

SUPERCRITICAL FLUID EXTRACTION AND FRACTIONATION OF HIGH QUALITY FISH OIL FROM HAKE SKIN.

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Abstract

Polyunsaturated fatty acids (PUFA), among them, omega-3 and omega-6 fatty acids, have been shown to have great significance in human health. Many epidemiological studies have concluded that a diet with an appropriate consumption of omega-3 can prevent cardiovascular diseases, bronchial asthma,^{1,2} and some types of cancer and psychiatric disorders.^{3,4} Nutritional experts have recommended to maintain an omega-6/omega-3 ratio of 5:1 or lower in human diet. This ratio is actually maintained only in specific diets as Japanese or Mediterranean, both of them characterized by a high consumption of fish and green vegetables, whereas the majority of modern Western diets, based in a high consumption of meat, seed oil and fast food, bring an amount of omega-6 higher than the recommended. For that reason, in the last years many products enriched with omega-3, like nutritional supplements or functional food, have been developed to balance the omega-3/omega-6 ratio without changing nutritional consumer's habits too much. This increasing demand of omega-3 enriched products promoted the search for natural sources of omega-3 fatty acids and the design of new extraction methods to obtain these compounds at production scale.

The aim of this work was to study the extraction of oil from hake skin (*Merluccius capensis-Merluccius paradoxus*) using supercritical carbon dioxide and the fractionation of the extract to obtain oil enriched with omega-3 PUFA

The extraction experiments were carried out in a semi-pilot SFE-plant with solvent recycling. The size of the plant, with a 2-L extraction vessel and two separators, one of them with 1 L and the other one with 0.5 L, allowed us to study the validity of a SFE process for new applications and to obtain the process parameters for scale-up.

In a preliminary study, using one separator, we found that the highest yield of the SFE process could be obtained when using grounded and freeze-dried hake skin. The optimum experimental parameters were found to be 250 bar, 40 °C and 10 kg CO₂/h upflow. Under these extraction conditions, we obtained oil with a high omega-3/omega-6 ratio (10:1) and the yield of the process, after 3 h of extraction, was close to 90 %. However, there was an important drawback in this process, i.e.: the free fatty acids content of the extracted oil was fairly high, in fact, higher than the value established for edible oils.

In the present study, the extracted oil was fractionated at the exit of the extractor in two separators in order to obtain a fraction rich in polyunsaturated fatty acids and with low free fatty acid content. The experimental extraction conditions were 250 bar, 40 °C and 10 kg CO₂/h upflow. The results obtained indicate that working at a pressure of 90 bar in the first separator and a pressure of 50 bar in the second separator it is possible to obtain two extracts with different characteristics. The quality of the oil recovered in the first separator was higher, not only because its low acidity (1 %), but also because of the higher amount of omega-3 (especially EPA and DHA) and the greater stability against oxidation along storage.

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