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Membrane Technologies for Obtaining Bioactive Fractions from Blood Main Protein: An Exploratory Study for Industrial Application

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Abstract : The meat industry generates large volumes of blood as a result of meat processing. Several industrial procedures have been implemented in order to treat this by-product, but are focused on the production of low-value products, and in many cases, blood is simply discarded as waste. Besides, in addition to economic interests, there is an environmental concern due to bloodborne pathogens and other chemical contaminants found in blood. Consequently, there is a dire need to find extensive uses for blood that can be both applicable to industrial scale and able to yield high value-added products. Blood has been recognized as an important source of protein. The main blood serum protein in mammals is serum albumin. One of the top trends in food market is functional foods. Among them, bioactive peptides can be obtained from protein sources by microbiological fermentation or enzymatic and chemical hydrolysis. Bioactive peptides are short amino acid sequences that can have a positive impact on health when administered. The main drawback for bioactive peptide production is the high cost of the isolation, purification and characterization techniques (such as chromatography and mass spectrometry) that make unaffordable the scale-up. On the other hand, membrane technologies are very suitable to apply to the industry because they offer a very easy scale-up and are low-cost technologies, compared to other traditional separation methods. In this work, the possibility of obtaining bioactive peptide fractions from serum albumin by means of a simple procedure of only 2 steps (hydrolysis and membrane filtration) was evaluated, as an exploratory study for possible industrial application. The methodology used in this work was, firstly, a tryptic hydrolysis of serum albumin in order to release the peptides from the protein. The protein was previously subjected to a thermal treatment in order to enhance the enzyme cleavage and thus the peptide yield. Then, the obtained hydrolysate was filtered through a nanofiltration/ultrafiltration flat rig at three different pH values with two different membrane materials, so as to compare membrane performance. The corresponding permeates were analyzed by liquid chromatography-tandem mass spectrometry technology in order to obtain the peptide sequences present in each permeate. Finally, different concentrations of every permeate were evaluated for their in vitro antihypertensive and antioxidant activities though ACE-inhibition and DPPH radical scavenging tests. The hydrolysis process with the previous thermal treatment allowed achieving a degree of hydrolysis of the 49.66% of the maximum possible. It was found that peptides were best transmitted to the permeate stream at pH values that corresponded to their isoelectric points. Best selectivity between peptide groups was achieved at basic pH values. Differences in peptide content were found between membranes and also between pH values for the same membrane. The antioxidant activity of all permeates was high compared with the control only for the highest dose. However, antihypertensive activity was best for intermediate concentrations, rather than higher or lower doses. Therefore, although differences between them, all permeates were promising regarding antihypertensive and antioxidant properties.

Keywords : bioactive peptides, bovine serum albumin, hydrolysis, membrane filtration
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