CONTRIBUTIONS ON THE NUTRITIONAL VALUE KNOWLEDGE FOR THE MEAT PRODUCED BY ROSS-308 CHICKEN HYBRID

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Abstract

Quality of those animal products used in human alimentation is in the top of mass-media and scientific field debates. The researches focused on the achievement of certain data related to poultry meat nutritional value: caloricity, proteins, lipids, amino acids, fatty acids and cholesterol content. 60 Ross-308 broilers have been reared till slaughtering (42 days) then some muscular samples have been taken from breast, wings, thighs and shanks. The samples followed some analytical methods: oven drying, calcination, Kjeldahl and Soxhlet for raw chemical content and caloricity, HPLC for amino acids content, gas-cromatography for cholesterol and fatty acids contents. Energetic value ranged between 138.93-200.28 Kcal/100 g. Maximal proteins level was found in pectoral muscles (23.80%), respectively lipids minimal (0.95%). Lysine had the highest level in thighs muscles (6.89-6.92g/100 g), while methionine in the wings ones (3.92-3.95g/100 g). Pectoral muscles were richer in threonine (1.59-1.72g/100 g). Saturated fatty acids quantity was higher in red muscles (1.123 g/100 g), than in white ones (0.336 g/100 g). Thighs musculature was the richest in Ω-3 fatty acids (0.107 g/100 g). Cholesterol reach maximal value in thighs muscles (82-83 mg/100 g). The acquired data revealed that although breast fillet meat is more dietetic, higher nutritional value is characteristic to limbs musculature.

Key words: poultry meat, caloricity, amino acids, fatty acids, cholesterol

INTRODUCTION

Known as a mixture of different tissues, the meat presents a variable chemical composition, due to certain factors (species, breed, age, gender, fattening degree carcass part etc.). Assessment of organic and inorganic constituents from food is a trend which remains relevant within the researches related to human consumer food quality and safety. Chemical composition definitely influences meat nutritional value. It comprises water – 66.52% in mammals – cattle, sheep; 61.64% in fowl – chicken, turkey, ducks geese and dry matter (proteins, lipids, carbohydrates, minerals, vitamins, enzymes) – 33.48% in mammals, 38.36% in fowl, respectively [3]. The data published by US Agric. Database [9], state interesting aspects related to poultry meat: white meat (breast) has poor content in amino acids/100g especially essential amino acids (due to high collagen content – poor quality protein), comparing with the red meat. However, dietetic features of breast are better than those of wings, thighs and shanks, due to lower cholesterol content (51 mg/100g) and higher poly unsaturated fatty acids proportion. It is known that meat quality is strictly influenced by some technological, sensorial, hygienic and technological factors and also under the influences of other traits related to inner nutritional value and processing technology [2, 10]. The researches presented in this paper are straightly related to the chemical composition and nutritional value of chicken meat produced within the intensive technological system, in Romania.

MATERIAL AND METHOD

The biological material comprises 60 ROSS-308 chicken broilers, 30 females and 30 males, reared on permanent litter till 42 days old, when they were slaughtered.

Feeding conditions complied with the hybrid technological guide. Feed recipes energy level progressively increased, from

3012.06 Kcal ME/Kg feed (Starter), till 3225.97 Kcal ME/Kg feed (Finisher). Protein content in feed gradually decreased from 24% CP (Starter), to 22.5% (Grower), till 20% respectively (Finisher). Fatty acids profile in feed was kept in accordance with the Aviagen company, because it was not intended to influence the meat lipids profile through feeding, knowing that certain poultry meat traits could be modified by dietary usage of organic Se and Omega-3 fatty acids [4, 5]. A symbiotic product (mix of probiotic, prebiotic and botanical compounds) was used as alternative to antibiotics as growth promoters.

Muscular tissue samples were taken from each slaughtered individual, respectively from breast, wings, thighs and shanks. Average samples have been formed and forwarded to analytical laboratory assessments, in order to achieve data related to chemical composition, energetic value or to some elements which characterize the nutritional and dietetic value (amino acids, fatty acids and cholesterol contents). 6 repetitions have been carried out for each chemical composition analysis.

Meat content of water and dry matter (DM) was assessed through oven drying at 105°C (according to SR ISO 1442/1997 standard).

Ash (minerals) meat content was obtained through calcinations at 550°C (according to SR ISO 936: 1998 standard).

Lipids quantity in meat was analyzed through the Soxhlet method, at Velp Scientific – SER 148 extractor (method recommended by equipment producer-AOAC Official methods of analysis/1990, compatible with SR ISO 1443: 2008 standard).

Whole nitrogen content, implicitly the protein content in meat was assessed through Kjeldahl method, adapted to VelpScientifica DK6-UDK7 apparatus (producer method 981:10, AOAC Official methods of analysis/1990, compatible with SR ISO 937:2007 standard).

Nitrogen free extract (NFE) content was algebraically calculated, using the relation:

% NFE = DM% – Ash% – (Lipids% + Proteins%)

Meat caloricity was calculated through the relation who involves the raw gross energy (GE) issued from burning 1g of proteins, lipids and carbohydrates in calorimetric bomb:

GE (Kcal/Kg) =5.70 Kcal x g proteins + 9.50 Kcal x g lipids + 4.2 Kcal x g NFE

Meat content in amino acids was assessed in the Analytical Chemistry Laboratory which belongs to the Institute of Research and Development for Biology and Animal Nutrition – Balotesti place, through liquid chromatography (High Precision Liquid Chromatography – Thermo Electron), according to SR EN ISO 13903:2005 standard. Fatty acids and cholesterol content were investigated in the same laboratory through gas-chromatography, which complied to AOCS Ce 1f-96/US referential.

The acquired data were algebraically and statistically processed through the ANOVA single factor method.

RESULTS AND DISCUSSIONS

Data achieved from analytical chemistry have been calculated as percentage and presented in tab. 1. Thus, the dry matter content ranged from 25.11±0.36% (breast fillet – females) till 29.67±0.77% (thighs - females). The 4.56 p.p. difference is based on the high lipid content in rear limbs muscles. Meat content in minerals varied between 0.88±0.03% (shanks-males) and 1.44±0.02% (breast fillet – females) Statistical significant differences ($\hat{F}$>F. Tab. α 0.05 at 1;10 DF) occurred between males and females ash content in thighs and shanks muscles, while in breast fillet muscles the differences proved to be highly significant ($\hat{F}$>F. Tab. α 0.001 at 1;10 DF). Biological and nutritional value of meat is given by its proteins content, mainly on proteins quality, which means the ratios between essential and common amino acids.

The analyses revealed protein content between 17.13±0.52% (thighs-males)– 23.80±0.34% (breast fillet-females). In red muscles, proteins proportion was higher in females than in males. No statistical significance occurred for the differences related to meat proteins content, no matter the examined carcass area.

Meat proteins composition, expressed through amino acids content is revealed in tab. 2.

Table 1- Meat chemical composition and its energetic value

Carcass area	Chickens gender	Assessments (%)	$\overline{X}$	$\pm S_{\overline{X}}$	V%	Energetic value (Kcal/100 g)
Breast fillet	♂	Water	74.27	0.30	1.22	141.87
		Dry matter	25.73	0.30	3.53	
		Ash	1.29[a]	0.03	7.23	
		Lipids	0.95[a]	0.02	6.92	
		Proteins	22.81	0.23	2.98	
		Nitrogen free extract	0.68[a]	0.12	12.50	
	♀	Water	75.65	0.33	1.35	142.74
		Dry matter	27.12	0.33	3.89	
		Ash	1.44[d]	0.02	4.87	
		Lipids	1.05[c]	0.03	8.44	
		Proteins	23.80	0.34	4.48	
		Nitrogen free extract	0.96[b]	0.13	16.54	
Wings	♂	Water	73.52	0.48	1.94	162.92
		Dry matter	26.48	0.48	5.38	
		Ash	0.97	0.02	7.44	
		Lipids	4.86[a]	0.11	6.73	
		Proteins	20.01	0.41	6.08	
		Nitrogen free extract	0.64	0.16	11.31	
	♀	Water	72.57	0.45	1.85	172.09
		Dry matter	27.43	0.45	4.90	
		Ash	0.96	0.02	6.64	
		Lipids	5.82[d]	0.10	5.12	
		Proteins	20.04	0.41	6.18	
		Nitrogen free extract	0.61	0.09	15.21	
Thighs	♂	Water	72.62[b]	0.55	2.28	180.73
		Dry matter	27.38[a]	0.55	6.05	
		Ash	1.18[b]	0.03	6.83	
		Lipids	8.49[a]	0.10	3.42	
		Proteins	17.13	0.52	9.08	
		Nitrogen free extract	0.58	0.12	12.43	
	♀	Water	70.33[a]	0.77	3.28	200.28
		Dry matter	29.67[b]	0.77	7.78	
		Ash	1.02[a]	0.02	6.14	
		Lipids	9.92[d]	0.07	2.20	
		Proteins	18.26	0.57	9.36	
		Nitrogen free extract	0.47	0.11	16.14	
Shanks	♂	Water	74.08	0.75	3.03	166.69
		Dry matter	25.92	0.75	8.65	
		Ash	0.88[a]	0.03	9.71	
		Lipids	6.54[b]	0.08	3.59	
		Proteins	17.91	0.64	10.64	
		Nitrogen free extract	0.59	0.11	11.82	
	♀	Water	72.76	0.68	2.80	178.86
		Dry matter	27.24	0.68	7.49	
		Ash	0.96[b]	0.02	7.08	
		Lipids	7.84[d]	0.10	3.87	
		Proteins	17.96	0.63	10.49	
		Nitrogen free extract	0.48	0.05	17.21	

ANOVA test – for each assessment and carcass area, compared between genders:
[ab] significant ($\hat{F}$>F. Tab. α 0.05 at 1;10 DF); [ac] distinguished significant ($\hat{F}$>F. Tab. α 0.01 at 1;10 DF); [ad] highly significant ($\hat{F}$>F. Tab. α 0.001 at 1;10 DF)

Breast meat presents higher values for certain indispensable amino acids (threonine: 1.59-1.72 g/100 g; phenylalanine: 5.00-5.78 g/100 g) than wings, shanks and thighs

musculature. However, lysine content was poorer in breast fillet (3.31-3.52 g/100 g), compared with the maximal level found in thighs meat (6.89-6.92 g/100 g). For methionine and isoleucine, the values were almost similar in all studied samples.

Table 2-Amino acids content in the studied muscles

Investigated amino acids	M.U.	Ross-308 hybrids. females				Ross-308 hybrids. males			
		Breast	Wings	Thighs	Shanks	Breast	Wings	Thighs	Shanks
Glutamic acid	g/100g	0.89	1.02	3.20	2.71	0.46	1.05	3.61	2.78
Serine	g/100g	7.76	9.33	6.32	8.46	10.24	10.43	7.09	7.63
Histidine	g/100g	3.21	1.72	0.93	1.37	3.03	1.51	0.97	1.35
Glycine	g/100g	3.47	3.38	1.98	2.30	3.52	3.81	2.02	2.22
Threonine	g/100g	1.59	1.20	0.54	1.36	1.72	1.23	0.58	1.21
Alanine	g/100g	0.94	0.80	0.99	0.96	1.34	0.83	1.03	1.12
Tyrosine	g/100g	3.38	2.22	3.50	3.51	4.35	2.15	3.88	3.49
Cysteine	g/100g	3.38	1.69	1.99	1.54	1.44	2.03	1.89	1.35
Valine	g/100g	0.77	0.46	0.67	0.66	0.45	0.45	0.84	0.69
Methionine	g/100g	3.03	3.92	3.58	3.62	3.48	3.95	3.24	3.85
Phenylalanine	g/100g	5.00	4.60	2.81	3.65	5.78	4.64	2.89	3.37
Isoleucine	g/100g	2.11	1.70	0.54	2.12	2.22	1.73	0.57	2.23
Leucine	g/100g	0.72	0.69	0.47	0.59	0.87	0.72	0.46	0.58
Proline	g/100g	0.38	0.13	0.21	0.10	0.55	0.16	0.22	0.11
Lysine	g/100g	3.31	4.85	6.89	4.70	3.52	4.88	6.92	4.71

Lipids constituted the chemical compound with the highest variation amplitude between the studied muscular samples. Thus, the minimal value was found in males breast fillet (0.95±0.02%), while the highest one occurred in females thighs muscles (9.92±0.07%). The differences related to lipids content between males and females were considered highly significant for all red meat samples ($\hat{F}$>F. Tab. α 0.001 at 1;10 DF), respectively distinguished significant ($\hat{F}$>F. Tab. α 0.01 at 1;10 DF) for breast fillet samples.

The cholesterol content oscillated between 58 mg/100 g (breast fillet in females) and 83 mg/100 g (thighs meat in males) (tab. 3).

Table 3-Cholesterol and fatty acids contents in the studied muscles

Assessed compound	M.U.	Ross-308, females				Ross-308, males			
		Breast	Wings	Thighs	Shanks	Breast	Wings	Thighs	Shanks
SFA*, i.e.:	g/100g	0.340	0.931	1.004	0.962	0.356	0.951	1.123	1.084
12:0	g/100g	0.000	0.010	0.020	0.041	0.009	0.031	0.031	0.020
14:0	g/100g	0.010	0.031	0.020	0.031	0.019	0.039	0.041	0.031
16:0	g/100g	0.217	0.584	0.482	0.625	0.214	0.051	0.549	0.564
18:0	g/100g	0.102	0.287	0.266	0.246	0.106	0.283	0.297	0.266
MUFA**, i.e.:	g/100g	0.307	0.871	1.240	1.086	0.305	0.984	1.135	1.045
16:1	g/100g	0.029	0.062	0.184	0.155	0.037	0.116	0.146	0.133
18:1	g/100g	0.246	0.758	1.035	0.830	0.241	0.799	0.924	0.871
20:1	g/100g	0.000	0.010	0.010	0.010	0.009	0.018	0.025	0.010
22:1	g/100g	0.000	0.010	0.000	0.000	0.009	0.013	0.020	0.010
PUFA***, i.e.:	g/100g	0.330	0.825	0.984	0.876	0.318	0.850	0.965	0.865
18:2	g/100g	0.174	0.482	0.769	0.656	0.172	0.574	0.639	0.635
18:3	g/100g	0.010	0.021	0.031	0.021	0.004	0.029	0.039	0.031
20:4	g/100g	0.041	0.123	0.092	0.072	0.047	0.109	0.123	0.094
20:5 ω-3	g/100g	0.000	0.020	0.010	0.010	0.000	0.025	0.031	0.014
22:5 ω-3	g/100g	0.021	0.041	0.020	0.021	0.029	0.039	0.045	0.029
22:6 ω-3	g/100g	0.031	0.051	0.041	0.031	0.039	0.049	0.061	0.041
Cholesterol	mg/100g	58	61	82	70	59	60	83	74

*SFA-saturated fatty acids; **MUFA-mono unsaturated fatty acids; ***PUFA-poly unsaturated fatty acids

Quantity of saturated fatty acids was found almost triple in red muscles than in white ones (max. 1.123 g/100g in thighs-males, 0,340 g/100g in breast fillet-females) (tab. 3). This fact is counter balanced by the higher content of limbs meat in mono- and polyunsaturated fatty acids, well known for their protective effect against the circulatory diseases in human consumers. However, the saturated:unsaturated fatty acids ratio is better balanced in breast meat. Males thighs musculature was the richest in Ω-3 fatty acids-0.107 g/100 g (20:5 ω-3, eicosapentaenoic=0.031g/100 g, 22:5 ω-3, docosapentaenoic acid=0.045g/100 g, 22:6 ω-3, docosahexaenoic acid=0.061 g/100 g).

The results we achieved fill in the range specified by literature: 20.1% proteins in broiler meat [1]; 23.8-24.5% proteins in broiler meat [10]; 22.5-23.0% proteins in breast muscles and 18.0-18.5% proteins in thighs muscles at "ROSS-308" hybrid [8]; 23-24% proteins in "ISA" hybrids [7]. Cholesterol and PUFA contents presented close values to other research reports [6].

The minimal value for gross energy was 141.87 Kcal/100 g breast fillet in males, while the maximal one was found in females thighs meat (200.28 Kcal/100 g) (table 1). The values we found comply with the referential average data (177.00Kcal/100 g) from literature [1].

CONCLUSIONS

Breast fillet could be considered as higher qualitative if chemical composition and dietetic value is considered (poor energy level, low cholesterol content and high polyunsaturated fatty acid content).

Nutritionally speaking, the white meat (breast) presented lower quality, although it was richer in proteins. The fact could be explained by the reduced content in certain essential amino acids, such as lysine, knowing that collagen, a poor protein is a common compound of the pectoral muscles connective tissue.

Basing on the previously specified data, poultry meat consumption should be encouraged, grace to its high nutritional and biological features or to its reduced caloricity. Chicken meat is a viable gastronomic alternative in replacing meat issued from other species, being able to generate real benefits in circulatory diseases prevention or in observing a curative diet in those people already affected by cardiac/metabolic chronic diseases.

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