METROFOOD: an Infrastructure for Promoting Metrology in Food and Nutrition

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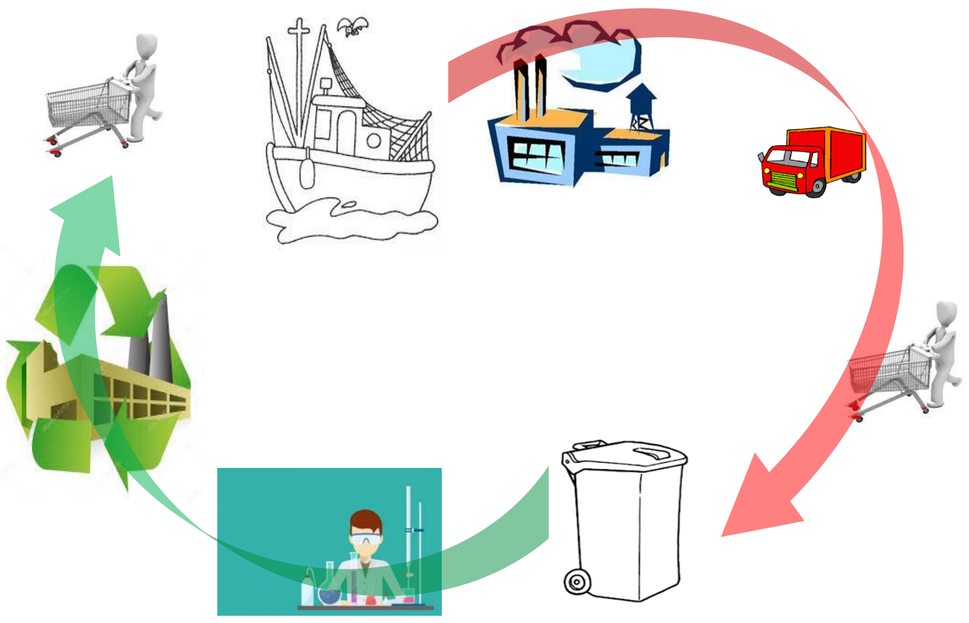
Introduction

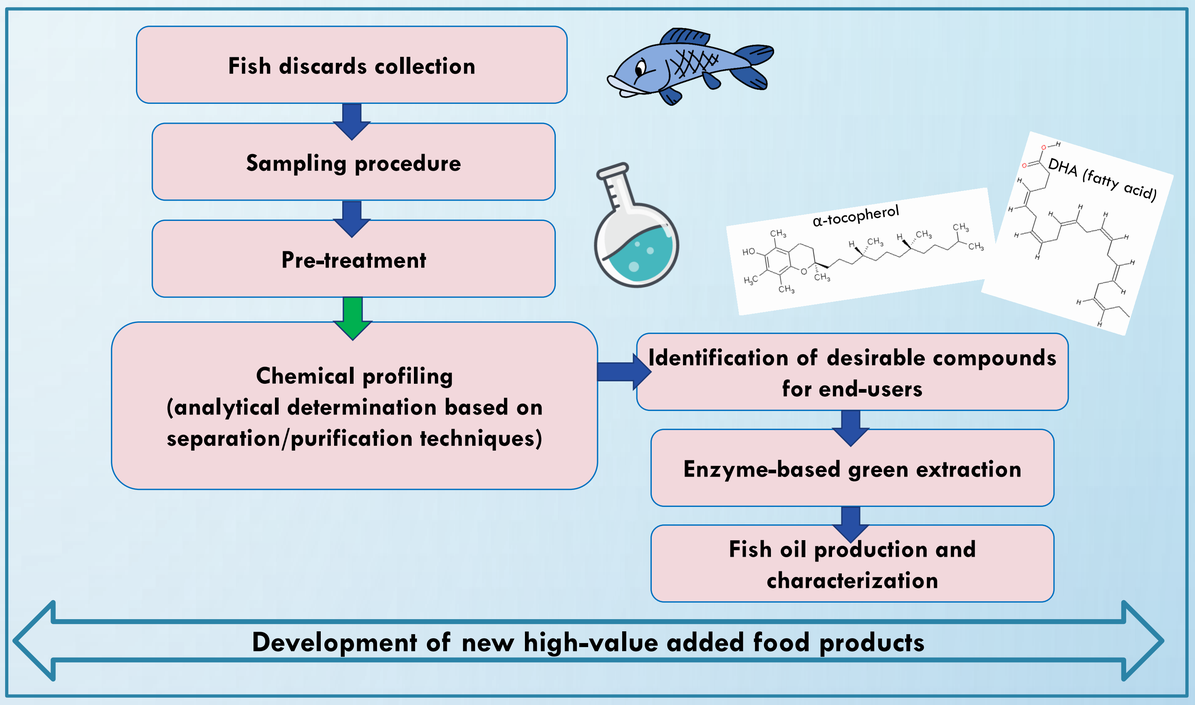
METROFOOD is an infrastructure aimed at improving the quality and the reliability of measurements in food science. It promotes data sharing, cooperation of the scientific community and harmonization of procedures. The project engages multiple actors and sectors throughout the food value chain, including sustainable development, food safety, quality, traceability, authenticity, environmental safety and human health. The METROFOOD network will include analytical laboratories for the characterization of agri-food matrices and technological systems for the production and transformation of food.

Aim of the present work

In the METROFOOD framework, an important aspect is the exploitation of food by-products, to reduce waste and promote circular economy. In fact, waste from the food chain is becoming a resource, since it can provide new high-added value ingredients. The case study here reported describes an approach to valorise fisheries waste. Although unsuitable for human consumption, it is rich of valuable nutrients, such as polyunsaturated fatty acids (EPA, DHA) and liposoluble vitamins. These can be recovered in the form of fish oil, by applying sustainable biotechnological processes, thus becoming important for several industrial applications.

Exploitation of fish processing waste

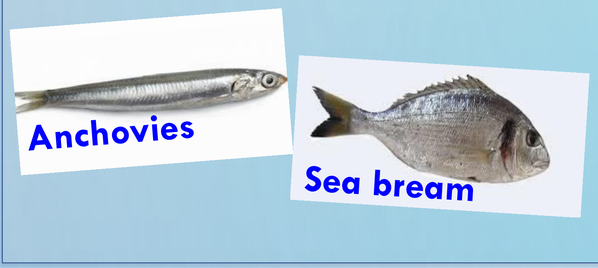




EXPERIMENTAL

Characterization of fish waste

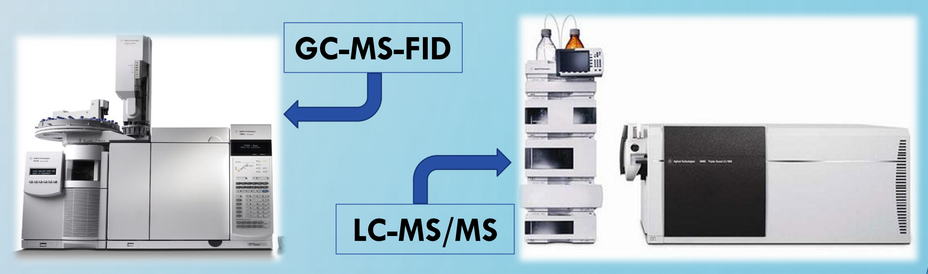
Samples



Waste: heads, viscera, frames

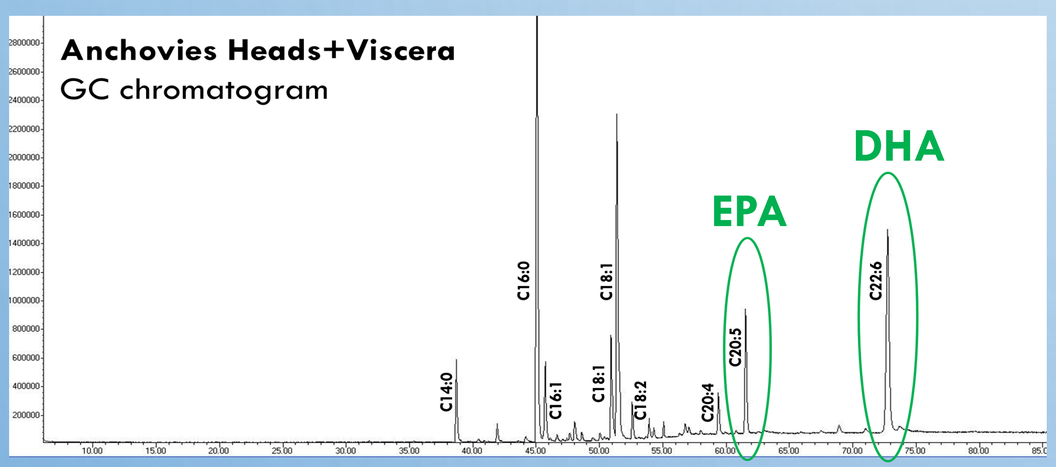
The waste material coming from anchovies processing were pooled and treated as a unique matrix (heads+viscera); the waste from sea bream was divided into viscera, frames and heads.

Analytical equipment



Fatty acids composition determined by GC/MS

- **Extraction of lipids by Bligh&Dyer method(1)**
- **Methylation of Fatty acids by BF_3 in MeOH→ Fatty Acid Methyl Esters (FAME)**
- **GC-MS-FID analysis (qualititive and semi-quantitative)**



Fatty acid (analyzed as methyl ester)	Sea bream HEADS	Sea bream VISCERA	Sea bream FRAMES	Anchovies HEAD+VISCERA
	% (relative quantitation)			
C14:0	2 ± 0.8	2.2 ± 1	2.2 ± 1.4	4.8 ± 1.9
C15:0	ND	ND	ND	1.2 ± 0.5
C16:0	17 ± 4.2	17.1 ± 4	16.9 ± 2.1	30.3 ± 6.6
C16:1	4.4 ± 1.6	4.1 ± 1.1	4.5 ± 1.9	5.2 ± 1.5
C17:0	ND	ND	ND	1.1 ± 0.1
C17:1	ND	ND	ND	0.5 ± 0.1
C18:0	3.7 ± 0.6	4.3 ± 1	3.4 ± 0.4	6 ± 0.7
C18:1 (elaidic+oleic)	44.9 ± 4.6	40 ± 8.8	41.4 ± 5.7	20.6 ± 4.5
C18:2	21 ± 2	23.2 ± 5.7	20.6 ± 6.7	1.1 ± 0.6
C18:3	4.8 ± 1	4 ± 0.7	4.1 ± 0.6	ND
C20:1	1.4 ± 0.7	1.1 ± 0.5	1.6 ± 0.7	0.9 ± 0.5
C20:4	ND	ND	ND	2.3 ± 1.3
C20:5 (EPA)	0.8 ± 0.4	1.5 ± 0.5	2.3 ± 1.7	**7.6 ± 4.3**
C22:6 (DHA)	2.2 ± 1.9	3.5 ± 0.4	4.1 ± 1.6	**17.9 ± 8.6**

Liposoluble bioactive compounds determined by LC/MS-MS

- **Lipidic extract subjected to hot saponification by KOH in EtOH**
- **Extraction of the unsaponifiable fraction by ethyl acetate/hexane**
- **LC-APCI-MS/MS analysis (absolute quantitation and reliable identification)**

Compound	Sea bream VISCERA	Sea bream FRAMES	Anchovies HEADS+VISCERA
	µg/g (fresh sample)		
retinol	46.6 ± 3.4	0.1 ± 0.01	4.8 ± 0.4
γ-tocopherol	0.9 ± 0.1	ND	0.1 ± 0.01
α-tocopherol	44.8 ± 5.5	12 ± 1.5	1.1 ± 0.1
squalene	33.2 ± 4.8	10.7 ± 1.5	7.3 ± 1
β-sitosterol	25.4 ± 2.4	0.6 ± 0.1	4.6 ± 0.4
brassicasterol	1.6 ± 0.1	ND	ND
campesterol	2.5 ± 0.2	ND	2.8 ± 0.2
sitostanol	9.1 ± 0.6	ND	1.6 ± 0.1
stigmasterol	7.6 ± 1.1	ND	2.1 ± 0.3

Conclusions and perspectives

- **Fish waste is rich in polyunsaturated fatty acids and is source of tocopherols, retinol, squalene and phytosterols (in minor extent)**
- **Quantitative chromatographic data can be correlated to FTIR spectra by chemometric models, speeding analysis**
- **The identified compounds can be recovered through sustainable approaches in the form of fish oil, a resource for many industrial applications**

References

(1) Bligh, E. G., & Dyer, W. J. A rapid method of total lipid extraction and purification. *Canadian J. of 387 Biochemistry and Physiology*, 1959, 37: 911-917.