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Cholesterol and fatty acids profile of Brazilian commercial chicken giblets

Nádia Rosa Pereira, Edvani Curti Muniz, Makoto Matsushita & Nilson Evelázio de Souza

Department of Chemistry, State University of Maringá-Maringá, Paraná State, Brazil

SUMMARY. This study was carried out to determine the chemical composition, cholesterol contents and fatty acids profile of Brazilian commercial chicken giblets. The analysis were performed in gizzard, liver and heart *in natura* and also in cooked gizzard, fried liver and roasted heart. Fat and cholesterol contents ranged from 0.88% and 72.68 mg/100g, in cooked gizzard, to 22.19% and 213.18 mg/100g, in roasted heart. As the fat content gets higher, so does the cholesterol content. Palmitic (C16:0) and stearic acids (C18:0) were the predominant saturated fatty acids (SFA). The C16:0 ranged from 6.39% in cooked gizzard to 18.51% in fried liver. The C18:0 level ranged from 6.62% in roasted heart to 19.19% in cooked gizzard. Linoleic acid (C18:2ω6) was the predominant polyunsaturated fatty acid (PUFA). The data revealed that the three different analysed giblets presented a good PUFA/SFA ratio, with values of 1.11, 1.14 and 1.40 for cooked gizzard, fried liver and roasted heart, respectively.

Key words: Chicken; giblets; fatty acids; cholesterol.

RESUMEN. Colesterol y perfil de ácidos grasos en vísceras de pollos comerciales brasileños. Este estudio fue realizado para determinar la composición química, contenido de colesterol y perfil de ácidos grasos en vísceras de pollos comerciales brasileños. Los análisis fueron hechos en mollejas, hígados y corazones al natural y también en mollejas cocidas, hígados fritos y corazones asados a las brasas. El contenido de grasas y colesterol varió de 0,88g/100g y 72,68 mg/100g en mollejas cocidas a 22,19g/100g y 213,18 mg/100g en corazones asados a las brasas. Se observó que a mayor contenido de grasa, mayor el contenido de colesterol. Entre los ácidos saturados (AGS) presentes, los principales fueron los ácidos palmítico (C16:0) y esteárico (C18:0). El nivel de C18:0 varió de 6,39% en molleja cocida hasta 18,51% en hígado frito. El nivel de C18:0 varió de 6,62% en corazón asado a la brasa hasta 19,19% en hígado cocido. Entre los ácidos grasos polinsaturados (AGPI), el predominante fue el ácido linoleico (C18:2ω6). Los resultados mostraron que los tres tipos de vísceras analizadas presentaron una buena relación AGPI/AGS, a cuales fueron 1,11, 1,14 y 1,40 para mollejas cocidas, higados fritos y corazones asados, respectivamente.

Palabras clave: Pollos, vísceras, ácidos grasos, colesterol.

INTRODUCTION

During the 80's Brazil presented a chicken meat production of about one million tons per year and a per capita consumption of 8.7 kg per year. By increasing its production, in 1998 production went up 4.5 million tons per year and a per capita consumption of 24.0 kg (1). Nowadays Brazil is the third largest producer and consumer of chicken meat, behind the United States of American and China. Brazil is the country that the higher exportation rate, that is 0.6 million tons in 1998 (2).

In Brazil, chicken meat is sold as a whole chicken or in separated pieces, such as wing, thigh, back, breast, heart, gizzard and liver. The gizzard, liver and heart are consumed cooked, fried and roasted, respectively. Consumers have increasingly become aware of the health quality of the foods they consume. Lipid composition, in particular, is the primary parameter that consumers have taken in consideration, mainly the amount and composition of fat, due to the risk of coronary heart disease and certain forms of cancer (3). The coming of nutritional tables and the consumers interest has gave emphasis for the need of additional and more complete data of the foods (4).

Dietary cholesterol is an important issue in public health because it is often related to the incidence of arteriosclerosis. Currently, consumers are specially aware of their dietary intake of high-fat animal food, that contains saturated fat and cholesterol (5).

Few data exists in the literature concerning the chemical composition, cholesterol content (6) and the fatty acid profile of chicken giblets.

The purpose of this study was to determine the chemical composition, cholesterol content and fatty acid profile of chicken giblets.

MATERIAL AND METHODS

Sampling

Five samples of giblets having 1kg each were randomly collected from different commercial establishments in

Maringá, Paraná State, Brazil. The giblets were prepared without oil, seasoning or condiment addition, as follows: gizzard was cooked in water, liver was fried in a pot recovered by Teflon®, and the heart was roasted over hot charcoals. (The giblets were prepared as the way its were consumed in Brazil). The samples were triturated, homogenized and analysed in triplicate.

Determination of moisture, ash, lipid and protein contents

Moisture, ash and protein contents were determined as described by Cunniff (7). Lipids were extracted from giblets using a modified Folch *et al.* (8) method. Giblet samples (15 ± 0.01g) were transferred to 90 mL of chloroform-methanol (2:1, v/v) solution and stirred for 2 min. After blending, 30 mL of chloroform and 30 mL of deionized water were added and the mixture was stirred again. A 0.58% aqueous NaCl solution was added, causing the chloroform layer (containing lipid) to separate from the methanol-water phase. The lipid extract was transferred to a 250 mL flask and the solvent was evaporated under a stream of nitrogen. The lipid content was determined gravimetrically. Carbohidrate was determined by difference

Extraction and analysis of cholesterol

The extraction and quantification of the cholesterol were carried out by the method of Al Hasani *et al.* (9) with modifications. Samples of giblets (10 ±0.0001 g) were placed in a 250 mL flat-bottom flask. The sample was dispersed in an ethanol-methanol-isopropanol (90:5:5, v/v/v) solution, in an equivalent amount to 4 mL gram of sample and 1 mL 60% KOH per gram of sample. The flask containing the mixture was connected to a water-cooled condenser, and refluxed during 1 hr. After cooling the digest to the room temperature, 100 mL of hexane was added and the mixture was stirred for 10 min. Next, 25 mL of de-ionized water were added and the mixture was stirred for 15 min. The layers were then separated and the hexane layer was collected in a flask. An aliquot of the 25 mL hexane layer was evaporated to dryness under a stream of nitrogen. The residue was dissolved in 2 mL of hexane containing 0.2 mg of 5α-cholestane, used as internal standard, and transferred to a sample vial. Around 3 μL was injected into a gas chromatograph. A Shimadzu 14A (Japan) equipment fitted with flame ionization detector (FID, 300°C) and a split/split less injector (260°C, split 1:150) was used for the cholesterol analysis. Separation was carried out in a fused silica capillary column (25 m; 0.25 mm i.d.), coated with SE-30 (0.25 μm phase thickness), at 300°C. The carrier gas was hydrogen (1.5 mL/min) and the make up gas was nitrogen (25 mL/min). Cholesterol identifications were made by comparing the relative retention time peaks from samples to the standards from Sigma (USA). For peak integration, a CG-300 Computing integrator (CG Instruments, Brazil) was used.

Transesterification and fatty acid composition

Methyl esters were prepared by transmethylation according to the method 5509 of the ISO (10), using KOH 2 mol/L in methanol and *n*-heptane. Fatty acid methyl esters (FAME) were analyzed using a Shimadzu 14A (Japan) gas chromatograph equipped with flame ionization detector and fused silica capillary column (50 m x 0.25 mm and 0.20 μm of Carbowax 20M). Column temperature was programmed at 7 degree/min from 150-240°C. The injection port and detector were maintained at 220°C and 245°C, respectively. Carrier gas was hydrogen (1.2 mL/min) and the make up gas was nitrogen (30 mL/min). The split used was 1:100. Comparing the relative retention times of FAME peaks from samples with those observed on the standards from Sigma (USA) did identification of normal fatty acids. The peak areas were determined by the CG-300 Computing integrator (CG Instruments, Brazil). Data were calculated as normalized area percentages of fatty acids.

Statistical analysis

The experimental data are presented as x ± SD (mean ± standard deviations). They were statistically confronted for one-way ANOVA as described by Montgomery (11). Data were processed using the Statistica 5.1 software (StatSoft, USA, 1996).

RESULTS AND DISCUSSION

The proximate chemical composition found for five samples of chicken giblets *in natura* that were analyzed in triplicates, is presented in Table 1. Comparing the three kinds of analysed giblets, it can be noticed that the liver presents the largest content of ash, as expected. There are not significant differences ($P<0.05$) of ash content between gizzard and heart. Among all the analysed kinds, the moisture presents significant differences ($P<0.05$). The fat of liver, gizzard and heart presented significant differences ($P<0.05$). The heart presented the largest level, 16.98g/100g. In relation to the liver and gizzard, the heart presented significant difference ($P<0.05$) in protein content. The liver was the unique giblet that presented carbohydrates (1.75g/100g) in its composition.

The proximate chemical composition of prepared chicken giblets is presented in Table 2. All the samples were submitted to heating, although in different ways. When analysing the prepared giblets its present significant differences ($P<0.05$), in content of protein, ash, fat and its do not present significant difference in the moisture content between fried liver and cooked gizzard. It is note worthy the higher content of fat presented by the roasted heart presents (22.19g/100g) when

compared to the fried liver (2.38g/100g) and cooked gizzard (0.88g/100g). For the cholesterol content in mg/100g, there were not significant differences among fried liver (192.09) and roasted heart (213.18). Compared to the literature, the content found for the chicken fried liver is smaller than the one found for bovine fried liver (273.94mg/100g) as described by Rowe *et al.* (14). In the prepared form, significant differences ($P<0.05$) for the content of proteins was observed.

TABLE 1
Proximate chemical composition of giblets *in* natura[1] (g/100g)

Giblets	Gizzard	Liver	Heart
Moisture (g)	79.50±0.20[2]	75.38±0.04[3]	70.49±0.82[4]
Ash (g)	0.66±0.04[2]	1.29±0.02[3]	0.65±0.08[2]
Fat (g)	0.56±0.07[2]	2.09±0.15[3]	16.98±0.19[4]
Protein(g)	20.19±3.03[2]	19.49±0.16[2]	10.83±2.10[3]

[1]Data presented as *mean* ± SD of five samples, each one in triplicate.
[2,3,4]Means within a row with no common superscripts are significantly different (P<0.05).

TABLE 2
Proximate composition (g/100g) of prepared giblets[1]

Giblets	Cooked gizzard	Fried liver	Roasted heart
Moisture (g)	68.63±0.16[2]	69.07±0.22[2]	35.08±0.70[3]
Ash (g)	0.75±0.03[2]	1.68±0.02[3]	2.37±0.05[4]
Fat (g)	0.88±0.05[2]	2.38±0.24[3]	22.19±0.96[4]
Protein (g)	28.82±0.28[2]	23.24±0.26[3]	39.01±0.58[4]
Cholesterol (mg)	72.68±15.95[2]	192.09±31.05[3]	213.18±19.47[3]

[1]Data presented as mean±SD of five samples, each one in triplicate.
[2,3,4]Means within a row with no common superscripts are significantly different (P<0.05).

The fatty acids profile of prepared chicken giblets is presented in Table 3. The roasted heart presents smaller content of saturated fatty acids. The palmitic acid (C16:0) is the predominant acid (16.86%) followed by the stearic acid (C18:0) (6.62%). In fried liver, the content of those acids is 18.51% and 16.37%, respectively. However, for the polyunsaturated fatty acids, the fried liver presents a larger percentage (40.55%). Should be taken in account the presencebe of the arachidonic acid (C20:4ω6) (16.76%) and linoleic acid (C18:2ω6) (19.81%) and DHA (C22:6ω3) (2.52%). All the giblets presented good PUFA/SFA ratio whith values higher than 1. Values for the PUFA/SFA ratio higher than 0.45 have been recommended by the Department of Health (15). A decrease of this value indicates food that are not very healthy, in relation to cardiovascular diseases.

TABLE 3
Fatty acid profile of prepared giblets[1]

	Cooked gizzard[2]	Fried liver[2]	Roasted heart[2]
C14:0	Trace[3]	0,24±0,01[4]	Trace[3]
C16:0	6.39±0,18[3]	18,51±1,07[4]	16,86±0,50[4]
C16:1ω7	1.61±0,05[3]	2,12±0,14[4]	6.50±0,17[5]
C17:0	Trace[3]	0,16±0,02[4]	Trace[3]
C17:1 ω10	1.28±1,01[3]	Trace[4]	Trace[4]
C18:0	19.19±2.46[3]	16.37±1.03[3]	6.62±0.31[4]
C18:1ω9	20.71±8.94[3]	21.57±1.28[3,4]	30.93±1.53[3,5]
C18:2 ω6	7.49±1.56[3]	19.81±1.55[4]	22.32±1.12[5]
C18:3ω6	1.86±0.82[3]	0.55±0.04[4]	Trace[5]
C18:3ω3	3.23±0.39[3]	Trace[4]	3.40±1.09[3]
C20:0	5.43±0.76[3]	Trace[4]	1.34±0.77[5]
C20:1ω9	2.75±0.85[3]	0.32±0.03[4]	1.44±0.00[5]
C20:2ω6	4.89±0.71[3]	0.91±0.03[4]	2.15±0.15[5]
C20:3 ω6	3.13±1.08[3]	Trace[4]	1.61±0.45[3]
C20:3ω3	4.81±0.41[3]	Trace[4]	4.00±0.56[3]
C20:4ω6	5.81±1.73[3]	16.76±1.80[4]	Trace[5]
C20:5ω3	2.95±0.52[3]	Trace[4]	1.35±0.30[5]
C22:0	2.61±0.35[3]	Trace[4]	Trace[4]
C22:1ω9	2.64±1.27[3]	Trace[4]	1.41±0.40[3]
C22:2ω6	3.21±1.09[3]	Trace[4]	Trace[4]
C22:6ω3	Trace[3]	2.52±0.16[4]	Trace[3]
C24:0	Trace[3]	0.32±0.04[4]	Trace[3]
MUFA[6]	29.09	24.01	40.28
PUFA[6]	37.41	40.55	34.83
SFA[6]	33.62	35.60	24.82
PUFA/SFA[7]	1.11	1.14	1.40

[1]Calculated as wt% of fatty acid methyl esters as percentage of total fatty acids.
[2]Data presented as mean±SD of five samples, each one in triplicate.
[3,4,5]Means within a row with no common superscripts are significantly different (P<0.05).
[6]Monounsaturated fatty acids; saturated fatty acids; polyunsaturated fatty acids.
[7]Ratio of polyunsaturated to saturated fatty acids.

CONCLUSIONS

Considering the contents of fat, protein and cholesterol, it could be pointed out that the chicken giblets would more advisable be the cooked gizzard, if the consumer is looking for a diet with low calorie and high levels of protein and also polyunsaturated fatty acids.

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