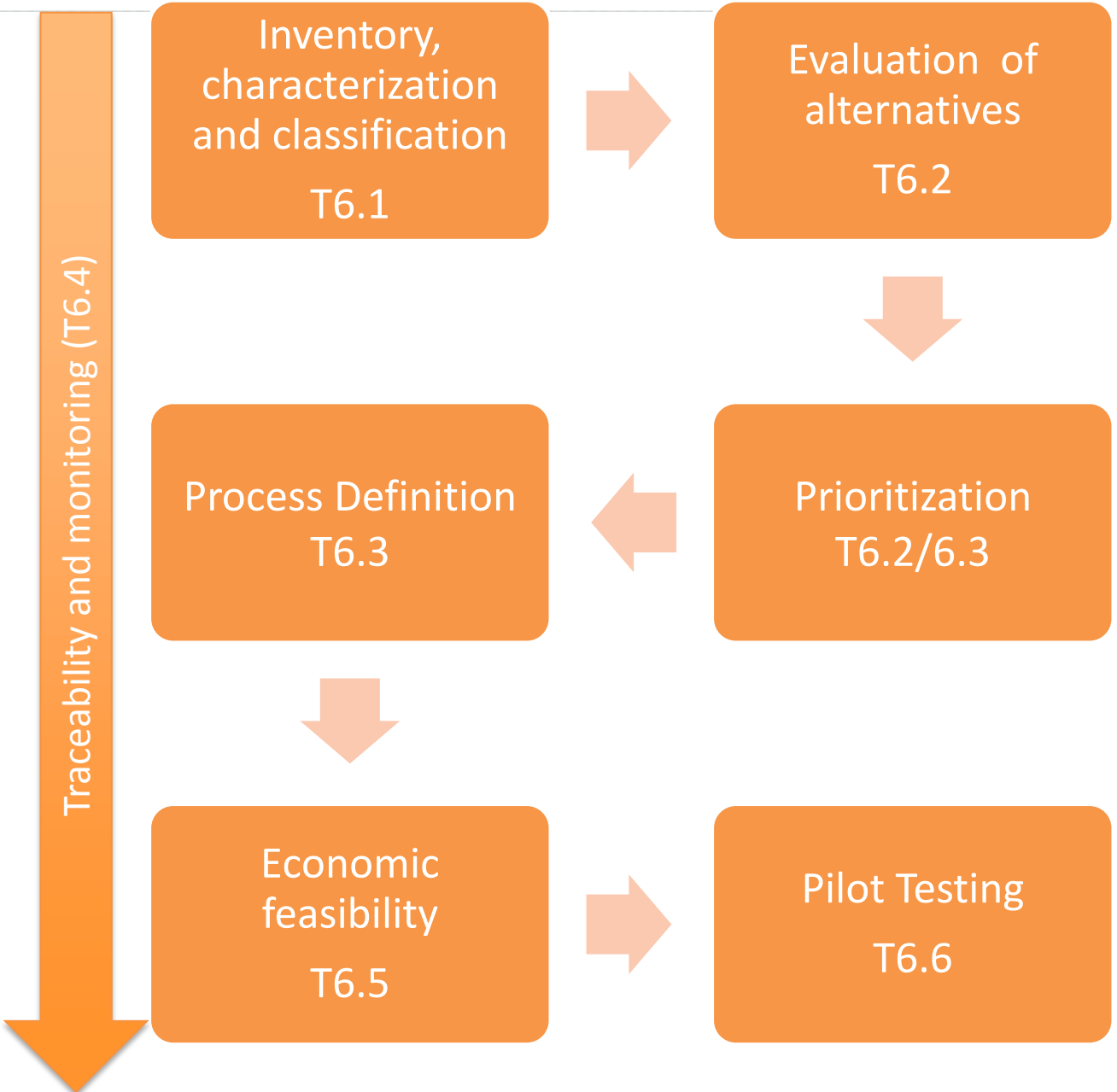
To identify, evaluate, select and demonstrate an integral solution to make best use of unwanted catches without creating economic incentives and inadvertently developing markets for such products.

Specific objectives:

1) Analysing the potential resource of unavoidable unwanted catches available in specific harbours;
2) Evaluating most suitable uses of unavoidable unwanted catches;
3) Constructing an initial selection of potential uses and solution approach;
4) Ensuring traceability and market acceptance of the products resulting from unavoidable unwanted catches valorization;
5) Obtaining a clear and convincing picture of the economic profile and the feasibility of the implementation of the proposed solutions;
6) Validating the solution proposed for best use of unavoidable unwanted catch by a pilot trial;

Discard valorisation study phases

General scheme for unavoidable unwanted catch valorisation study.



Task 6.1: Diagnosis of the inventory of the generated unavoidable unwanted catch

1. Volume of unavoidable unwanted catch
   - Current volume
   - Estimated with PPC application
2. Physicochemical characterization
   - Per species
3. Dispersion of generation
   - Data per harbour
4. Seasonal variability
5. Classification analogies

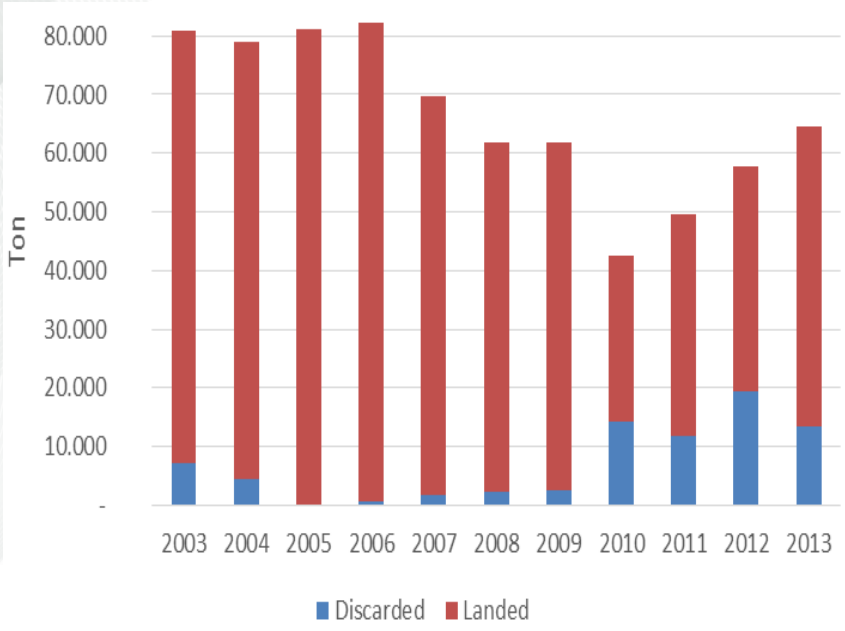
5 selected fisheries:

- ✓ Bay of Biscay (Basque country)
- ✓ North Sea (Danish fleet)
- ✓ Iceland
- ✓ Mediterranean (bottom trawlers landing in Mallorca)
- ✓ English Channel (French fleet)

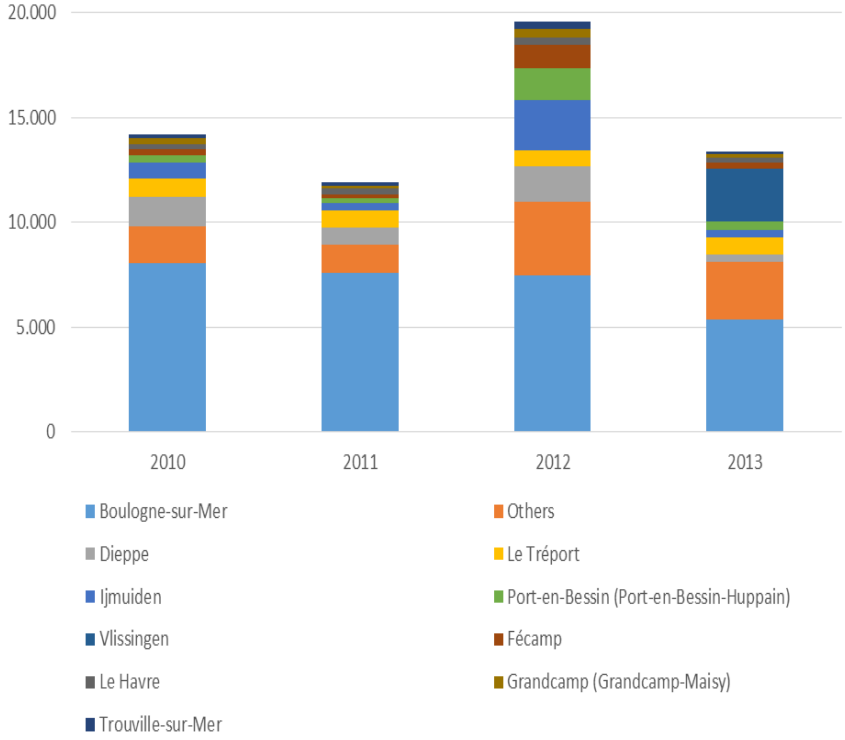
UUC data classified by: fishery, fishing zone, specie, per month/season, per port. With safety and quality aspects taken into account.

The amount of fish that can be valorised will determine de economic feasibility of most options (Task 6.1)

Eastern Channel – French fleet



Annual discards 10-20 thousand tonnes



Boulogne, Ijmuiden & Vlissingen the main discard harbours (out of 196 harbours in total)

Task 6.1: Diagnosis of the inventory of the generated unavoidable unwanted catch

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Main conclusions:

- ✓ Relatively few species and fleets account for most of the discards in nearly all the case studies
- ✓ Very few fishing ports stand out in most fishing areas, representing vast majority of the discards
- ✓ The available facilities are in most cases going to be sufficient to cope with changing supplies of catches intended for production of products for human consumption.
- ✓ Catches below Minimum Conservation Reference Size (MCRS) and other catches that cannot be used for direct human consumption will however present a challenge in many areas. Solutions for processing those materials will either have to be simple and inexpensive, or strategically located so that raw materials can easily be transported to them
- ✓ The lessons learned from Iceland are that a successful implementation takes time and that economic incentives generally work best.

Task 6.2: Evaluation of most suitable uses

To identify the most suitable valorization alternatives including biological aspects, infrastructure aspects, market and economic aspects, regulatory aspects, and cultural aspects.

1. Amount of new-product generated.
2. Existing market.
   - Added (market price in € / kg) value.
   - National/International market demand.
   - Competition from other equivalent products.
3. Degree of investment required.
4. Existence of infrastructure.
5. Legal aspects.
6. Environmental aspects.
7. Cultural aspects.
8. Other.

Possible uses of UUC

Objective: to obtain maximum use of fish resources, but:

- In compliance with landing obligation
- Not encouraging overfishing
- Not distorting current markets and commercialization channels

Children market: Opportunities

There are not many fish products for kids enriched in protein, easy to chew, with suitable flavors, combined with healthy matrices and boneless

Senior market: Opportunities

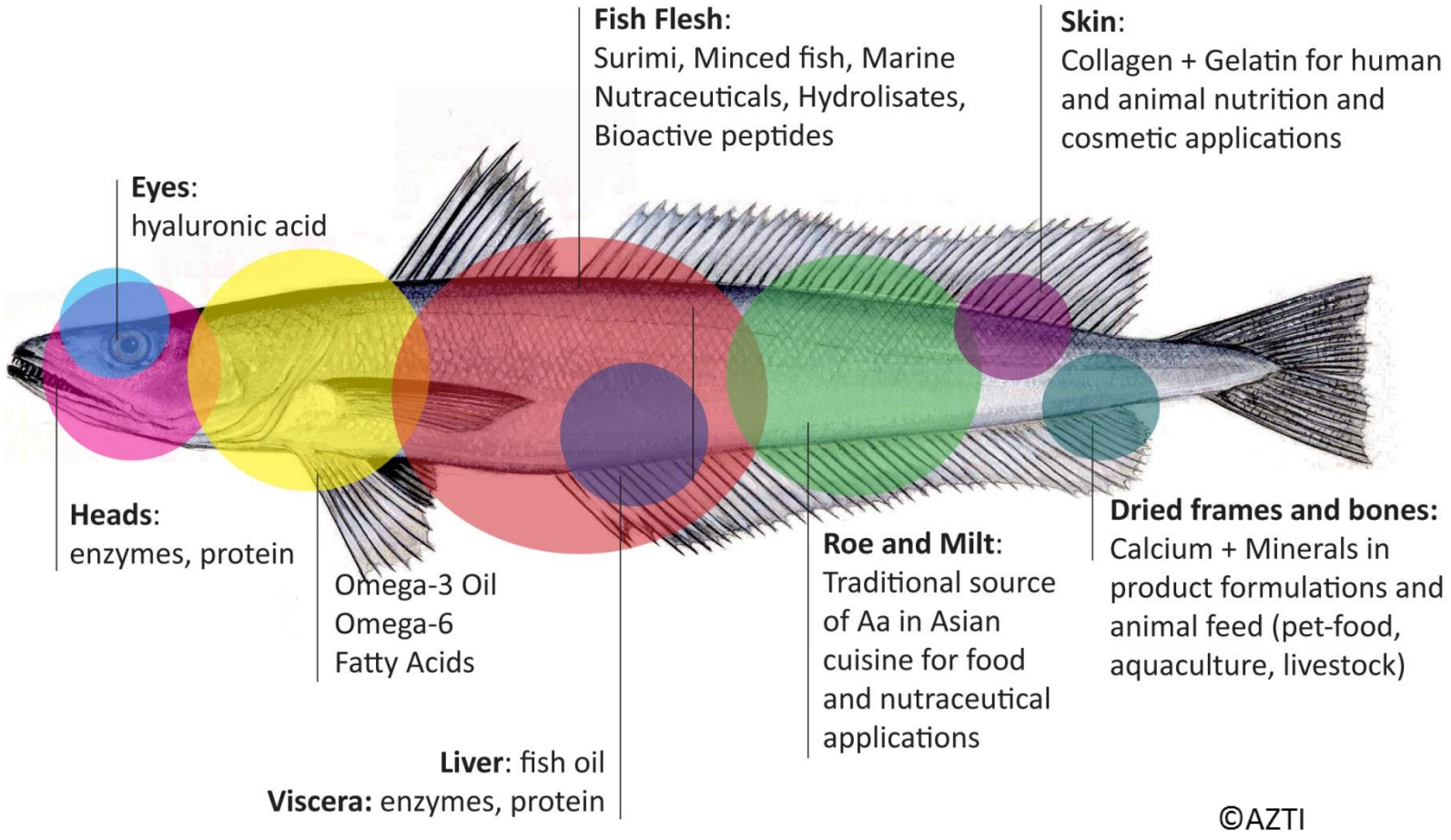
One of the niche markets with higher growth expectations. Globally, the number of those aged 65 and over is growing at around twice the rate of the overall population.

Alternative uses

New Seafood Products

Opportunity: New concepts adapted to the USER - CUSTOMER

Possible uses of fish beyond human consumption



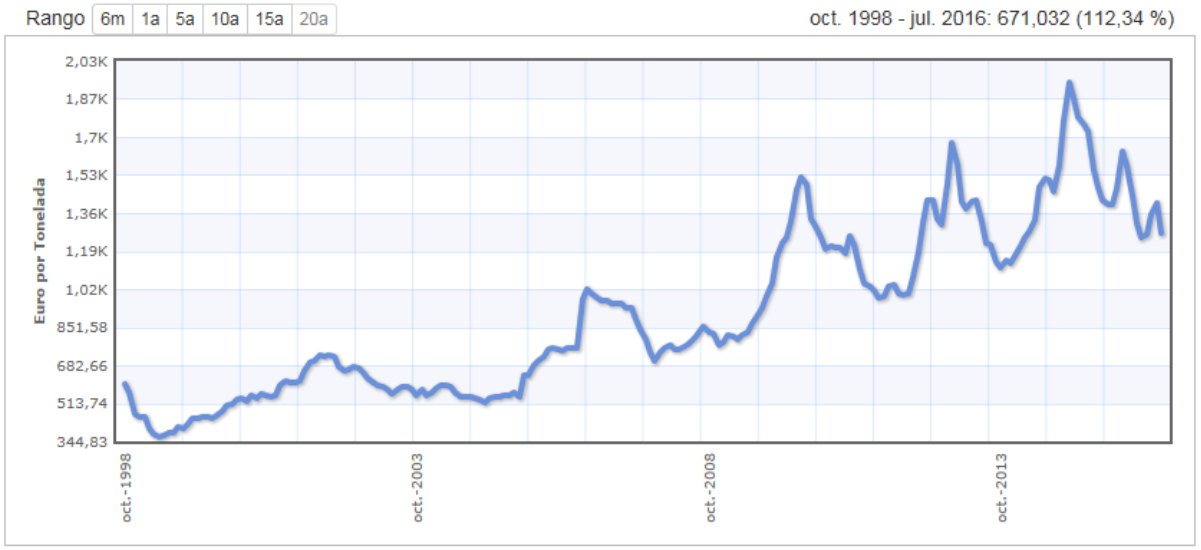
All Ingredients: For foods, dietary supplements, animal nutrition, medicine, cosmetic Ingredients, and what cannot be used previously , can go ultimately to bioenergy (biogas)

Alternative uses

ANIMAL FEED USES

Ingredients for feed (dried, ensilaged,…):

- Pet-food
- Aquaculture
- Livestock



Descripción: Fishmeal, Peru Fish meal/pellets 65% protein, CIF, Euro por Tonelada

Unidad: Euro por Tonelada

Fish meal prices – Last 20 years

Task 6.3: Initial selection of potential uses and solution approach

Selection based on:

1. Economic value (volume and market price).
2. Demand and market developments
3. Immediacy of commissioning
4. Investment required

Short term alternative:

- Existence of buyer and infrastructure
- Potential positive results
- Comprehensive solution (100 % of waste valorized).
- Delivery without on board pre-treatment.

Medium term alternatives:

- Additional I&Inv for greater economic value.

Methodology for the selection of potential uses (I)

For a specific scenario, applying Multi-Criteria Decision Analysis (MCDA) using an Analytic Hierarchy Process (AHP) method.

Categories and Criteria for the MCDA

Category	Criteria	Units
CS dependent	Available Raw Material (A)	t/year
	Available facilities (B)	Nº Facilities
Technical factors	Yield (C)	%
	Technology maturity (D)	H/M/L/Exp
Economic factors	Value of the product (E)	€/Kg
	Potential Market (F)	t/year
	Production Costs (G)	€/Kg
	Competing companies (H)	t/year

For each case study: Raw material availability

			Atlantic horse mackerel	Atlantic mackerel	European hake	Blue whiting(=Poutassou)	Mediterranean horse mackerel	Boarfish	Cuckoo ray	European anchovy	Whiting	Blackbellied angler	Megrim	Angler(=Monk)	Haddock	Thornback ray	Soles nei	Undulate ray	Sharks, rays, skates, etc. nei	European plaice	Raja rays nei	Norway lobster	Spanish ling	Spotted ray	Amer. plaice(=Long rough dab)	Northern cods nei
FOOD	New Fish Produts		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Surimi		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Fish pulp		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BIO-PRODUCTS	Bioactive Peptides		X	X			X			X																	
	Polyunsaturated fatty acids (PUFAs)		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	
	Proteases and Proteolytic enzymes (Trypsin ...)																										
	Chondroitin sulphate								X							X		X	X		X			X	X	X	
	Fat-soluble vitamins		X	X			X			X																	
	Minerals: Calcium, CaCO3		X	X	X	X	X	X		X	X	X	X	X	X		X			X		X	X		X	
	Dye / pigments (Astaxantin)																					X					
	Collagen								X							X		X	X		X			X	X	X	X
	Gelatine								X							X		X	X		X			X	X	X	X
	Sterols		X				X																				
	Insulin																										
	Protamine																										
	Hyaluronic acid																		X					X			
	Chitin / Chitosan																					X					
	Pearl Essence																										
	Phospholipids																										
	Peptone																										
	Escualene																		X								
FEED	Fish meal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Fish oil	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Mink feed		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Marine beef/Bait		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Direct Pig Feed		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Protein concentrate (FPC)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Protein Hydrolysate (FPH)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Silage	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
	Insects growth	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
INDUSTRIAL USES	Leather															X			X								X
	Fish oil	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Minerals: Calcium, CaCO3		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Chitin / Chitosan																					X					
ENERGY	Biogas	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AGRONOMIC USES	Compost	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Fertilizers	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Methodology for the selection of potential uses (IV)

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Valorisation options for BoB prioritised

		CS dependent			Technical Parameters			Economical Parameters					
	Option	Available Raw Material (A)	Existing facilities (C)		Yield (B)	Technology maturity (D)		Value of the product (E)	Potential Market (F)	Production Costs (G)	Competing companies (H)		Total Score (FACTOR)
Category	Valorisation option	10	7	5	7	5	7	10	10	7	2	7	
FOOD	New Fish Products	5	5	1,00	5	5	1,00	5	5	3	1	0,85	0,94
	Surimi	3	0	0,35	3	5	0,77	5	3	1	1	0,61	0,60
	Fish pulp	5	5	1,00	3	5	0,77	5	5	5	5	1,00	0,91
BIO-PRODUCTS	Bioactive Peptides	5	1	0,67	3	3	0,60	5	3	1	3	0,64	0,63
	Polyunsaturated fatty acids (PUFA	5	3	0,84	3	5	0,77	5	5	3	1	0,85	0,81
	Proteases and Proteolytic enzym	3	0	0,35	0	1	0,08	1	1	1	1	0,20	0,20
	Chondroitin sulphate	0	3	0,25	1	5	0,53	5	3	1	1	0,61	0,49
	Fat-soluble vitamins	3	0	0,35	1	3	0,37	3	3	1	1	0,48	0,40
	Minerals: Calcium, CaCO3	5	1	0,67	3	5	0,77	3	3	5	3	0,70	0,72
	Dye / pigments (Astaxantin)	1	0	0,12	0	5	0,42	5	3	1	3	0,64	0,42
	Collagen	3	3	0,60	1	5	0,53	3	3	3	1	0,57	0,57
	Gelatine	3	3	0,60	1	5	0,53	3	3	3	1	0,57	0,57
	Sterols	1	0	0,12	1	3	0,37	3	3	0	3	0,46	0,33
	Insulin	1	0	0,12	3	1	0,43	3	1	0	0	0,28	0,29
	Protamine	1	0	0,12	0	3	0,25	1	1	1	0	0,19	0,19
	Hyaluronic acid	1	0	0,12	1	3	0,37	3	3	1	0	0,46	0,34
	Chitin / Chitosan	1	0	0,12	1	5	0,53	5	3	3	1	0,71	0,49
	Pearl Essence	3	0	0,35	1	5	0,53	1	0	3	3	0,26	0,38
	Phospholipids	3	0	0,35	1	3	0,37	3	3	0	3	0,46	0,40
	Peptone	5	1	0,67	3	5	0,77	1	1	5	1	0,39	0,60
	Escualene	0	0	0,00	1	3	0,37	5	3	1	0	0,60	0,36
FEED	Fish meal	5	5	1,00	5	5	1,00	1	5	5	1	0,67	0,88
	Fish oil	5	5	1,00	5	5	1,00	1	5	5	1	0,67	0,88
	Mink feed	5	3	0,84	5	3	0,83	1	1	5	3	0,42	0,68
	Marine beef/Bait	5	1	0,67	5	3	0,83	1	1	5	3	0,42	0,64
	Direct Pig Feed	5	1	0,67	5	3	0,83	1	3	5	3	0,56	0,69
	Protein concentrate (FPC)	5	3	0,84	5	5	1,00	3	5	5	3	0,83	0,90
	Protein Hydrolysate (PH)	5	3	0,84	5	5	1,00	3	5	5	3	0,83	0,90
	Silage	5	0	0,59	5	5	1,00	1	1	5	5	0,45	0,69
	Insects growth	5	0	0,59	3	3	0,60	1	1	5	5	0,45	0,54
INDUSTRIAL USES	Leather	1	3	0,36	1	5	0,53	3	1	3	5	0,49	0,47
	Fish oil	5	5	1,00	5	5	1,00	1	5	5	1	0,67	0,88
	Minerals: Calcium, CaCO3	5	3	0,84	3	5	0,77	1	3	5	3	0,56	0,71
	Chitin / Chitosan	0	0	0,00	3	5	0,77	1	3	3	1	0,43	0,44
ENERGY	Biogas	5	1	0,67	1	3	0,37	1	3	3	1	0,43	0,47
AGRONOMIC USES	Compost	5	1	0,67	3	3	0,60	0	3	5	1	0,46	0,57
	Fertilizers	5	1	0,67	3	5	0,54	0	3	5	1	0,46	0,54

Methodology for the selection of potential uses

Valorisation options for BoB: higher scores

	Option	CS dependent	Technical Para	Economical Parameters		Total Score (FACTOR)
Category	Valorisation option	5	7	7		
FOOD	New Fish Products	1,00	1,00	0,85		0,94
	Fish pulp	1,00	0,77	1,00		0,91
BIO-PRODUCTS	Bioactive Peptides	0,67	0,60	0,64		0,63
	Polyunsaturated fatty acids (PUFA	0,84	0,77	0,85		0,81
FEED	Fish meal	1,00	1,00	0,67		0,88
	Fish oil	1,00	1,00	0,67		0,88
	Protein concentrate (FPC)	0,84	1,00	0,83		0,90
	Protein Hydrolysate (PH)	0,84	1,00	0,83		0,90

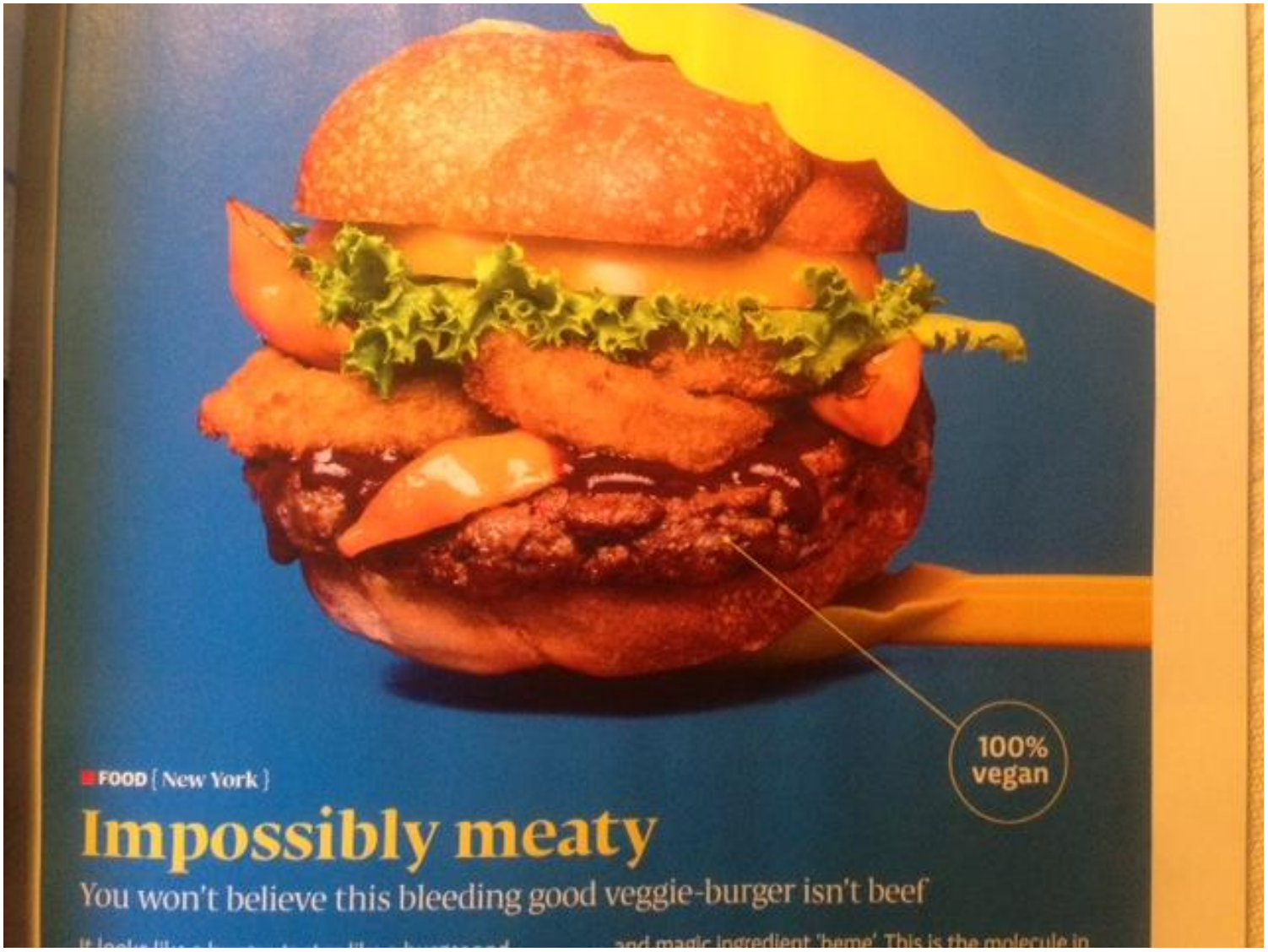
Selection of potencial uses: main conclusions for BoB

=> In the BoB case study, three approaches for single products have been selected for detailed process definition and piloting:

- Minced fish products from Mackerel (>MRCS)
- Adapt management in present fishmeal facilities
- Fish protein hydrolysate from Hake

=> The combination of different solutions can be studied following a bio-refinery scheme, which may result in an increase on raw material use, profitability and sustainability. A detailed evaluation of the biorefinery solution implementation will be performed to evaluate in detail its economic viability.

Task 6.3: Initial selection of potential uses and solution approach



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An example using Mackerel (minced fish, fish pulp) in food service for the Basque schools

HORECA sector needs to introduce new fatty fish based products at school canteens, sensorially accepted by child population

Who is the target?

Conclusions till date

- ✓ Each scenario need an *ad hoc* solution: different UUC quantities, quality, dispersion, available infrastructures…
- ✓ No clear future scenario regarding the volume available: application of selective gears, new fishing strategies, new rules…
- ✓ We are working in short term solutions to facilitate rapid adaptation and simultaneously in mid and long term for a sustainable future:
  - Short term: feed products
  - Mid term: minced fish, pulps, intermediate products with stable markets and mature technologies (e.g. gelatin, omega-3,…)
  - Long term: high value options that require important investments (e.g. specific biomolecules)

Valorization Option Fact Sheets

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Valorisation Option Fact Sheet:

GELATINE

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680.

Product description:

Gelatine is an irreversibly hydrolysed form of collagen, which produces smaller peptides with a broad molecular weight ranges.

Gelatine is a viscous semi-solid gel; its general composition includes 85% to 90% protein, 2% to 4% mineral salts and 8% to 12% water.

There are two main types of gelatines:

- Type A: obtained from the acid hydrolysis procedure.
- Type B: obtained from the alkaline hydrolysis procedure.

Raw materials:

The most common raw material for fish gelatine is fish skin (specially tuna skins), but substantial amounts are also made from fish scales. Fish bones or fish muscle are seldom used, since they do not contain very much collagen.

For hydrolysed products, collagen from both warm and cold water fish are used.

Hygienic requirements are strict in order to could be used for added value applications.

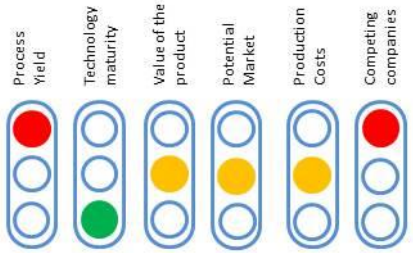
Product applications:

Gelatine is commonly used as a gelling agent in food, pharmaceutical drugs, photography and cosmetics manufacturing.

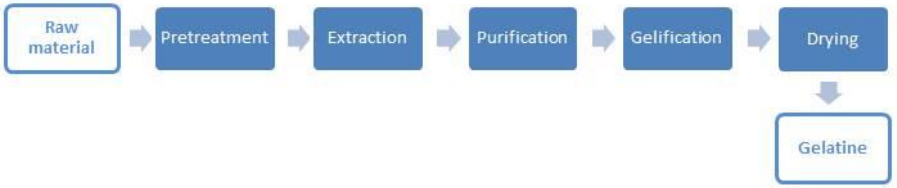
Gelatine is found in most gummy candy, as well as other products such as marshmallows, gelatine deserts and some ice creams, dips and yogurts.

The traditional application for cold water fish gelatine is microencapsulation of heat sensitive vitamins and other nutrients.

Feasibility:



Simplified process scheme:



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Valorization Option Fact Sheets

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Valorisation Option Fact Sheet:

FISH PROTEIN HYDROLYSATES

This project has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement no. 633680

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Product description:

Fish protein hydrolysate is produced from the protein fraction of whole fish, fish by-products or process waters .

Typically, it is a powder with creamy colour and a fishy smell. It presents around 80 % protein, less than 5 % humidity and less than 11 % of fat content.

There are two main presentations:

- Soluble Fish protein Hydrolysate (FPH)
- Partially hydrolyzed protein (PHP).

Raw materials:

They can be obtained by all species. Fish muscle, whole fish or fish by-products.

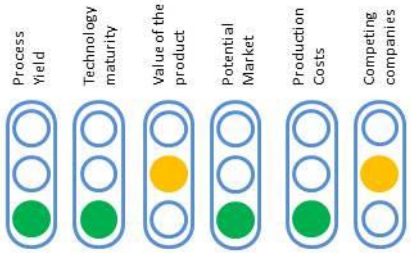
There is no need of previous transformation although previous drying would be advisable in order to reduce transport costs. Raw material should be storaged in refrigerated conditions or frozen. Hystamine production should be carefully controlled.

Product applications:

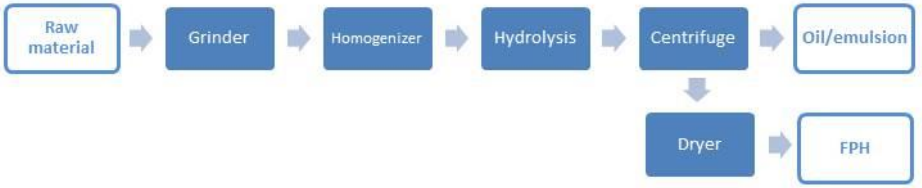
The main applications are:

- Food industry: tasting and flavoring agents in bakery, ice creams, sweets, soups, mayonnaise. Texturizing, jelling or emulsifying agents. Salt and monosodium glutamate replacer. Fish sauce.
- Feed sector: feed supplements
- Fertilizers: nitrogen source
- Chemical industry: additives in paints, varnishes, lacquers, paper, fire extinguishers, resins, leather and textiles, soaps, cosmetics.
- Medicine: amino-acids source.

Feasibility:



Simplified process scheme:



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