COMPARATIVE STUDY OF FATTY ACID COMPOSITION OF NUTRITIONALLY MODIFIED COOKED MEAT SAUSAGES

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INTRODUCTION

In recent years an increasing demand for low fat products has been observed, since they offer a reduction in calorie values, saturated fatty acids and cholesterol content[1]. The levels of fat consumption, and particularly saturated fatty acids, are still considered to be excessive and a major risk factor for coronary heart disease [2]. In addition, monounsaturated fatty acids (MUFAs), particularly oleic acid (C18:1) from olive oil, may play a beneficial role in heart disease prevention.
Nowadays, consumers demand foods with low fat content or foods in which the animal fats have been substituted by vegetable fats.
Cooked sausages are products with a high consumption in Spain; traditionally they have been manufactured with pork meat and more recently, and with the aim to reduce the fat content, other meats as turkey and chicken are being used with more frequency. In addition, to satisfy the increasing demand of consumers, the researchers and food industry are working to formulate low fat sausages with non-animal fat and fat substitutes. All of these modifications in product composition must be analyzed with care to evaluate the real nutritional impact.

OBJECTIVE

The purpose of this study is to determine the fat composition of a broad range of sausages, made with different kinds of fat, and compare the fatty acid profile among all of them, in order to evaluate the new nutritional characteristics.

MATERIALS

Samples:

Different types and commercial brands of meat sausages were obtained from local supermarkets. Meat sausages were grouped according to the meat utilized in their manufacture: pork sausage (PS-A), Iberian pork sausage (PS-B), turkey sausage (TS-A), turkey sausage with vegetable fat (TS-B), low fat turkey sausage (TS-C), turkey sausage with olive oil (TS-D), chicken sausage (CH-A) and chicken sausage with vegetable oil (CH-B).

Chemical composition:

Chemical composition was determined for all sausages analyzed. Total protein was analyzed according to the International Standard ISO/R 937 [3]. Moisture was determine using the International Standard ISO 1442 [3]. Fat content was determined using the Soxhlet method ISO/R 1443 [3].

Gas Chromatographic analysis:

The fatty acid methyl esters (FAME) were analyzed by Gas Chromatography (GC) using a chromatograph Hewlett Packard 6890 with a flame ionization detector (FID). The analytical column was a fused silica capillary column (30 m x 0.25 mm, ID and 0.20μm film) (Supelco, Inc.). Oven temperature along chromatographic analysis was 200°C. The split injection used was 1/100. The carrier gas was Helium. The injector temperature was 200°C and detector temperature was 250°C.
FAME were identified by comparison of retention times with standards and quantified. Standards of FAME were oil reference standard (Sigma Chemical Co., St. Louis, Mo. and Supelco Inc., Deerifeld, Il.).

Statistical analysis:

The statistical data analysis was carried out by an analysis of variance (ANOVA). The statistical significance of each factor under consideration was calculated at the α=0.05 level using the *F*-test. Data were processed using Statgraphic Plus for Windows Computer Package (Manugistics, Inc., 1995).

RESULTS AND DISCUSSION

The chemical composition and the fatty acids profile of meat sausages are shown in table 1. These analysis were performed in triplicate.
The fat is the ingredient with higher variability, ranging between 7.3 and 59.3%. Cooked meat sausage TS-C showed the lowest fat content, as it was announced in its label, and the highest percentage of moisture and protein. It is remarkable the high content of fat in chicken sausages, which usually are considered by the consumers a low fat product. On the contrary, turkey sausages are formulated to get products with a low content of fat, except TS-D, a special sausage that include olive oil as fat.
The composition of fatty acids of different kind of sausages was compared; being oleic and palmitic, the two main fatty acids in cooked sausages. Among sausages of the same group, pork, chicken or turkey, significant differences were found in the percentages of C18:1, C18:2, C18:3 and C20:1.

For most of the sausages a similar ratio between saturated and unsaturated (mono and polyunsaturated) fatty acids were found (around 35% and 62%, respectively). This ratio was different in sausages with vegetal fat (TS-B, CH-B), where the percentage of saturated acid was higher, and in the sausage with olive oil (TS-D) with the highest proportion of unsaturated acids.

If we take the sausage PS-A as a traditional sausage, that must be nutritionally improved, and compare it with the other groups, which have been manufactered using different strategies to modify the fat composition; either by replacing meat pork for poultry meat or by addition of vegetable fat, the obtained product is not always nutritionally improved. Comparing PS-B and PS-A, a higher amount in total fat is observed and also a slight increase of saturated fatty acids in detriment of polyunsaturated in Iberian pork cooked sausages. The groups TS-A, TS-C and CH-A showed a similar composition as PS-A with some differences in total fat content, especially in TS-C (7.29%).

It is remarkable the high content of linoleic acid in chicken sausages without added vegetable fat (CH-A). In addition to the use of poultry meat, a good strategy to consider is the substitution of animal fat by vegetable fat; although the selection of the most appropriate fat must be taking in account to avoid a nutritionally unsuitable composition. In this sense, sausages with vegetal fat (CH-B and TS-B), usually associated with a healthy product, showed a higher content of the saturated fatty acid C16 and a reduction in the content of oleic acid, in comparison with the equivalent sausages without vegetal fat. By the other side, turkey cooked sausages with olive oil (TS-D) presented a completely different profile, being oleic acid the main fatty acid prevailing. This sausage, in our criteria, is the one that shows the best nutritional profile, with a noticeable reduction of saturated fatty acids and an increase of unsaturated, especially oleic acid. To improve this product is necessary to decrease the fat content.

CONCLUSIONS

The different strategies used by manufacturers to try to get a healthier sausage do not give always suitable nutritional results, since in some formulations the proportion of saturated and unsaturated fatty acids is unbalanced.

In our opinion, the sausage closer to obtain the "expecting food" is TS-D made with olive oil, which could be modify by decreasing the total fat.

REFERENCES

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Table. 1. Chemical composition and fatty acids profile of commercial meat sausages (mean value and standard deviation).

Sausage	PS-A	PS-B	TS-A	TS-B	TS-C	TS-D	CH-A	CH-B
% Moisture	57.03±2.75^{b}	54.93±0.47^{ab}	65.80±2.83^{c}	69.91±1.84^{d}	71.39±0.24^{d}	64.17±1.11^{c}	53.71±2.05^{a}	57.67±5.37^{b}
% Protein*	37.03±1.73^{b}	34.27±0.38^{ab}	48.13±4.56^{c}	55.13±4.80^{d}	55.84±1.34^{d}	43.92±2.54^{c}	32.04±4.09^{a}	37.89±9.65^{b}
% Total Fat*	46.47±6.80^{de}	59.33±2.14^{g}	42.40±5.14^{c}	28.07±2.60^{b}	7.29±1.41^{a}	50.94±2.64^{ef}	55.71±3.71^{fg}	42.34±2.68^{cd}
% Fatty Acids								
Saturated	34.94	37.97	36.70	43.62	36.22	15.43	32.39	42.70
Unsaturated	61.89	62.02	62.13	55.66	62.93	84.54	66.75	56.93
C12:0	-	0.28±0.40^{a}	-	0.92±1.37^{a}	-	-	-	-
C14:0	1.38±0.02^{bcd}	1.64±0.9^{d}	1.44±0.19^{cd}	1.66±0.58^{d}	0.57±0.89^{a}	0.35±0.15^{a}	1.07±0.01^{b}	1.22±0.03^{bc}
C16:0	21.22±5.31^{b}	23.40±0.27^{b}	23.76±1.17^{c}	33.37±1.13^{d}	24.15±0.28^{c}	8.41±1.86^{a}	23.35±0.35^{bc}	35.44±0.39^{d}
C16:1	2.98±0.19^{c}	2.92±0.04^{c}	3.54±0.30^{d}	1.93±0.13^{b}	3.74±0.47^{d}	0.90±0.29^{a}	4.68±0.06^{e}	1.81±0.29^{b}
C18:0	11.68±0.56^{d}	12.15±0.11^{c}	11.00±1.48^{c}	6.87±0.40^{b}	10.96±0.49^{cd}	5.32±0.51^{a}	7.49±0.13^{b}	5.55±0.11^{a}
C18:1	42.75±1.09^{c}	47.07±0.22^{e}	41.95±1.70^{c}	37.49±0.44^{a}	43.42±2.66^{c}	69.84±3.50^{e}	41.40±1.02^{bc}	39.93±0.54^{b}
C18:2	13.63±3.97^{bc}	9.52±0.07^{a}	14.63±2.68^{bc}	14.78±0.66^{bc}	15.77±0.70^{c}	12.76±1.05^{ab}	18.82±0.73^{d}	14.10±0.10^{bc}
C18:3	1.06±0.07^{c}	0.79±0.0^{a}	1.15±0.26^{c}	1.06±0.14^{c}	-	0.54±0.06^{a}	1.16±0.12^{c}	0.68±0.15^{ab}
C20:0	0.04±0.08^{a}	-	0.13±0.29^{ab}	0.17±0.28^{ab}	-	0.28±0.07^{b}	0.13±0.06^{ab}	0.27±0.06^{b}
C20:1	0.90±0.01^{e}	1.1±0.0^{e}	0.79±0.12^{d}	0.05±0.12^{a}	-	0.40±0.06^{b}	0.56±0.05^{c}	0.31±0.04^{b}
C22:0	0.62±0.04^{b}	0.5±0.01^{bc}	0.37±0.25^{ac}	0.63±0.37^{bc}	0.54±0.83^{abc}	1.07±0.14^{d}	0.35±0.10^{abc}	0.22±0.14^{a}
C22:1	0.57±0.12^{c}	0.62±0.01^{b}	0.07±0.17^{a}	0.35±0.39^{b}	-	0.1±0.15^{a}	0.13±0.20^{a}	0.1±0.17^{a}

Means in the same row with different letters are significantly different ($p \geq 0.05$). * In dry weight.