Antioxidant peptides obtained from enzymatic hydrolysis of animal by-products

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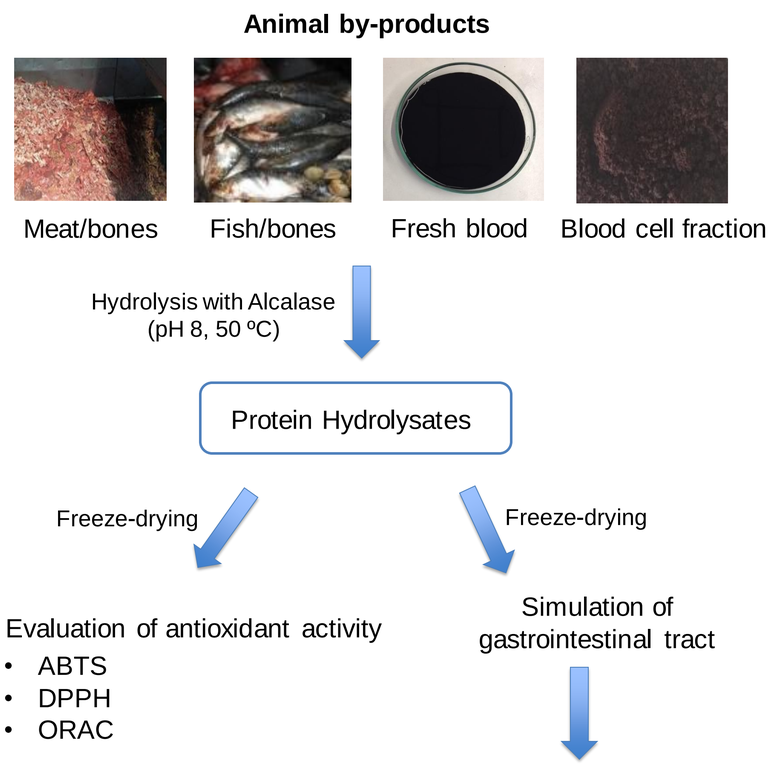
Introduction

Dietary proteins have a beneficial role in human health beyond their well-recognized nutritional value. Protein hydrolysis is used to improve the functional and biological properties of the proteins by the generation of bioactive peptides. Enzymatic hydrolysis is a common choice for producing food-grade protein hydrolysates, cause this process is safe, easily controlled and does not impair the nutritional quality of the original protein substrate [1, 2]. Bioactive peptides have been defined as protein hydrolysates which, upon entry and absorption into the body, have the ability to produce desirable biological functions, such as antioxidant activity [3].

Reactive oxygen species (ROS) and reactive nitrogen species (RNS) are free radicals that have a vital role in the body (e.g. host defense against pathogens), however an imbalance between free radical production and endogenous antioxidant defense may cause cellular oxidative stress. Oxidative damage has been related to cause several pathologies, such as heart diseases, stroke, arteriosclerosis, diabetes and cancer. Dietary intake of antioxidants could be a strategy to prevent these diseases. Antioxidants can directly scavenge free radicals or inhibit free radical production by chelating metal ions. Enzymatic hydrolysis under ideal conditions is the most effective and reliable way for releasing antioxidant from food proteins [4].

The large volume of organic by-products generated by food industries can be exploited to extract high value ingredient. In that context, the aim of this study was to hydrolyze proteins from animal by-products such as meat/bones, fish/bones and blood (fresh blood and blood cell fraction) obtaining hydrolysates with antioxidant activity.

Methods



Results

Table 1 – Antioxidant activity of protein hydrolysates

Protein Hydrolysates	ABTS (mg ascorbic acid equivalent/ g hydrolysate)	DPPH (mg Trolox equivalent/ g hydrolysate)	ORAC (mg Trolox equivalent/ g hydrolysate)
Meat/bones	9.2 ± 1.4	4.9 ± 0.0	116.5 ± 41.4
Fish/bones	11.0 ± 0.5	4.0 ± 0.4	153.2 ± 29.4
Fresh blood	11.1 ± 0.2	3.3 ± 0.0	180.2 ± 4.9
Blood cell fraction	14.1 ± 0.1	3.3 ± 0.1	166.8 ± 15.5

Table 2 – Antioxidant activity of protein hydrolysates after passage through gastrointestinal tract

Protein Hydrolysates	ABTS (mg ascorbic acid equivalent/ g hydrolysate)	DPPH (mg Trolox equivalent/ g hydrolysate)	ORAC (mg Trolox equivalent/ g hydrolysate)
Meat/bones	10.8 ± 0.0	3.5 ± 0.1	114.3 ± 42.9
Fish/bones	13.7 ± 0.0	2.9 ± 0.0	127.4 ± 53.9
Fresh blood	11.5 ± 3.7	2.9 ± 0.0	107.3 ± 12.8
Blood cell fraction	13.9 ± 0.2	2.7 ± 0.1	102.0 ± 43.0

Conclusions

From the sustainability point of view, it is important to valorize animal protein by-products in the context of environmental impacts as well as economic benefits of processing industries. In this study, animal by-products (meat/bones, fish/bones, fresh blood and blood cell fraction) were used to extract and hydrolyze proteins in order to obtain bioactive peptides. The hydrolysis was performed using a commercial enzyme (alcalase) at ideal conditions for each animal by-product. All protein hydrolysates showed antioxidant activity according the three complementary methods used (ABTS, DPPH and ORAC). Bioactive peptides were also submitted to an *in vitro* simulation of gastrointestinal tract and it was verified that the bioactivity was maintained.

This study recognizes the capability of proteins of different animal by-products to generate antioxidant peptides, proving that its functionality is preserved during gastrointestinal tract.

References

1 - Aspevik, T., et al. (2017). "Valorization of proteins from co-and by-products from the fish and meat industry." Topics in Current Chemistry 375(3): 53.
2 - de Castro, R. J. S. and H. H. Sato (2015). "Biologically active peptides: Processes for their generation, purification and identification and applications as natural additives in the food and pharmaceutical industries." Food Research International 74: 185-198.
3 - Agyei, D., et al. (2016). "Bioprocess challenges to the isolation and purification of bioactive peptides." Food and Bioproducts Processing 98: 244-256.
4 - Chai, T.-T., et al. (2017). "Enzyme-assisted discovery of antioxidant peptides from edible marine invertebrates: A review." Marine drugs 15(2): 42.

Acknowledgements

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