AQUACULTURE FISH BY-PRODUCTS: A SOURCE OF MARINE COLLAGEN

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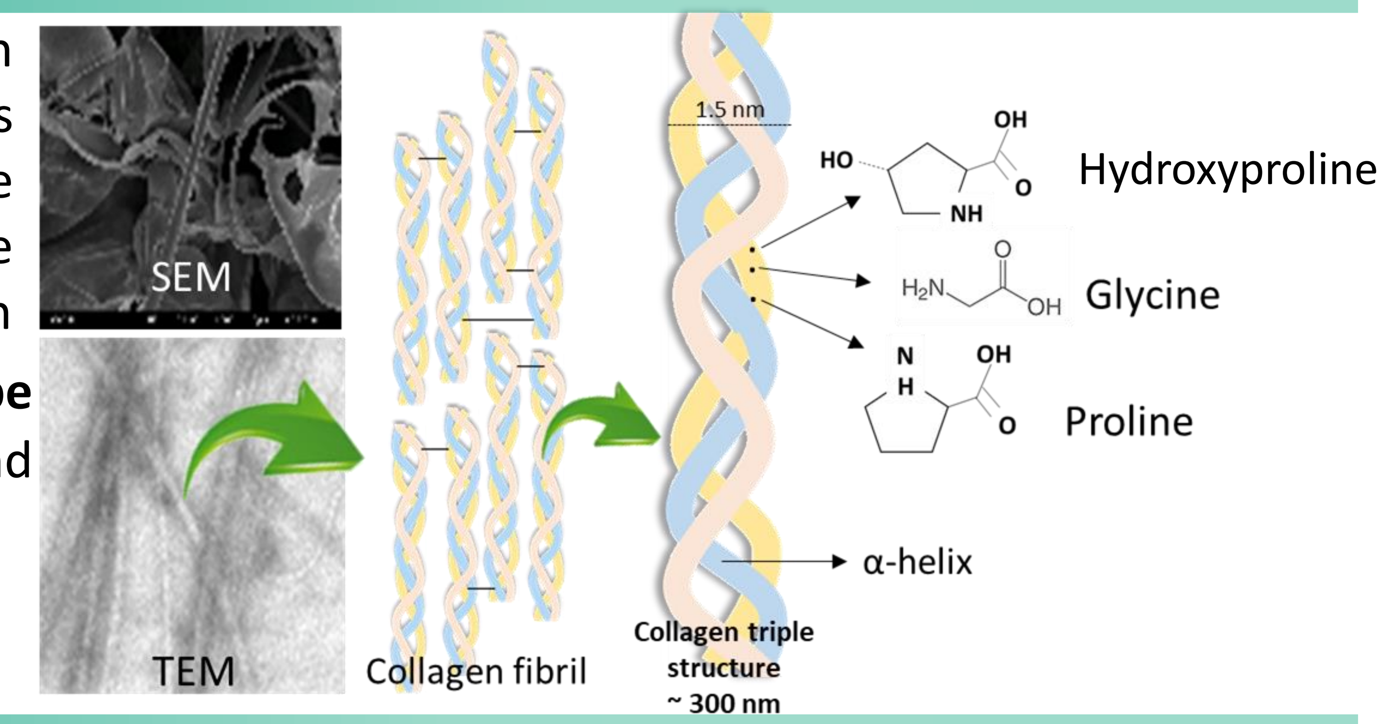
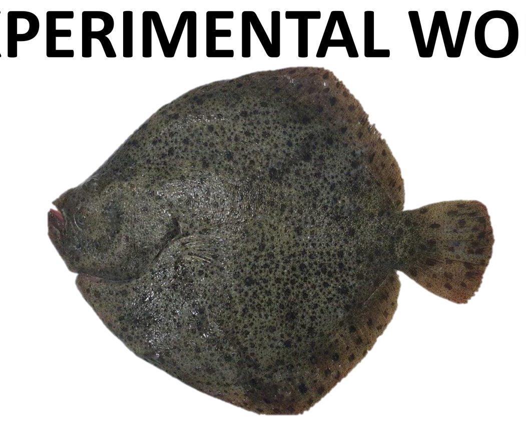
INTRODUCTION AND OBJECTIVE

Collagen is one of the most important structural proteins in the animal kingdom and it is present in different types of tissues and structures, such as connective tissues, bones or skin. Collagen and its denatured form, gelatine, exhibit a great number of **industrial applications**, such as ingredient for the cosmetic , nutraceutical and pharmaceutical ,food industries and even for biomaterial and tissue engineering. The potential of some **aquaculture by-products** for obtaining collagen as a main **by-product** in the framework of the **H2020 project Green Aquaculture Intensification in Europe** was studied.The main outcome of the project was to increase quantity, quality and sustainability of farmed products.



EXPERIMENTAL WORK

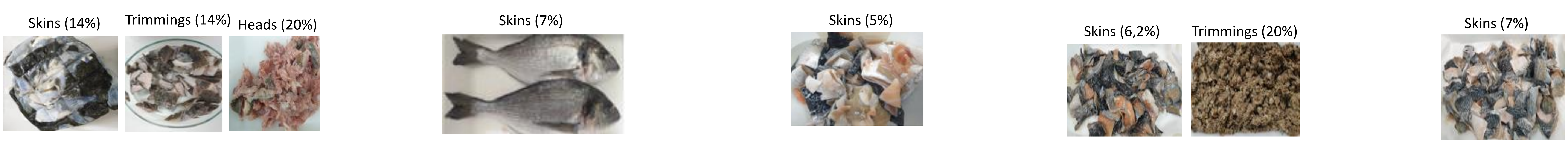

Turbot (S. maximus)


Seabream (S. aurata)


Salmon (S. salar)

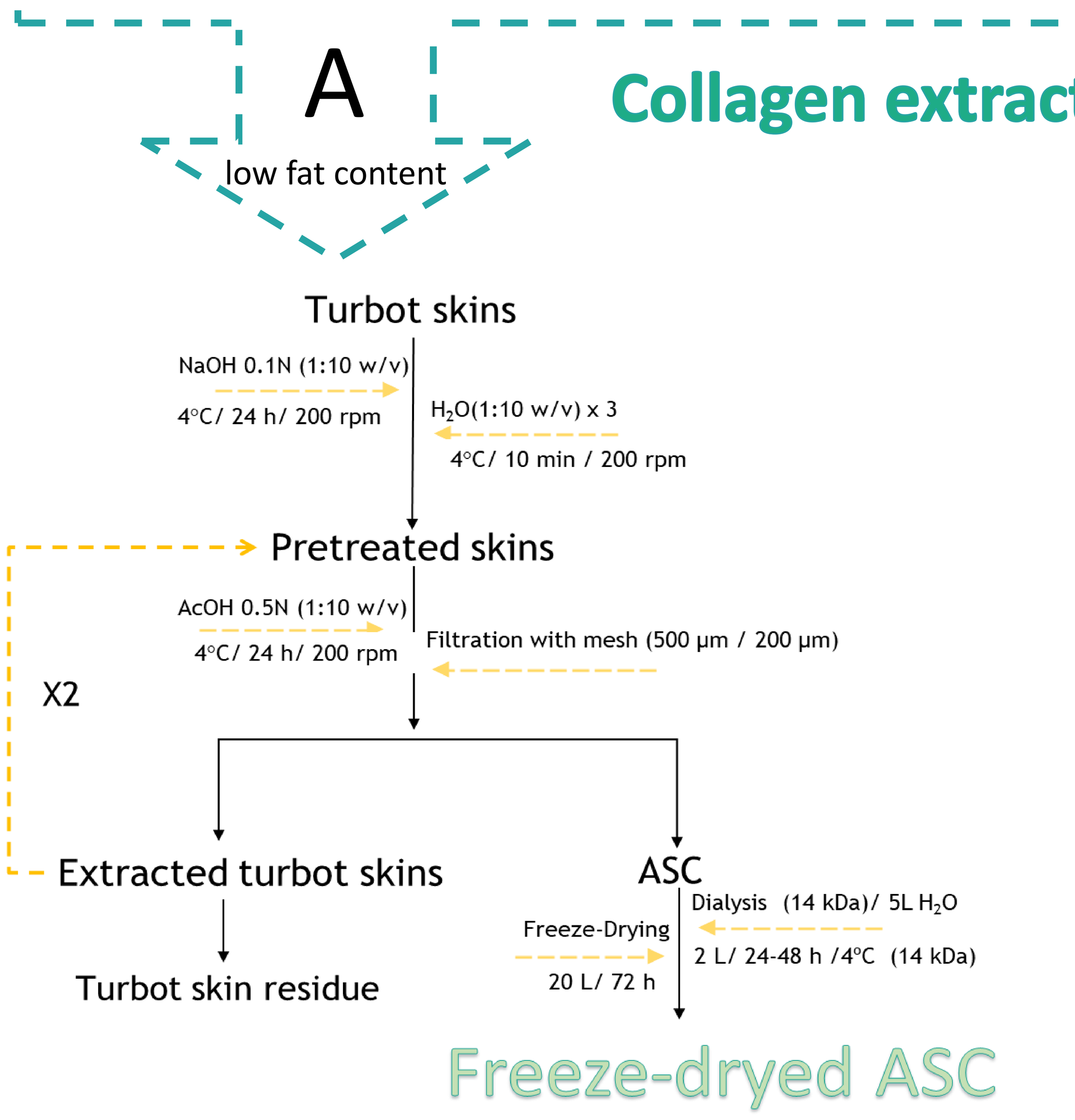

Trout (O. mykiss)

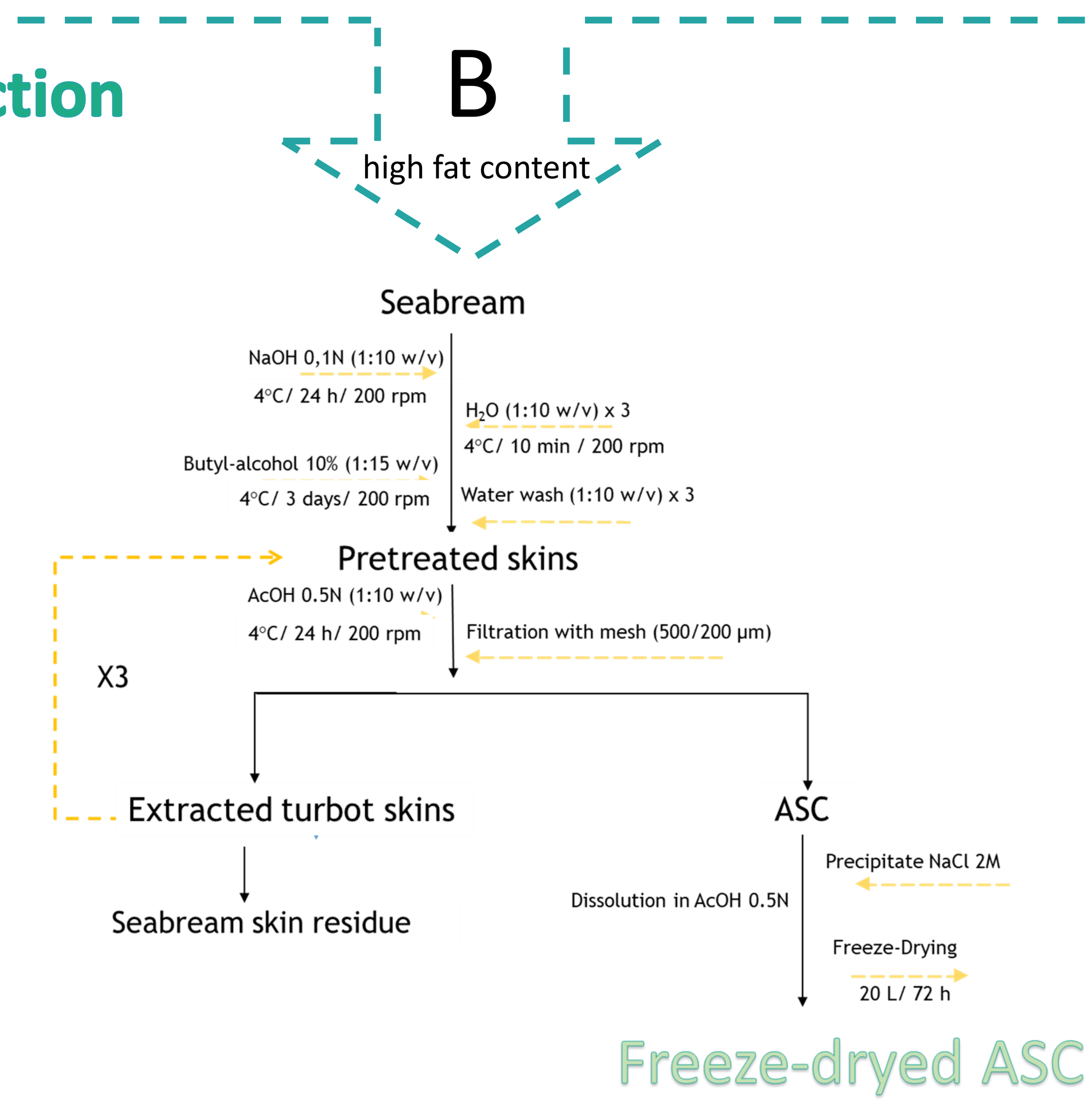

Seabass (D.labrax)



Aquaculture by-products from different species used for collagen extraction

Collagen extraction





By-products chemical characterization

By-products	Water %	Protein %	Lipid %	Ash %
Trout skins	66.20±0.72	19.56±0.03	12.40±0.07	1.85±0.08
Trout trimmings	66.01±0.62	15.14±0.08	11.14±0.08	3.76±0.09
Salmon skins	55.41±0.50	28.20±0.45	21.88±0.54	1.64±0.11
Turbot skins	71.96±0.78	24.30±0.81	2.59±0.30	1.38±0.09
Turbot trimmings	76.58±0.29	17.84±0.30	0.80±0.01	4.56±0.11
Turbot heads	75.05±0.64	17.13±0.34	1.52±0.01	5.84±0.18
Seabass skins	59.49±1.66	22.56±0.57	13.09±0.03	1.34±0.05
Seabream skins	44.06±0.78	23.27±1.23	29.28±0.68	2.37±0.120

Chemical composition of aquaculture by-products used for collagen extraction. Values are expressed as percentage on a wet basis.

Collagen yield	% Yield (wb)	% Yield (db)
Turbot skins	18 ± 1.24	63 ± 4.42
Turbot trimmings	8 ± 1.09	34 ± 4.67
Turbot heads	3 ± 0.52	13 ± 2.10
Seabream skins	13 ± 0.09	24 ± 0.16
Salmon skins	5 ± 0.52	11 ± 1.17
Trout skins	5 ± 0.38	16 ± 1.13
Trout trimmings	1 ± 0.06	2 ± 0.18
Seabass skins	10 ± 1.56	25 ± 3.86

Collagen characterization

	Fish by-products							
	Salmon skin	Turbot skin	Turbot trimmings	Turbot head	Seabass skin	Seabream skin	Trout skin	Trout trimmings
Alanine	101.21 ± 0.48	121.67 ± 0.11	117.80 ± 0.42	120.61 ± 0.28	116.83 ± 0.22	118.60 ± 0.16	102.65 ± 0.04	110.77 ± 0.31
Arginine	49.28 ± 0.19	53.73 ± 0.05	50.94 ± 0.21	50.29 ± 0.13	48.20 ± 0.10	46.68 ± 0.05	44.87 ± 0.23	44.48 ± 0.08
Aspartic acid	60.12 ± 0.09	52.93 ± 0.03	50.88 ± 0.26	50.02 ± 0.10	53.44 ± 0.06	44.88 ± 0.10	50.08 ± 0.14	52.13 ± 0.02
Cysteine	3.99 ± 0.06	3.25 ± 0.01	3.40 ± 0.05	3.61 ± 0.01	4.32 ± 0.09	2.92 ± 0.00	4.07 ± 0.04	4.50 ± 0.02
Glutamic acid	78.61 ± 0.12	74.48 ± 0.07	72.32 ± 0.30	68.50 ± 0.17	78.45 ± 0.14	72.22 ± 0.10	69.06 ± 0.01	75.06 ± 0.12
Glycine	275.50 ± 1.40	290.61 ± 0.09	292.56 ± 0.16	87.52 ± 0.25	297.07 ± 0.14	300.82 ± 0.36	236.54 ± 13.69	325.70 ± 0.81
Histidine	10.33 ± 0.03	7.34 ± 0.01	6.89 ± 0.05	6.61 ± 0.01	6.67 ± 0.01	5.52 ± 0.00	8.47 ± 0.04	7.81 ± 0.02
Isoleucine	13.64 ± 0.05	10.53 ± 0.06	9.80 ± 0.04	9.31 ± 0.03	9.62 ± 0.05	5.44 ± 0.01	9.48 ± 0.10	9.28 ± 0.04
Leucine	29.45 ± 0.12	25.33 ± 0.01	24.10 ± 0.08	23.41 ± 0.02	25.83 ± 0.06	20.08 ± 0.03	20.46 ± 0.11	22.02 ± 0.03
Lysine	28.85 ± 0.02	30.40 ± 0.04	29.00 ± 0.17	28.07 ± 0.06	29.46 ± 0.04	26.58 ± 0.02	25.06 ± 0.07	25.93 ± 0.04
Hydroxylysine	7.15 ± 0.07	5.35 ± 0.04	4.42 ± 0.02	4.67 ± 0.01	4.21 ± 0.06	4.98 ± 0.08	5.93 ±0.02	6.90 ± 0.06
Methionine	17.81 ± 0.02	16.61 ± 0.00	16.37 ± 0.07	15.88 ± 0.04	15.22 ± 0.01	16.49 ± 0.06	18.06 ± 0.08	19.41 ± 0.02
Phenylalanine	17.24 ± 0.06	17.93 ± 0.08	16.30 ± 0.05	16.46 ± 0.00	15.73 ± 0.04	14.65 ± 0.13	14.92 ± 0.16	18.10 ± 0.09
Hydroxyproline	48.52 ± 0.43	62.91 ± 0.07	60.98 ± 0.34	62.93 ± 0.24	63.56 ± 0.21	77.46 ± 0.07	52.76 ± 0.50	53.82 ± 0.22
Proline	85.84 ± 0.43	102.32 ± 0.03	94.35 ± 0.33	305.34 ± 0.77	98.23 ± 0.14	101.47 ± 0.16	158.89 ± 12.69	86.11 ± 0.18
Serine	50.48 ± 0.14	58.09 ± 0.07	55.91 ± 0.36	54.58 ± 0.12	49.56 ± 0.08	46.17 ± 0.01	50.01 ± 0.08	51.61 ± 0.10
Threonine	28.02 ± 0.07	25.83 ± 0.02	24.46 ± 0.16	24.06 ± 0.04	28.43 ± 0.01	24.36 ± 0.05	21.96 ± 0.09	22.29 ± 0.00
Tyrosine	6.14 ± 0.06	6.28 ± 0.02	3.83 ± 0.02	3.66 ± 0.02	4.09 ± 0.03	2.96 ± 0.01	2.33 ± 0.01	2.63 ± 0.02
Valine	22.83 ± 0.07	21.62 ± 0.10	19.32 ± 0.06	18.74 ± 0.03	20.91 ± 0.15	15.14 ± 0.02	16.29 ± 0.06	17.04 ± 0.02
Imino acids	134.36	165.23	155.34	368.27	161.79	178.93	211.65	139.93
% hydroxylation Pro	36.11	38.07	39.26	17.09	39.29	43.29	24.93	38.46

CONCLUSIONS

- The highest ASC yield was obtained for turbot skin and the lowest for the trimmings of trout. Collagen was significantly pure as high molecular weight subunits can be observed in the gel. Small differences were observed in the molecular structure between collagens.
- Salmon and seabream skins presented high lipid content (> 20%) while others like turbot showed low lipid content (< 3%). This can have an impact on the collagen yield obtained.
- Results showed that although some by-products, such as turbot skin, is a rich source of collagen represent a poor potential for the industry due to current low production volume of this species coupled with very low processed turbot. On the other hand, other by-products like salmon skin, while not rendering high collagen amount are highly processed, rendering a significant amount of by-products, suitable for a potential upscaling of collagen extraction.

REFERENCES

Malcorps W. et al.2021. Nutritional Characterisation of European Aquaculture Processing By-Products to Facilitate Strategic Utilisation. Front. Sustain. Food Syst. 5:720595. doi: 10.3389/fsufs.2021.720595

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