STUDY ON THE NUTRITIONAL QUALITY OF HENS MEAT REARED IN FREE-RANGE SYSTEM

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Abstract

The purpose of the research was to evaluate the nutritional quality of meat from hens reared in free-range system (in the rural area of Iasi County). Were collected the main muscle groups (muscles Pectoralis superficialis (PS), Semimembranosus (SM) and Gastrocnemius (Gn) of 26 specimens (16 females and 10 males), aged five months, of New Hampshire mixed breed (variety scarlet thread). It was determined the content of proteins, lipids, collagen and water using Food Check automatically analyzer (infrared spectrophotometer); the minerals substances were determined by calcination and nitrogen free extract (NFE) and energetic value were determined by calculation, based on the classical formulas. The average values determined for lipids varied significantly in PS muscles, with a double proportion for females (1.65%), compared to that of males (0.81%); for muscles SM and Gn, the same phenomenon it was observed, but with smaller differences. For the proteins it was observed a slightly higher value for males, for all anatomical portion analyzed, compared to females. The energetic value was higher for SM muscles (118.79 kcal/100 g meat, for females, respectively 115.39 kcal/100 g meat, for males) due to higher proportion of lipids. Analysis of the results, by gender, using the ANOVA test highlighted preponderant significant differences for Gn muscle, and for the other muscles analyzed, the differences were preponderant insignificant.

Key words: hens, meat, proteins, lipids, collagen

INTRODUCTION

Chicken meat is an important meat product in people's daily life as it can provide abundant protein rich in essential amino acids, lipids and trace elements that are valuable to their nutrition and health [7, 16, 14].

Meat contains potential anticarcinogens, including omega-3 polyunsaturated fatty acids, and conjugated linoleic acid (CLA). Red meat, in particular, is an important source of micronutrients with anticancer properties, including selenium, vitamin B6 and B12, and vitamin D. Adjusting the balance between meat and other dietary components may be crucial to protecting against potential cancer risks [6].

The quality of chicken meat can be influenced by factors like breed, sex, slaughter weight, feed types and level of feeds, age and preslaughter stress [7, 16, 13].

Compared with broiler chickens, free-range chickens has desirable properties such as suitability to surroundings, high disease resistance, good reproductive capacity. In addition, free-range chicken meats are more delicious, nutritious and more popular with consumers [10, 16].

Free-range rearing systems reduce stress while increasing comfort and bird welfare, thus enhancing the flavour (taste and aroma) of products, as compared to conventionally raised birds. [1, 3, 4].

Specialty poultry products have long been popular in Europe. One of the most successful programs in Europe is the French *Label Rouge*, which requires outdoor access of the birds. It has occupied a large part of the French poultry market despite a higher retail price than conventional poultry products [15, 4].

The *Label Rouge* program, as well as organic programs throughout Europe, use slow-growing meat birds, which were designed for alternative production systems

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and four the gourmet market and have a growing period of at least 81 days [15, 2, 4].

Various slow-growing genotypes are available in Europe, and researchers have suggested the matching of this categories of quality meat for a specialized or gourmet market [2, 3, 4].

Unfortunately, indigenous chickens reared in free-range system, normally, have lower growth rate and body weights than commercial growers, but, with protein supplementation, they might attain similar growth rate and body weights as commercial type chickens.

Indigenous chicken flocks have hardly been improved by genetic manipulation and there has been no systematic breeding program unlike the case with meat-type chickens [9, 13].

The aim of this study was the assessment of nutritional quality of meat from chickens reared in free-range system.

The necessity of this work has started from a entirely lack of information related to this type of meat, which is so appreciated by modern consumers (which is in the traditional way consumed in rural areas and it is eventually offered to customers in the agrotouristic pensions).

MATERIALS AND METHODS

The biological material collected consisted from three main anatomical parts: breast (*Pectoralis superficialis* muscles), thighs (*Semimembranosus* muscles) and drumsticks (*Gastrocnemius* muscle) from hens of mixed New Hampshire breed (scarlet variety) grown in free-range system (from 26 specimens, 16 females and 10 males, aged five months).

It has been determined the content of proteins lipids, water and collagen using automatic analyzer Food check (infrared spectrophotometer); minerals were determined by calcination and nitrogen free extractive substances and energetic value (expressed in gross energy) were determined by calculation based on the classical formulas.

To determine the nutritional value of chicken meat, conversion factors for protein were 4.27, for lipids were to 9.02 and for nitrogen free extractive substances were 3.87 (FAO, 2003) [5].

Analysis of the results was performed by gender, using classical statistical methods and analysis of variance test, ANOVA.

RESULTS AND DISCUSSION

The average values determined for lipid varied significantly in PS muscles with a double proportion for females (1.65%) compared to that of males (0.81%); for muscles SM and *Gn*, the same phenomenon it was observed, but with smaller differences.

For the proteins, it was observed a slightly higher value for males (22.12% for *PS* muscles, 21.93% for *SM* muscles and 22.03 for *Gn* muscles), compared to females (21.65% for *PS* muscles, 21.93% for *SM* muscles and 21.70% for *Gn* muscles), for all anatomical portion analyzed.

After performed determinations at the level of the breast muscles (*Pectoralis superficialis)* the coefficient of variation has shown a very homogeneous population for the most of the parameters, with the exception of the one calculated for lipids where exceeded the threshold of 10% for males, thereby indicating a relatively homogeneous population (Table 1).

After applying the test for the analysis of variance ANOVA on data obtained from analyzes performed were identified, from statistic point of view, very significant differences between males and females at the levels of lipids and collagen.

Significant differences (between females and males) were observed at the level of GE, and for the most of the parameters analyzed were observed insignificant differences (Table 1).

Table 1 The chemical composition and energetic value of *Pectoralis superficialis (PS)* muscles

Chemical components	Gender	$\overline{X} \pm S_{\overline{x}}$	S^2	S	CV%	Min.	Max.	P value
Lipids%	Females	1.65±0.02	0.03	0.05	3.32	1.60	1.70	***
	Males	0.81±0.05	0.01	0.12	14.86	0.67	0.99	p=2.453e-08
Proteins%	Females	21.98±0.21	0.27	0.52	2.34	21.03	22.59	ns
	Males	22.12±0.20	0.24	0.49	2.22	21.20	22.70	p=0.64839
Collagen%	Females	4.36±0.08	0.04	0.19	4.40	4.11	4.51	***
	Males	4.47±0.07	0.03	0.18	4.00	4.19	4.59	p=2.691e-06
Water%	Females	76.10±0.24	0.33	0.58	0.76	75.10	76.90	ns
	Males	76.64±0.29	0.50	0.71	0.92	75.20	76.98	p=0.17648
Ash%	Females	1.11±0.03	0.00	0.07	6.26	1.02	1.23	ns
	Males	1.15±0.03	0.01	0.07	6.36	1.09	1.25	p= 0.31374
Dry matter%	Females	23.90±0.24	0.33	0.58	2.41	23.10	24.90	ns
	Males	23.36±0.29	0.50	0.71	3.03	23.02	24.80	p=0.17647
OS%	Females	22.79±0.24	0.36	0.60	2.63	21.97	23.82	ns
	Males	22.21±0.30	0.55	0.74	3.33	21.85	23.71	p=0.16282
NFE%	Females	0.84±0.32	0.60	0.77	2.16	1.63	2.15	ns
	Males	0.72±0.50	1.48	1.22	8.77	1.69	1.71	p=0.84534
GE kcal/100g	Females	105.46±1.03	6.37	2.52	2.39	102.03	109.77	**
	Males	99.58±1.14	7.79	2.79	2.80	97.53	105.03	p=0.00331

OS%= organic substances
NFE%= nitrogen free extract
GE kcal/100g=gross energy

For thighs, *Semimembranosus* muscles, the coefficient of variation expressed a very homogeneous population for the most of parameters being pursued, excluding NFE, where has exceeded the threshold of 20%, showing a inhomogeneous population (Table 2). A relatively homogenous population it has been observed at the lipid levels for the females, as well as at the ash level (both for females and for males).

Table 2 The chemical composition and energetic value of *Semimembranosus muscles*

Chemical components	Gender	$\overline{X} \pm S_{\overline{x}}$	S^2	s	CV%	Min.	Max.	P value
Lipids%	Females	2.90±0.28	0.61	0.48	10.97	2.20	3.60	*
	Males	2.13±0.11	0.27	0.07	9.81	1.80	2.40	p=0.03078
Proteins%	Females	21.65±0.07	0.16	0.03	0.76	21.50	21.80	ns
	Males	21.93±0.16	0.40	0.16	1.84	21.50	22.40	p=0.14211
Collagen%	Females	4.28±0.03	0.08	0.01	1.97	4.20	4.43	ns
	Males	4.28±0.05	0.12	0.01	2.78	4.20	4.43	p=0.97819
Water%	Females	75.10±0.25	0.62	0.39	0.83	74.50	75.70	ns
	Males	75.47±0.21	0.52	0.27	0.69	74.80	75.90	p=0.29573
Ash%	Females	1.06±0.05	0.13	0.02	11.95	0.94	1.28	*
	Males	0.75±0.12	0.29	0.09	18.74	0.38	0.99	p=0.04212
Dry matter%	Females	24.90±0.25	0.62	0.39	2.50	24.30	25.50	ns
	Males	24.53±0.21	0.52	0.27	2.14	24.10	25.20	p=0.29573
OS%	Females	23.84±0.25	0.61	0.37	2.55	23.25	24.54	ns
	Males	23.78±0.18	0.45	0.20	1.88	23.31	24.30	p=0.83989
NFE%	Females	0.71±0.07	0.17	0.03	23.65	0.88	1.47	ns
	Males	0.29±0.22	0.54	0.30	88.57	0.14	1.10	p=0.10073
GE kcal/100g	Females	115.79±2.37	5.82	33.8	5.02	110.39	121.49	ns
	Males	112.39±0.19	0.45	0.21	0.40	111.92	112.93	p=0.18430

OS%= organic substances
NFE%= nitrogen free extract
GE kcal/100g=gross energy

Applying ANOVA test to determine the statistical significance of differences (between females and males), in the *Semimembranosus* muscles, insignificant differences were found for the most of the parameters analyzed, with except of lipids and ash where significant differences were noted (Table 2).

The coefficient of variation calculated for *Gastrocnemius* muscles (drumsticks) exceeded the threshold of 20% for only one parameter pursued, NFE, representing from this point of view a inhomogeneous population. For the other parameters analyzed the coefficient of variation justifies a very homogeneous population (Table 3).

Table 3 The chemical composition and energetic value of *Gastrocnemius (Gn) muscles*

Chemical components	Gender	$\overline{X} \pm S_{\overline{x}}$	S^2	s	CV%	Min.	Max.	P value
Lipids%	Females	3.27±0.02	0.05	0.03	1.58	3.20	3.30	***
	Males	2.27±0.04	0.10	0.01	4.56	2.20	2.40	p=1.20582
Proteins%	Females	21.70±0.14	0.35	0.12	1.62	21.10	22.10	ns
	Males	22.03±0.12	0.29	0.08	1.30	21.80	22.40	p=0.10271
Collagen%	Females	4.33±0.03	0.01	0.09	0.24	4.32	4.34	ns
	Males	4.34±0.04	0.11	0.01	2.49	4.20	4.43	p=0.94159
Water%	Females	74.87±0.02	0.05	0.00	0.07	74.80	74.90	***
	Males	75.67±0.06	0.14	0.02	0.18	75.50	75.80	p=1.016E-1
Ash%	Females	1.03±0.03	0.07	0.01	6.89	0.98	1.12	**
	Males	1.22±0.04	0.09	0.01	7.46	1.12	1.32	p=0.00236
Dry matter%	Females	25.13±0.02	0.05	0.00	0.21	25.10	25.20	***
	Males	24.33±0.06	0.14	0.02	0.56	24.20	24.50	p=1.01643
OS%	Females	24.10±0.04	0.11	0.01	0.45	23.98	24.22	***
	Males	23.11±0.02	0.05	0.04	0.21	23.08	23.18	p=1.70930
NFE%	Females	0.86±0.18	0.44	0.20	51.46	0.18	1.42	ns
	Males	1.19±0.10	0.25	0.06	21.48	1.02	1.52	p=0.15255
GE kcal/100g	Females	118.69±0.16	0.39	0.15	0.33	116.35	119.28	ns
	Males	110.52±0.27	0.65	0.42	0.59	107.99	111.35	p=1.42459

OS%= organic substances
NFE%= nitrogen free extract
GE kcal/100g= gross energy

As regards of the statistical significance of differences (Table 3) applying the ANOVA test for the same anatomical portion analyzed for males and females, were observed significant differences for lipids, water, dry matter and organic substances, distinctly significant differences for the ash and insignificant deference for the other parameters analyzed (proteins, collagen, NFE and GE).

The energetic value (Figure 1) was higher for Gn muscles (118.79 kcal/100 g meat, for females, respectively 110.52 kcal/100 g meat, for males), due to higher percentage of lipids, and in contrast, the lowest energetic value was determined for PS muscles (99.1 kcal/100g meat for males and 105.72 kcal/100 g meat for females) due to a lower percentage of lipids.

The average values observed at the level of muscles *PS* from this study, for females and males (proteins 21.98 - 22.12%, lipids 1.65 - 0.81%, SU 23.90 -23.36% and ash 1.11 to 1.15%) were similar to those determined by Bogosavljevic-Boskovic et al., 2010, these finding 22.96% proteins, a slightly higher percentage for lipids (2.26%) and SU% (26.07) and one slightly lower for the ash 1.07%.

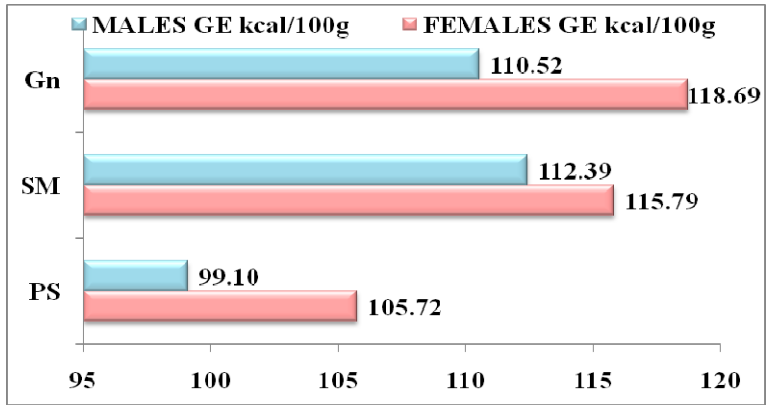

Figure 1 The energetic value of *Gn, SM* and *PS* muscles for males and females (kcal/100g)

Wang et al., 2007, determining the quality of meat of reared chickens in free-range system, at the level of muscles *Pectoralis* has found higher values for proteins (24.49%) and lowest for lipids (0.54%) and water (71.92%), compared with the data obtained in this study.

Husak et al. 2008, analyzing the chemical composition of meat from chickens reared in free-range system (breast and thigh) has determined average values relatively close to those presented in this study for water content (74.81-73.22 %) and proteins (23.2-19.49%) and higher values for lipids (1.8–7.23%).

Ponte et al, 2008a, in a study in which follows the effect of ingestion of clover of chickens meat quality reared in free-range system, has determined (in the breast muscles) the similar amounts of fat (0.9%) from those identified in the present study.

In another study, Ponte et al, 2008b, suggest that the slow-growing genotypes produces meat with greater sensory attributes compared with the fast-growing Ross genotypes, and pasture intake can further improve its intrinsic overall quality and acceptance.

CONCLUSIONS

Analysis of the results, according to sex, using the ANOVA test has highlighted the significant differences at the level of lipids and the collagen for the muscles *PS* and for the lipids levels, water, dry matter and of organic substances of muscle *Gn*, while for all other parameters the differences were not significant. For *SM* muscles significant differences were observed for the lipids and ash, and for the all other parameters insignificant differences were found.

As a additional remarks the higher percentage of proteins (and inclusively collagen) determined for the chicken breast (PS muscles) explains tougher texture at mastication of its, compared to chicken thigh and drumstick (*SM* and *Gn* muscles), the shear force being higher, the tenderness decreases; also the percentage of lipids content of muscles analyzed, influence and underlines once more this perception, for *SM* and *Gn* being higher (2.2 to 3.27%) compared to that obtained for the breast (0.8 to 1.6).

Furthermore, for all muscle groups collected from females the amount of lipids was higher than those harvested from males, and that of proteins lower.

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