FATTY ACID COMPOSITION AND LIPID OXIDATION IN CHICKEN BURGERS PRODUCED WITH MEAT FROM BROILERS FED EXTRUDED LINSEED.

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Abstract – The aim of this work was the evaluation of fatty acid (FA) composition and lipid oxidation in chicken burgers from broiler fed extruded linseed (EL). Ross 308 broilers were fed a diet supplemented or not with 5% of EL. Control (C) and Linseed (L) burgers were obtained by separately processing meat from the two experimental groups. FA composition of triglycerides and phospholipids was evaluated on fresh burgers, whereas lipid oxidation was evaluated on cooked burgers. Linseed supplementation resulted in a significant increase of ω-3 FA content in the L burgers (+160%). Nevertheless, the high content of ω-3 FA decreased the oxidative stability of L burgers, as suggested by the increase of TBARS and peroxides values in cooked burgers.

Key Words – cooked meat; TBARS; omega-3 fatty acids

I. INTRODUCTION

It is well known the potential role of ω-3 FA in the prevention of cardiovascular disease, diabetes and some cancers. Currently the levels of ω-3 dietary intake is lower than recommended, and dietary polyunsaturated FA (PUFAs) are mostly ω-6 FA [1,2]. The scientific evidences about the benefits of Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) on human health, led to the promotion of the market of ω-3 enriched foods [3]. More recently, the European Food Safety Agency proposed a specific health claims also for alpha-linolenic acid (ALA), irrespective to the role of ALA as metabolic precursor of EPA and DHA. The best way to increase the consumption of ω-3 FA is to increase their content in the food chain, including chicken meat, which is one of the most consumed meat [4,5]. The supplementation of animal's diet with extruded linseed, linseed oil, canola oil or fish oils may be a strategy to increase the ω-3 FA in meat. However, changes in fatty acid composition of intramuscular fat toward a more unsaturated profile can lead to a more rapid muscle tissues oxidation especially during the heating process [6]. The aim of the present research was the evaluation of fatty acid composition and lipid oxidation in chicken burgers obtained by processing meat from broilers supplemented with extruded linseed.

II. MATERIALS AND METHODS

Twenty Ross 308 broilers were allotted to two experimental groups supplemented or not with a concentrate containing 5% of extruded linseed. The whole experiment lasted 40 days. The two diets were formulated to be isoenergetic and isoproteic. Chicken burgers were produced by separately processing meat from broilers of the two experimental groups. Meat for burger production was obtained from the lean parts of the trunk. Meat was grinded and mixed in order to obtain burger weighing 200 g and with nearly 4.5% of fat. Nine burgers from each experimental group were obtained. The burgers were analysed both as raw meat and after cooking. The heating process was carried out in the microwave for 3 minutes at 300W. The maximum internal temperature of burgers during the cooking was 80 °C. On raw meat the composition of FA of different lipid fractions: triglycerides (TG), phospholipids (PL) and free FA (FAA) were evaluated. The oxidation stability on cooked meat was assessed on cooked meat. The content of primary oxidation products was evaluated by the quantification of the peroxide values (PV), whereas the secondary oxidation process was assessed by quantification of thiobarbituric acid reactive substances (TBARS). Moreover, the secondary oxidation process of lipids was also evaluated by analysing the composition of volatile organic compounds (VOCs) on cooked burgers. VOCs were determined by solid phase micro extraction (SPME) technique. The data obtained were processed using the JMP software, according to the following linear model:

$y_i = \mu + diet_i + \epsilon_i$ where y_i = dependent variables (fatty acid, PV of TBARS); μ = average effect; $diet_i$ = fixed effect of the i-th diet (control, linseed); ϵ_i = random error.
Differences between means were considered significant at a P value <0.05. Data of VOCs were processed by principal components analysis (PCA).

III. RESULTS AND DISCUSSION

The ratio between polar and non polar lipids did not changed between C and L burgers. Linseed supplementation in the broiler diet led to a significant increase of ALA (+200%) content and a decrease in monounsaturated fatty acids (MUFA) (-20%) in total lipids of burgers. The increase in ALA content was associated with an increase of the EPA C20: 5 ω-3 (+ 338%) and DHA C22: 6 ω-3 (+ 70%) content in the burgers. The increase of ALA was mainly related to the neutral fraction (triglycerides) of fat extracted from chicken burgers, whereas the content of ALA in the polar fraction was not affected by the dietary treatment. On the contrary, the content of long chain PUFA ω-3 increased mainly in the polar fraction, which accounted for 30% of total lipids extracted from chicken burgers. The linseed supplementation also resulted in a reduction of the content of SFA such as myristic acid (C14: 0) (-44%), heptadecanoic acid (C17: 0) (-56%), stearic acid (C18: 0) (-27%). Interestingly, in the polar fraction, the increase of long chain PUFA ω-3 was associated with a decrease of arachidonic acid (C20: 4 ω-6) (-45%) content. The ω-6:ω-3 ratio in total lipids of burgers dramatically decreased from more than 10 in C burgers to less than 4 in L burgers. Changes in FA composition of burgers were associated with changes in the oxidative stability of lipids. In fact, in the L burgers, the level of peroxides tended to increase whereas the level of TBARS significantly increased (+135%) after the cooking process. As regard VOCs composition, the aromatic profile of L burgers was richer in some characteristic aldehydes of fatty acid oxidation such as exanal, eptanal and nonanal, confirming the higher sensitivity of L burgers to the oxidation during the heating process.

IV. CONCLUSION

Dietary linseed supplementation of broiler allowed to obtain chicken burgers enriched with ALA and long chain PUFA ω-3, probably due to an efficient process of desaturation and elongation of ALA in the chicken tissues. Nevertheless, data about primary and secondary products of lipid oxidation (PV, TBARS and VOCs) suggested that changes in PUFA composition increased the sensitivity of burgers to lipid oxidation during the cooking process. Since lipid oxidation is an important issue in nutritional, organoleptic and technologic characteristics of meat, specific strategies to increase antioxidant power of meat should be applied. Therefore, further studies are needed to evaluate type and level of antioxidants to be added in the feed, as well as the effect of different types of processing and storage methods on the oxidative stability of meat.

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