THE INFLUENCE OF FEED PROTEIN AND ENERGY LEVEL ON MEAT CHEMICAL COMPOSITION AT „HYBRO PN^{+}" BROILER CHICKENS

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Abstract

In this paper was studied the influence of feed energy-protein level on meat chemical composition depending on: sex and anatomical region for chicken broiler belonging „Hybro Pn^{+}" hybrid, slaughtered at 42 days old. The two groups (control group-Lc and experimental groups-Lexp) were given feed mixed with different level of energy and protein (Lc-standard hybrid, Lexp-higher by 10% compared to standard hybrid). After slaughter, from each group were sampled 10 carcasses (five females and five males), and from different portions of the carcass (breast, thighs and shanks), was determined the meat chemical composition (water, dry matter, protein, lipids and minerals) using STAS methods. For analysis of variance were used Mann Whitney test. For males the pectoral muscle had a greater amount of dry matter, compared with females, the situation is reversed when has referring to the muscles of the thighs and shanks. The lipids content in meat showed the biggest variation between muscles analyzed, with minimum values in the pectoral muscles (from 0.91% at males-Lexp up to 1.13% in females-Lc) and maximum values in the upper thigh muscles (from 6.98% in males-Lexp up to 7.94% in females-Lc). At the Lexp group, the feed with higher protein-energy level has lead to increases of the protein content and decreased lipids content of meat.

Key words: chemical composition, dry matter, lipids, minerals, proteins

INTRODUCTION

One of the most current problems for human nutrition is the proteins nutrition and especially the existing deficiency in provision with protein for the human body [23, 24].

From the nutritional standpoint, meat obtained from animals and poultry represent one of the very important foods for humans, because has an energetic and plastic role [24]. Meat poultry is a valuable source of proteins, minerals, vitamins and has low fat content [24]. Thus, the chemical composition of muscles of the major parts in the whole carcass structure is an important element of broiler meat quality [3, 17].

The chickens' meat quality is dependent upon genetic and no-genetic factors [2, 7, 11]. Among no-genetic factors that influencing the meat quality the chickens nutrition has a very important role and can affect chemical composition of muscles [9, 10].

Broiler chickens have specific nutritional requirements to achieve performance criteria proposed. Thus, the foods rations must ensure an optimal level of energy, protein, amino acids, minerals, vitamins and essential fatty acids [8, 9, 10]. Only an adequate feeding program can ensure maximum expression of genetic potential and achieving top quality carcasses [5, 9, 10].

A carcass of superior quality is characterized by a maximum proportion of meat, and a minimum proportion of fat and bone. The meat obtained from broilers specialized in this area is known for its qualities: sensory, technological, physical, chemical, nutritional and dietary [23, 24].

Obtaining of broiler chicken with high quality carcasses and nice commercial aspect at competitive price are the essential conditions for development of the poultry

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meat production in Romania. Also, Romanian consumer demand for the poultry meat quality and for the quality of poultry products has increased greatly in lately.

Since research on improving the performance of growing for broiler chickens carried both in our country and abroad include in particular the quantitative aspects of meat production on this category of poultry, in this paper was studied the influence of the feed energy and protein level on the meat chemical composition from different anatomical regions at broilers belonging to the „Hybro Pn^{+}" hybrid sacrificed at the age of 42 days.

MATERIAL AND METHODS

Our research was made on broiler chicken belonging „Hybro Pn^{+}" hybrid, sacrificed at 42 days. In this study, were two groups of chicks (males and females in equal ratio), control group (Lc) and experimental group (Lexp.), reared in the same microclimate condition.

In the growth period (1-42 days) for microclimate factors of the house (air temperature and air relative humidity), the values have been according to the manual „Hybro Pn^{+}" hybrid [5]. The growth system was on the permanent litter, with a density of 12 chicks/m^{2}.

At the two groups of chickens was given feed mixed with different protein and energy levels as follows: Lc-protein and energy level was conforming with recommendations of company „Hybro BV" for the „Hybro Pn^{+}" hybrid [5] and Lexp-protein and energy level with 10%. Depending on the age of chicks during growth (1-42 days) for each group were given three fodder recipes (starter, growing and finishing) (table 1).

After the slaughter, from each group were sampled 10 carcasses (five females and five males) and was determined the chemical composition of meat (water, dry matter, protein, lipids and minerals) for three anatomical regions (breast, thighs and shanks).

Table 1 Features of the mixed feed recipes

Specification	Chicken group	
	Lc	Lexp.
Starter 1-14 days		
Crude protein (%)	23.80	26.18
M. E. (kcal/kg feed)	3036	3281
Energy/protein ratio	127.56	125.32
Grower 15-35 days		
Crude protein (%)	21.86	24.03
M. E. (kcal/kg feed)	3142	3439
Energy/protein ratio	143.73	143.11
Finisher 36-42 days		
Crude protein (%)	20.18	22.27
M. E. (kcal/kg feed)	3196	3483
Energy/protein ratio	158.37	156.47

Methods of analysis used to determine the chemical composition of the meat were: drying oven for dry matter determination (Standard ISO 1442/1997); calcinations method for determination of totals minerals (Standard ISO 936/1998); Soxhlet method on modern appliances-Soxtest Raypa PG-16 E01 to determine the amount of lipids (Standard ISO 1443/2008); Kjeldahl method adapted on appliances FOSS TECATOR to determine protein substances (Standard ISO 937/2007) [12].

Raw data obtained from measurements were processing using methods of biostatistics with Microsoft Excel spreadsheet application. To test the statistical significance of differences between mean values of the characters studied has been applied analysis of variance using Mann Whitney test from the program MINITAB 14 [6].

RESULTS AND DISCUSSIONS

Results on the chemical composition of meat from the pectoral muscles are shown in table 2.

The data from table 2 shows that, in the breast meat the water content was between 73.10 to 73.60% at males and between 73.22 to 73.34% at females. The analysis of variance not showed the presence of differences statistically significant.

For the pectorals muscles in the samples taken at females, the water quantity was lower and the dry matter content was greater, compared with males where the situation is reversed [14, 15, 16].

At control group, for pectorals muscles the water content was greater as compared with Lexp. group (73.60% vs. 73.10% in males and 73.34% vs. 73.22% in females) and for dry matter content the situation is reversed (26.40% vs. 26.90% in males and 26.66% vs. 26.78% in females).

Table 2 The chemical composition of meat from the breast muscles

Specification	Males-Lc		Females-Lc		Males-Lexp		Females-Lexp.	
	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%
Water	73.60 ±0.30	0.90	73.34 ±0.36	1.09	73.10 ±0.31	0.94	73.22 ±0.31	0.94
Dry matter	26.40 ±0.18	1.56	26.66 ±0.18	1.51	26.90 ±0.22	1.83	26.78 ±0.19	1.60
Proteins	23.65^{b} ±0.20	1.85	23.56^{b} ±0.22	2.06	24.51^{a} ±0.22	2.03	24.16^{a} ±0.24	2.23
Lipids	1.31^{ab} ±0.03	5.34	1.69^{a} ±0.06	8.03	0.91^{b} ±0.04	9.68	1.13^{ab} ±0.07	14.08
Minerals totals	1.13 ±0.01	2.96	1.18 ±0.02	3.46	1.16 ±0.03	6.70	1.20 ±0.05	9.51

Mann Whitney test: ^{ab}significant differences $p \leq 0.05$

Lipids content in pectoral muscles, had values ranging from 0.91 to 1.31% in males and from 1.13 to 1.69% in females. Variance analysis showed the presence of differences statistically significant for $p \leq 0.05$ (table 2).

In Lexp. group, the breast muscles was characterized by lower lipids content (from 0.91 up to 1.13%) and higher protein content (from 24.16 up to 24.51%) compared with the control group which has had higher lipids contents (from 1.31 up to 1.69%) and lower protein content (from 23.56 up to 23.65%) [4, 13, 14, 15, 16].

In pectoral muscles the protein content ranged between 23.65 to 24.51% in males and from 23.56 to 24.16% in females. Thus, at Lexp group the average values obtained for protein content were higher, as compared with control group (24.51% vs. 23.65% in males and 24.16% vs. 23.56% in females). The values obtained in this study are situated to the higher limit specified in the literature for this type of meat [1, 18, 19, 20, 21].

At Lexp. group, for the chemical composition of the pectoral muscles were recorded the lowest values for water content and lipids and the higher values for dry matter content and proteins, as compared with the control group (Lc).

In table 3 it is presented the chemical composition of meat for the samples taken from thighs area.

Table 3 The chemical composition of meat from the thigh muscles

Specification	Males-Lc		Females-Lc		Males-Lexp		Females-Lexp.	
	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%
Water	71.92 ±0.47	1.45	71.05 ±0.81	2.56	72.32 ±0.29	0.91	71.62 ±0.56	1.75
Dry matter	28.08 ±0.47	3.71	28.95 ±0.81	6.29	27.68 ±0.29	2.38	28.38 ±0.56	4.41
Proteins	18.68 ±0.53	6.30	18.50 ±0.59	7.13	19.24 ±0.43	4.94	19.09 ±0.65	7.59
Lipids	7.81^{ab} ±0.17	4.81	8.98^{a} ±0.35	8.82	6.98^{b} ±0.17	5.47	7.94^{ab} ±0.21	5.91
Minerals totals	0.95 ±0.04	9.69	8.93 ±0.02	3.92	0.98 ±0.03	5.90	0.95 ±0.03	6.73

Mann Whitney test-between groups: ^{ab}significant differences $p \leq 0.05$

In muscles from thighs area, the water content has ranged from 71.05 to 72.32%, with higher values for males compared with the females (71.92% vs. 71.05% at Lc and 72.32% vs. 71.62% at Lexp.). Thus, for samples taken from experimental group (Lexp.), water content was from 71.62% (in females) up to 72.32% (in males) and at control group (Lc) from 71.05% (in females) up to 71.92% (in males).

In thighs muscles the dry matter content was higher in the case of samples taken from females compared with males and for control group (Lc) compared with experimental group (Lexp).

For proteins in the thigh meat was found values from 18.50 up to 18.68% at control group (Lc) and from 19.09 up to 19.24% at experimental group (Lexp.). Thus, for samples taken from males averages values for protein content were higher compared with females (18.68% vs. 18.50% at Lc group and 19.24% vs. 19.09% at Lexp. group) [21, 22].

The variation coefficient not exceeding the value of 7.59% and revealed a very good homogeneity. Analysis of variance no revealed statistical differences between averages values obtained at males compared with females and between the control group compared with the experimental group.

The lipids proportion in thighs muscles was higher at control group (7.81% at males and 8.98% at females), compared with the experimental group (6.98% at males and 7.94% at females). The test for analysis of variance revealed statistical differences ($p \leq 0.05$) between averages values obtained at males compared with females and between control group vs. experimental group.

Data related to water content, dry matter, proteins, lipids and minerals in the samples taken from shanks are presented in table 4.

Table 4 The chemical composition of meat from the shank muscles

Specification	Males-Lc		Females-Lc		Males-Lexp		Females-Lexp.	
	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%	$\bar{X} \pm s_{\bar{X}}$ (%)	V%
Water	72.46 ±0.68	2.08	72.02 ±0.66	2.05	72.09 ±0.81	2.51	71.94 ±0.89	2.77
Dry matter	27.54 ±0.68	5.48	27.98 ±0.66	5.28	27.91 ±0.81	6.48	28.06 ±0.89	7.71
Proteins	20.55 ±0.59	6.37	20.13 ±0.63	7.91	21.71 ±0.62	7.08	21.23 ±0.44	4.66
Lipids	5.33[a] ±0.19	8.07	5.84 ±0.34	13.04	4.68[b] ±0.31	14.63	5.29 ±0.27	11.41
Minerals totals	1.01 ±0.03	5.89	1.02 ±0.05	11.86	1.03 ±0.03	5.51	1.04 ±0.05	11.06

Mann Whitney test-between groups: [ab]significant differences $p \leq 0.05$

Water proportion in shank muscles was higher at males compared with females (72.46% vs. 72.02% at Lc group and 72.09% vs. 71.9% at Lexp. group). Thus, for the dry matter proportion from shank muscles situation is reversed. For water content and dry matter, the differences between compared average values were not statistically, in any considered situation.

However, meat taken from shanks at experimental group (Lexp) was richer in protein (with +5.46%, in females up to +5.64%, in males) and poor in lipids (with -9.42%, in females up to -12.20%, in males), compared to the control group (Lc). Thus, in shank muscles samples taken from males the lipids content was lower (with -8.73%, at Lc up to -11.53%, at Lexp), as compared with females.

Chemical analysis of meat (water, dry matter, proteins and lipids) from breast fillet, shanks and thighs revealed differences between values obtained at males compared with females and between values obtained at experimental group (Lexp.) compared with control group (Lc) [13, 14, 15, 16, 18, 22].

The protein proportion in the breast fillet have higher values (from 23.56 up to 24.51%), compared with the shanks and thighs (from 20.13 up to 21.71%, in shanks and from 18.50 up to 19.24%, in thighs) [3, 4, 21, 25].

Thus, were observed the following differences: between the breast and shanks from 2.80 up to 3.43%; between the breast and thighs from 4.97 up to 5.27% and between the shanks and thighs from 1.63 up to 2.47%.

The lipids content, in breast fillet was up to 1.69%, for thighs muscles from 6.98 up to 8.98% and for shanks muscles from 4.68 up to 5.84%. Thus, were calculated the following differences: between shank muscles and breast of 3.77 up to 4.16%; for thighs muscles differences vs. breast were of 6.07 up to 7.29% and between thighs and shanks of 2.3 up to 3.14%.

The results which were obtained in this study, for the chemical composition of meat from breast fillet, thighs and shanks from broiler chickens sacrificed at the age 42 days, are similar with the values mentioned in the scientific literature for these meats [2, 18, 19, 20, 21]. The values obtained at Lexp group are to the higher limit value specified in the literature and those recorded in Lc group to the lower limit for this muscle types [3, 18, 19, 20, 21].

CONCLUSIONS

In breast fillet the water proportion, proteins and minerals was higher, as compared with shanks and thighs muscles, which have the higher lipids proportion.

At the Lexp group, the feeding with higher protein-energy level has resulted increase protein content and decrease lipids content of meat.

For the samples taken from females the lipids content of meat was higher, as compared with males, in any considered situation.

Lipids of the meat had the biggest variation between muscles analyzed, in the pectoral muscles were recorded minimum values (0.91 to 1.69%), and the thighs had maximum values (up to 8.98%).

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