SIMULTANEOUS DETERMINATION OF CHOLESTEROL OXIDES, CHOLESTEROL, TOTAL LIPIDS AND FATTY ACIDS IN CHICKEN FRANKFURTERS, SAUSAGE AND MORTADELLA

Sueli R. Baggio[1] & Neura Bragagnolo[1]

[1]Departamento de Ciência de Alimentos, Faculdade de Engenharia de Alimentos, UNICAMP, 13083-970, Campinas, SP, Brasil, e-mail: neura@fea.unicamp.br

Background

Products of animal origin contain cholesterol as one of their constituents, it being present in all cell membranes and having important functions in the human body. It is the intermediary key in the production of bile acids, masculine and feminine sexual hormones, adrenocortical hormones and also in vitamin D_3 synthesis. However high blood cholesterol levels have been correlated with arteriosclerosis and heart diseases [8], which are the main cause of natural death in Brazil and many other countries. In order to lower the blood cholesterol levels of individuals in the high risk zone (above 200mg/dL), the AMERICAN HEART ASSOCIATION [1] recommends a reduction in the consumption of lipids, saturated fat and cholesterol. Cholesterol is subject to oxidation when exposed to atmospheric oxygen, light and high processing and storage temperatures [9]. Cholesterol oxides are considered more dangerous than cholesterol itself in the formation of arteriosclerotic plaque. Thus the oxidation of cholesterol can be considered to be a health risk in humans. In addition to being arteriogenic, cholesterol oxides are associated with various biological effects such as mutagenicity, carcinogenicity, cytotoxicity, alterations of the cell membrane properties and inhibition of HMG-CoA (3-hydroxy-3-methyl-glutaryl-CoA) reductase activity [4]. The amount of *trans* fatty acids in non-ruminant animal meat is usually low and also depends on the presence of *trans* fatty acids in the animal feed [7].

Objectives

The objective of this study was to determine the cholesterol oxide, cholesterol, total lipid and fatty acid contents in chicken frankfurters, sausage and mortadella.

Material and methods

Three types of processed chicken product were analyzed: frankfurters (2 brands), sausage (1 brand) and mortadella (1 brand). Three batches of each brand, with different expiry dates, were analyzed. Each batch consisted of three units.

Lipid extraction was carried out according to FOLCH *et al.* [3]. Cholesterol oxides and cholesterol were determined by HPLC according to BAGGIO *et al.*[2] and the fatty acids by gas chromatography, transmethylation of the samples being carried out according to HARTMAN & LAGO [5].

Results and discussion

Table 1 shows the cholesterol and total lipid contents of the chicken frankfurter, sausage and mortadella samples analyzed. The cholesterol levels varied from 40 ± 3 in the brand 1 frankfurters to 62 ± 4mg/100g in the brand 2 frankfurters. There was no significant difference between the samples of sausage and mortadella. The total lipid levels varied from 11.4 ± 0.7 in the sausage to 19.1 ± 0.3g/100g in the mortadella, presenting a significant difference amongst the samples analyzed. PEREIRA *et al.* [6] found cholesterol and total lipid levels of 43.6 ± 14.8mg/100g and 11.4 ± 4.2g/100g respectively in chicken sausage, similar to the values found in this study. The USDA table [11] shows the highest cholesterol content found in chicken sausage as being 101mg/100g.

None of the cholesterol oxides investigated (cholesta-4,6-dien-3-one, 20α-hydroxycholesterol, 25-hydroxycholesterol, 5,6α-epoxycholesterol, 5,6β-epoxycholesterol, 7α-hydroxycholesterol, 7β-hydroxycholesterol and 7-cetocholesterol) were found in any of the samples analyzed.

The non-occurrence of cholesterol oxides in the processed meat products analyzed, could be due to the addition of anti-oxidant in the formulations. According to TAI *et al.* [10], the use of anti-oxidant in the formulations and the use of appropriate packages, creating a physical barrier to air and light, could prevent the formation of cholesterol oxidation products.

Table 2 shows the percentages of saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids found in the processed chicken products. The percent SFA was lowest in the brand 2 frankfurters (30%) and highest in the brand 1 frankfurters (35%), there being no significant difference between the sausage and mortadella samples. There was no significant difference between the brand 1 frankfurters and the mortadella with respect to the percent MUFA, varying from 40% in the brand 2 frankfurters to 44% in the mortadella. The percent PUFA was lowest in the brand 1 frankfurters (22%) and greatest in the brand 2 frankfurters (30%), there being no significant difference between the brand 1 frankfurters and the mortadella.

Conclusions

The cholesterol and total lipid contents were lowest in the brand 1 frankfurters and the saturated fatty acids were lowest in the brand 2 frankfurters. The brand 2 frankfurters showed the highest levels of polyunsaturated fatty acids. No cholesterol oxide was found in the processed chicken products analyzed.

References

[1] AMERICAN HEART ASSOCIATION. **Dietary Guidelines for Healthy American Adults,** (http://www.americanheart.erg/Heart-and-Stroke-A-Z-uide/dietg.html), 2003.

[2] BAGGIO, S. R.; VICENTE, E. & BRAGAGNOLO, N. Cholesterol oxides, cholesterol, total lipid and fatty acid composition of turkey meat. **J. Agric. Food Chem., 50(21):** 5981-5986, 2002.

[3] FOLCH, J.; LESS, M. & STANLEY, S. A simple method for the isolation and purification of total lipids from animal tissues. **J. Biol. Chem., 226:** 497-509, 1957.

[4] GUARDIOLA, F.; CODONY, R.; ADDIS, P. B.; RAFECAS, M. & BOATELLA, Biological Effects of Oxysterols: Current Status. **Food Chem. Toxic. 34:** 193-198, 1996.

[5] HARTMAN, L. & LAGO, R. C. A. Rapid preparation of fatty acid methyl esters from lipids. **Lab. Pract., 22:** 475-481, 1973.

[6] PEREIRA, N. R.; TARLEY, C. R. T.; MATSUSHITA, M. & SOUZA, N. E. Proximate composition and fatty acid profile in brazilian poultry sausages. **J. Food Composition Analysis, 13:** 915-920, 2000.

[7] PFALZGRAF, A.; TIMM, M. & STEINHART, H. Gehalte von *trans*-Fettsäuren in Lebens-mitteln. **Z. Ernährungswiss, 33:** 24-43, 1993.

[8] REISER, R. Oversimplification of diet: coronary heart disease relationships and exaggerated diet recommendations. **Amer. J. Cli. Nutr., 31:** 865, 1978.

[9] SMITH, L. L. Cholesterol Autoxidation. **Chem. Physis. Lipids, 44:** 87-125, 1987.

[10] TAI, C. Y.; CHEN, Y. C. & CHEN, B. H. Analysis, formation and inhibition of cholesterol oxidation products in foods: An overview (Part I). **J. Food and Drug Anal., 7 (4):** 243-258, 1999.

[11] USDA. **Nutrient Database for Standard Reference** (Release 15). Nutrient Data Laboratory Home Page, http://www.nal.usda.gov/fnic/foodcomp/Data/SR15/reports/sr15page.htm, 2003.

Table 1. Cholesterol (mg/100g) and total lipid (g/100g) contents in processed chicken products.

Meat products	Cholesterol M ± SD*	Total lipids M ± SD*
Frankfurter		
brand 1	40 ± 3 c	10.5 ± 0.7 d
brand 2	62 ± 4 a	13.7 ± 0.5 b
Sausage	45 ± 2 b	11.4 ± 0.7 c
Mortadella	46 ± 3 b	19.1 ± 0.3 a

*Mean and standard deviation estimate for the three samples in duplicate of each brand.
Values in the same column with the same letter do not show significant difference at the 5% level.

Table 2. Total saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids in processed chicken products.

Samples	SFA (% of area)*	MUFA (% of area)*	PUFA (% of area)*
Frankfurter 1**	35 a	43 a	22 b
Frankfurter 2***	30 b	40 c	30 a
Mortadella	33 ab	44 a	23 b
Sausage	33 ab	42 b	25 ab

*Mean of the samples analyzed in duplicate; **Brand 1; **Brand 2;
Values in the same column with the same letter do not show significant difference at the 5% level.

Acknowledgments

The authors are grateful to FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) and CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for their financial support of this study as well as to the Center of Food Chemistry and Applied Nutrition of the Institute of Food Technology (ITAL) for its collaboration in the running of the tests involved.