From fish to nutraceuticals – the potential of 'green solvents' to add value to fish by-products.

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Introduction

In the last years the fish industry suffered a pronounced growth due to the population seeking for healthier living habits and balance diets. According to led to Lopes et al., 2015 this growth outpaced in double the world population growth rate.

According to FAO data, in 2012, 58 million tonnes of fish were produced in fisheries and aquacultures, being the final destination of the fish divided into two fractions. About 80%, is used for direct human consumption and the remaining 20% is destine to non-food uses, such as fishmeal and oil production. For human consumption fish is processed in different levels before reaching to final consumer (Olsen et al., 2014). As a result, high amounts of fish by-products are produced, that have been used in low value applications such feed, fertilizers or even discarded.

The valorization of fish by-products is necessary to avoid environmental and economic negative impacts. Fish and fishery by-products are rich in proteins and other micronutrients that can have additional value. Besides fishmeal or oil production, from fish by-products it is possible to obtain bioactive components, polymers, amino acids, polyunsaturated fatty acids and others (Uddin et al., 2010). These have vast applications in food, nutritional and pharmaceutical industries. However, there is still a lack of efficient and green processes for the valorization of these by-products (Olsen et al., 2014).

Subcritical water (SCW) has been attracting interest due to its capacity of extracting, hydrolysate and modifying proteins and amino acids, opening new possibilities for industrial implementation (Tahir, 2015). SCW is liquid water at high temperature and because of its characteristics at these conditions it can be used as an efficient technique for obtaining various products from biomass such as sugars, peptides, organic acids or oils.

Experimental section

In this work, SCW was used for the extraction of proteins and peptides from sardine processing residues. The effect of temperature, pressure and reaction time in the extraction efficiency and composition of the extract was evaluated. Composition of peptides was studied according to molecular weight and amino-acid profile.

Due to their main differences in the feeding system and in the type of reactor that each one uses, semi-continuous and continuous apparatus were both applied and compared for studying the overall efficiency in the extraction and recovery of protein, without modifying a significant proportion of the naturally occurring high molecular weight proteins. In the semi-continuous process (figure 1), the fish residue is loaded into a 0.4 L reactor. The reactor temperature is controlled using a heating oven. Water is pumped through an HPLC pump and pre-heated to the desired temperature before entering the reactor. Pressure is controlled by a BPR valve at the end of the reactor.

In the continuous process (figure 2) the 0.4 L reactor was replaced with a ¼ inch stainless steel high pressure tube and a suspension of the fish residue in water with up to 10% of solids is pumped. Pure water is pumped and heated to the desired temperature before being mixed with the suspension stream ensuring the immediate heating of the reaction media. The diluted suspension stream is passed through the reactor where temperature is maintained and immediately decompressed at the outlet of the reactor. Pressure is controlled by a micrometer valve.

In both systems the recovered solutions at the end of the process are lyophilized and analyzed.

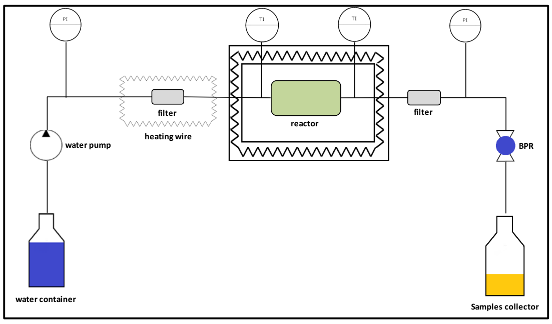

Figure 1. Semi-continuous sub-critical water extraction/hydrolysis process apparatus.

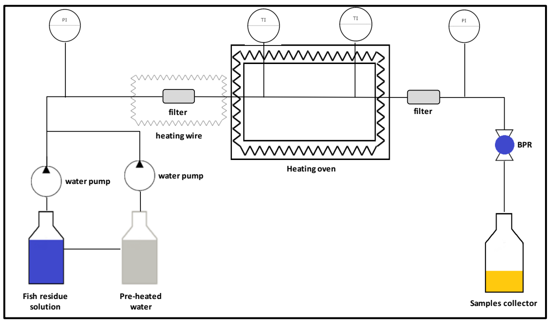

Figure 2. Continuous sub-critical water extraction/hydrolysis process apparatus.

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