

## Hempseed Oil Emulsion as Pork Back Fat Replacer in Cooked Sausages

Zaazaa A.<sup>a,b</sup>, Inchingolo R.<sup>a</sup>, Ansorena D.<sup>c</sup>, Cardenia V.<sup>d</sup>, Astiasarán I. ,

Rodriguez-Estrada M.T.<sup>a\*</sup>

<sup>a</sup>Department of Agricultural and Food Sciences, Alma Mater Studiorum-Università di Bologna, Bologna, Italy.

<sup>b</sup>Department of Animal Production and Animal Health, An-Najah National University, Nablus, Palestine. <sup>c</sup>Department of Nutrition, Food Science and Physiology, Faculty of Pharmacy and Nutrition, University of Navarra, Pamplona, Spain.

<sup>d</sup>Department of Agricultural, Forest and Food Sciences, University of Turin, Grugliasco (TO), Italy

Meat products are important sources of various nutrients that are essential for growth and development, but they are also rich in saturated fatty acids (SFA) and cholesterol, which are considered risk factors of several chronic diseases, mainly cardiovascular disease (CVD), cancer, obesity and type 2 diabetes. Several studies have demonstrated that the substitution of pork back-fat with polyunsaturated fatty acids (PUFA) emulsified oils is a good strategy to achieve healthier lipid profiles in meat products, with improved oxidative stability and sensory traits. Hempseed oil represents an interesting alternative, since it is an exceptionally rich source of PUFA with a n-6/n-3 ratio of 3:1 that matches human optimal nutritional needs according to the European Food Safety Authority recommendations (3-5:1).

The aim of this study was to evaluate the influence of partial or total replacement of pork back-fat (60% and 100%) by hempseed oil-in-water emulsion on the chemical composition, oxidative stability, and sensory analysis of reduced fat cooked sausages enriched with n-3 PUFA.

Three batches of bologna-type sausages were manufactured: control, 60% and 100% replacement. Hempseed oil emulsion was prepared by mixing nine parts of water with one part of isolated solid soy protein, and then with ten parts of hempseed oil. Diverse emulsion percentages were mixed with pork fat according to the desired replacement. All ingredients were minced in a chilled cutter to obtain the complete emulsification of the mixture, which was then subjected to vacuum before being stuffed in 6-cm diameter, water impermeable plastic casings. Sausages were cooked in a water bath at 80 °C for 1 h, until 72 °C was reached at product's core. Once heating was completed, the sausages were immediately cooled in a water bath for 2 h and stored frozen (-20 °C) under vacuum till analysis. The experiment was run in triplicate.

The addition of hempseed oil caused a significant increase in PUFA, with a consequent decrease of SFA and n-6/n-3 ratio according to the percentage of pork back-fat replacement. Sausages added with hempseed oil showed a significant increase in peroxide value, phytosterols and their oxidation products, but no significant effect on thiobarbituric acid reactive substances, cholesterol, cholesterol oxidation products and thiol content, was noted. Moreover, protein carbonyls significantly decreased with increasing amount of hempseed oil. Cooked sausages with 60% replacement showed good sensory acceptability scores, similar to those of samples formulated with pork back fat (control).