LOW FAT CHICKEN FRANKFURTERS MANUFACTURED WITH VEGETABLE OILS

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Introduction

Frankfurters, usually manufactured with pork meat and with a fat content higher than 30 %, are very popular food around the world. In recent years it has become important to decrease the consumption of total fats in the diet, especially saturated fats, due to the risk on health and their contribution in increasing high blood cholesterol levels. Almost half of the deaths arising from chronic disease are attributable to cardiovascular disease, although the rapid increase in the obesity/type 2 diabetes-related Metabolic Syndrome (Nugent, 2004) is very concerning, not only because it already affects a large proportion of the population worldwide, but also because it is now starting to affect people earlier in life. It has been recognized for time that diet makes a major contribution to the risk factors for chronic disease (Given et al., 2006). Therefore, manufacturing foods, such as low fat meat products, is of both economic and health interests (Yilmaz et al., 2002). In this study, chicken cooked frankfurters were manufactured, replacing pork meat and pork back fat by chicken breast and vegetables oils as canola, sunflower, olive oil and mixes of them, and reducing the total fat content in the product to 10 %. The objective was to obtain healthier frankfurters, based on a low fat content and a much better fatty acid profile provided by vegetable oils used, trying to keep the same quality attributes than the conventional ones.

Materials and Methods

Frankfurter manufacturing process: Eight different sausages were manufactured: two controls with 20 % and 10 % of fat content and 6 experimental with canola oil, mix 60:40 of olive/canola oils, sunflower oil, mix 60:40 of olive/sunflower oils, olive oil and pork back fat as source of fat. All the experimental sausages were formulated with 12 % of protein and 10 % of fat contents. Two batches of each sausage were elaborated. Base composition of the sausages in % were: 40 chicken breast, 9.87 oil or fat, 42.2 ice, 2.0 salt (0.6% nitrite), 2.0 caseinate, 1.5 potato starch, 0.75 flavor, 0.5 carrageenan, 0.25 phosphates, 0.25 dextrose, 0.05 ascorbic acid, 0.0011 colorant (E-124). Oils were pre-emulsified the same day of use, due to the instability of emulsions. Pre-emulsion was made mixing 8 parts of water with 1 part of sodium caseinate, then the emulsion 1:10 caseinate:oil was obtained stirring for 3 min in a bowl-chopper. Chicken meat at 2ºC was minced and mixed with salt, nitrite and phosphate in a cutter at low speed. Then, half of the ice was added and the mixing went on until reaching 3° C. At this point of the process, the pre-emulsified oil or animal fat, the rest of the ingredients and the rest of ice were added and the mixing went on at high speed until reaching the final temperature of 12° C. The mixture was stuffed into cellulose casings (22 mm diameter) and put into an oven (Eller-Micro 10. Meran, Italy), following the next steps: drying at 55° C for 15 min, smoking at 60° C and relative humidity of 75 % for 15 minutes, cooking till temperature reached 72° C in the core of the sausage, cooling with cold water showers. After peeling, the sausages were packaged under vacuum and pasteurized in a water bath at 75° C during 45 min. Sausages were kept under refrigeration at 4 ° C.

Fatty acid profile: Fatty acid composition was determined by Gas Chromatography. Fat was extracted from 2 g of sample according to Bligh and Dyer (1959) with chloroform:methanol (2:1). For methyl esters preparation, 2.5 ml methanol NaOH solution (0.5 N) were added to lipid extract and it was kept at 90 ° C for 20 minutes. Then, the extract was cooled and 3 ml of methanol BF_3 solution (14 % w/v) were added and the mixture was incubated at 90º C for 15 minutes.

Instrumental Texture Profile Analysis (TPA): It was performed with a texture analyzer TA-XT2 (SMS, Haslemere, UK) according to Bourne (1978). Ten cylinders (22 mm diameter x 10 mm height) were compressed twice 55% of the sample height with a probe of 50 mm diameter, at 1 mm/s speed.

Sensory analysis: Odor and flavor intensity were scored by a 10 members trained panel. Acceptability was evaluated by a non trained panel of 40 members. In both analyses a 5 point structured scale (1 minimum value, 5 maximum value) was used. Statistical analyses: ANOVA and post hoc test (LSD Fisher) were performed.

Results and Discussion

Table 1 shows the distribution of fatty acids of different sausages. Both controls, manufactured with poultry meat, presented the highest percentages of saturated fatty acids; however, it must be noted the sausage elaborated with pork back fat was more similar to sausages made with vegetable oil than to the control sausages.

Table 1. Fatty acids profile of chicken sausages elaborated with vegetable oils.

Frankfurters	Fatty Acids									
	C14:0	**C16:0**	**C16:1**	**C18:0**	**C18:1**	**C18:2**	**C18:3**	**C20:0**	**C20:1**	**C22:0**
Control 20%	1.22^{a}	23.57^{e}	5.17^{b}	8.67^{e}	44.91^{c}	14.49^{c}	1.03^{a}	-	0.68^{a}	0.51^{a}
Control 10%	1.12^{a}	23.36^{e}	5.76^{b}	7.44^{d}	43.25^{b}	15.89^{d}	1.20^{ab}	0.50^{a}	0.59^{a}	0.60^{a}
Canola	-	6.31^{a}	0.77^{a}	2.74^{a}	58.42^{e}	19.89^{e}	4.28^{c}	0.72^{a}	1.37^{a}	0.60^{a}
Olive/Canola	-	8.88^{c}	0.84^{a}	3.49^{ab}	68.79^{f}	12.66^{b}	2.15^{b}	0.70^{a}	0.77^{a}	0.45^{a}
Sunflower	-	7.48^{b}	0.53^{a}	5.79^{c}	31.82^{a}	54.85^{g}	-	0.29^{a}	-	0.88^{a}
Olive/Sunflower	-	9.05^{c}	0.71^{a}	3.96^{b}	57.10^{d}	27.43^{f}	0.50^{a}	0.38^{a}	0.31^{a}	0.57^{a}
Olive	-	10.93^{d}	1.09^{a}	3.64^{b}	71.60^{g}	10.59^{a}	0.98^{a}	0.43^{a}	0.41^{a}	0.32^{a}
Pork back fat	1.1^{a}	9.04^{c}	0.70^{a}	3.96^{b}	57.44^{de}	27.26^{f}	0.52^{a}	0.37^{a}	0.31^{a}	0.57^{a}

The values followed by different letters in a column are significantly different, P<0.05.

Fatty acid profile of experimental sausages differed depending on the type of oil used, showing sausages with olive oil and olive/canola oil the highest content of oleic acid (C18:1), sausages with sunflower oil the highest content of linoleic acid (C18:2) and sausages with canola oil the highest content of linolenic acid (C18:2).
The analysis of texture showed small differences between sausages. Hardness, the most influencing parameter on sensory acceptability, was lower in low fat frankfurters than in control sausage with 20% fat. However, this control sausage suffered a smaller increment of hardness along storage than the low fat sausages, resulting in no significant differences among sausages after 30 days of storage under refrigeration.

Table 2. Sensory parameters of chicken sausages elaborated with vegetables oils (1: Minimum value, 5: Maximum value).

Sausages	**Odor** Intensity	Hedonic value	**Taste** Intensity	Hedonic value
Control 10% poultry fat	2,2^{a}	3,9^{b}	2,6^{a}	3,9^{b}
Canola	2,6^{a}	3,5^{ab}	3,5^{ab}	2,5^{ab}
Olive / Canola	2,1^{a}	3,5^{ab}	3,2^{ab}	2,7^{ab}
Sunflower	4,0^{b}	2,2^{a}	4,2^{b}	1,9^{a}
Olive / **Sunflower**	3,4^{ab}	3,0^{ab}	4,0^{ab}	2,3^{ab}
Olive	2,4^{a}	2,9^{ab}	3,5^{ab}	2,8^{ab}

The values followed by different letters in a column are significantly different, P<0.05.

Table 2 shows results of sensory evaluation of odor and taste parameters. Concerning to odor intensity, the only significant difference was presented by sunflower oil sausage, which showed a higher value; being odor intensity of olive/sunflower oil sausage between that sausage and the rest of them. However, the odor hedonic value of control sausage was higher and the sunflower oil sausage value was lower, but not significant different, than the hedonic value of the rest of vegetal oil sausages. A very similar tendency was observed referring to sausage taste.

Conclusions

Taking into account, both nutritional concern and sensory properties, any of the frankfurters made with vegetable oils canola, sunflower, olive and its mixtures could be well accepted by the consumers, excepting frankfurters made with sunflower oil. Nevertheless, the frankfurter elaborated with canola oil was the healthiest choice due the lowest saturated fatty acids content and highest oleic acid and essential fatty acids values.

References

1. Bligh, E.G., and Dyer, W.J. (1959). A Rapid Method of Total Lipid Extraction and Purification. *Canadian Journal of Biochemistry and Physiology*, 37, 911-917.
2. Bourne, M..C. (1978). *Food Technology*, 32 (7), 62-66.
3. Givens, D.I., Kliem, K.E., and Gibbs, R.A. (2006). The role of meat as a source of n-3 polyunsaturated fatty acids in the human diet. *Journal of Meat Science*, 74, 209-218.
4. Nugent, A.P. (2004). The metabolic syndrome. *Nutrition Bulletin*, 29, 36-43.
5. Szczesniak, A.S. (1963). *Journal of Food Science*, 28, 385-389.
6. Yilmaz, I., Şimşek, O., and Işikli, M. (2002). Fatty acid composition and quality characteristics of low fat cooked sausages made with beef and chicken meat, tomato juice and sunflower. *Journal of Meat Science*, 62, 253-258.