

UNIVERSIDAD DE BURGOS

ESCUELA DE DOCTORADO

TESIS DOCTORALES

TÍTULO: DEVELOPMENT OF MEAT PRODUCTS FORTIFIED WITH OMEGA-3 RICH OIL OBTAINED FROM FISH BY-PRODUCTS BY SUPERCRITICAL CARBON DIOXIDE EXTRACTION

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RESUMEN: Fish oil is known to be an important source of omega-3 polyunsaturated fatty acids such as eicosapentaenoic acid and docosahexaenoic acid, which play an important role in the prevention of different human diseases. Fortification of foods with such fatty acids is, thus, increasingly recommended. A growing public awareness about the benefits and the dietary sources of PUFA has created a substantial interest in the production of PUFA concentrates.

Fish by-products can be a valuable source for extraction of fish oil rich in polyunsaturated fatty acids, especially omega-3 PUFA; being a good opportunity for the use of these by-products and providing a huge income to the fish processing and related industries. In this study, four different fish by-products were evaluated (*Merluccius capensis* – *Merluccius paradoxus*, *Hoplostethus atlanticus*, *Genypterus capensis* and *Salmo salar*). Supercritical Fluid Extraction using carbon dioxide as the solvent (“green” technology) from salmon by-products provided higher oil yield and minimum degradation of long chain omega-3 polyunsaturated fatty acids including EPA and DHA. Then, this oil was an excellent source of nutrients for future incorporation in functional food fortified with omega-3 fatty acids.

Due to the presence of these highly unsaturated fatty acids, fish oil is very prone to oxidation, leading to the production of off-odours and off-flavours. Considerable attention has been focused in three different extracts (*Melissa officinalis*, *Salvia officinalis* and *Rosmarinus officinalis*) as natural antioxidants. Their antioxidant activity has been demonstrated in order to promote their use as natural food additives. The most suitable extract in salmon oil was sage at 5 % of concentration. Also the use of propolis as a natural antioxidant was studied, but for the moment is not feasible due to the intense flavour that impart to the samples.

On the other hand, microencapsulation by spray drying technique protects salmon oil against oxidation in comparison to salmon oil non-encapsulated. In addition, sage effectively enhances protection against oxidation in salmon oil and its use in functional products.

Finally, reduced fat pork sausages fortified with omega-3 fatty acids can be manufactured using salmon oil obtained from fish by-products by supercritical fluid extraction stabilized with microencapsulation by spray-drying and natural antioxidants, getting more healthy products with sensory properties similar to the conventional sausages. They presented a low level of SFA and high level of PUFA, with a ratio n-3/n-6 of 1.6 and provided almost 250 mg of EPA + DHA per serving (125 g) that represent 50 % of the recommended daily intake.

Palabras clave: Omega-3, fish by-products, supercritical fluid extraction, stabilization, fortified sausages.