

## THE INFLUENCE OF FEED PROTEIN AND ENERGY LEVEL ON MEAT CHEMICAL COMPOSITION AT „ARBOR ACRES” HYBRID

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### Abstract

*In this paper was studied the influence of feed energy-protein level on the chemical composition of meat from different anatomical regions in broiler chicken meat belonging „ARBOR ACRES” hybrid, slaughtered at 42 days old. At the three groups (control group-Lc, experimental groups Lexp.<sub>1</sub> and Lexp.<sub>2</sub>) were given feed mixed with different level of energy and protein (Lc-standard hybrid, Lexp.<sub>1</sub>-higher by 10% and Lexp.<sub>2</sub>-lower by 10% compared to standard hybrid). After slaughter, from each group were sampled in 10 cases (five females and five males) from different anatomical regions (breast, thighs and shanks) and was determined the chemical composition (water, dry matter, protein, lipids and minerals) using STAS methods. Statistical analysis was performed with Microsoft Excel spreadsheet application and analysis of variance by Mann Whitney test. For males the pectoral muscle had a greater amount of dry matter, compared with females, the situation is reversed when referring to the muscles of the thighs and shanks. Fat meat showed the biggest variation between muscles analyzed, with minimum values in the pectoral muscles (from 0.67 to 1.48%) and maximum values in the upper thigh muscles (6.97 to 9.89%). The high nutritional value of meat occurred in the group Lexp.<sub>1</sub>, in all cases had the highest protein and lowest fat content in muscles.*

**Key words:** chemical composition, pectoral muscles, thighs, shanks

### INTRODUCTION

After Romania joined to the European Union, the competitive market for the poultry sector has spread in our country. Obtaining of broiler chicken with a high quality carcasses, the commercial aspect of the carcass and a competitive price are the essential conditions for development in Romania of the poultry meat production. Also, the demand of consumers in Romania for the poultry meat quality and for the quality of poultry products has increased greatly.

The poultry meat is much requested by consumers, taste characteristics due to special, high nutritional value and high degree of digestibility. The chemical composition of meat is one of the most important indicators that highlight its quality [2, 22, 23]. Besides these qualities, poultry meat is produced at lower cost compared

with meat from other domestic species [13, 23].

Hybrids of chicken meat have specific nutritional requirements to achieve performance criteria. Rations to ensure an optimal level of energy, protein, amino acids, minerals, vitamins and essential fatty acids [17, 18]. Only an adequate feeding program can ensure maximum expression of genetic potential and achieving top quality carcasses [11, 12]. A carcass of superior quality is characterized by a maximum proportion of meat, and a minimum proportion of bone and fat. The chemical composition of meat is greatly influenced by the food rations used at broiler [1, 4, 8, 9].

The meat obtained from broilers specialized in this area is known for its sensory, technological, physical, chemical, nutritional and dietary qualities [22, 23].

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

**MATERIALS AND METHODS**

Our research was conducted on broiler chicken belonging hybrids "ARBOR ACRES", sacrificed at the age of 42 days. For this study, comprising 3 (three) groups of chicks (males and females), of a control

group (Lc) and 2 (two) experimental groups (Lexp.<sub>1</sub> and Lexp.<sub>2</sub>), reared in the same microclimate. At the 3 (three) groups of chickens were given feed mixed with protein and energy levels differently as follows: Lc - protein and energy level as recommended company Aviagen for the „ARBOR ACRES” hybrid [25], Lexp.<sub>1</sub>- protein and energy level 10% higher than firm Aviagen recommendations for „ARBOR ACRES” hybrid and Lexp.<sub>2</sub> - protein and energy level 10% lower than firm Aviagen recommendations for „ARBOR ACRES” hybrid. Depending on the age of chicks during growth (1-42 days) for each group were given three fodder recipes (starter, growing, finishing) (tab. 1) [22, 23, 25].

Table 1-Features of the mixed feed recipes for chickens

Chicken group	Recipe features	Recipe type		
		starter 1-14 days	grower 15-35 days	finisher 36-42 days
Lc	Crude protein (%)	24.02	22.63	21.06
	M. E. (kcal/kg feed)	3041	3144	3190
	Energy : Protein ratio	126.60	133.00	151.50
Lexp. <sub>1</sub>	Crude protein (%)	26.23	24.90	23.12
	M. E. (kcal/kg feed)	3270	3435	3490
	Energy : Protein ratio	124.7	137.95	150.00
Lexp. <sub>2</sub>	Crude protein (%)	21.80	20.25	18.75
	M. E. (kcal/kg feed)	2860	2870	2890
	Energy : Protein ratio	131.20	141.70	154.10

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

Methods of analysis used to determine the chemical composition of meat were: drying oven for determination of water and dry matter (Standard ISO 1442/1997); calcinations method for determination of minerals (Standard ISO 936/1998); Soxhlet method in modern appliances such Soxtest Raypa PG-16 E01 to determine the amount of lipids (Standard ISO 1443/2008); Kjeldahl method adapted to modern appliances type FOSS TECATOR to determine protein substances (Standard ISO 937/2007) [6, 10].

Raw data obtained from measurements were performed by the processing methods of biostatistics with Microsoft Excel application. To test the statistical significance of differences between mean values of the characters studied, has been applied analysis of variance using with test Mann Whitney the program MINITAB 14 [7, 20].

**RESULTS AND DISCUSSION**

Average results, on the chemical composition of meat in the pectoral muscles, are shown in tab. 2.

The data presented in tab. 2 shows that the breast meat had the water content between 72.58 to 74.30% for males and between 73.02 to 74.65% for females. Only for the males, the test analysis of variance

showed the presence of differences statistically significant.

The pectorals muscles samples at the males, had a lower quantity of the water and a greater quantity of the dry matter, compared with females where the situation is reversed [3, 15].

Lipids content in pectorals muscle, had values ranging from between 0.69 to 1.43% in males and from 0.78 to 1.60% in females, with significant differences ( $p \leq 0.05$ ). (tab. 2)

In pectorals muscles the protein content ranged between 22.42 to 25.05% in males and from 21.91 to 24.36% at females. The values obtained at Lexp.<sub>1</sub> group are to the higher limit value specified in the literature and those recorded in Lexp.<sub>2</sub> group to the lower limit for this meat [3, 14, 16, 19, 24]

At the Lexp.<sub>1</sub> group, for the chemical composition of pectoral muscle, were recorded the lowest values for water content (72.58% in males and 73.02% for females) and the highest values for dry matter (27.42%

for males and 26.98% in females), compared with control group (Lc) and Lexp.<sub>2</sub> group.

In Lexp.<sub>1</sub> group the breast meat was characterized by very low fat content (0.69% on males and 0.78% at females), and a high protein content (25.05% at males and 24.36% at females) compared with the control group (Lc) and the Lexp.<sub>2</sub> group.

In the Lexp.<sub>1</sub> group case for the chemical composition from the pectoral muscles were recorded the lowest values for water content (72.58% at males and 73.02% at females) and the highest values for dry matter (27.42% for males and 26.98% in females) compared with the control group (Lc) and the Lexp.<sub>2</sub> group.

In the case Lexp.<sub>2</sub> group, the meat of the breasts was characterized by a higher fat content (1.43% at males and 1.60% at females) and a lower protein content (22.42% at males and 21.91% for females) compared with Lexp.<sub>1</sub> group and the control group (Lc) [15].

Table 2-The chemical composition of meat from the pectoral muscles

Specification	Males			Females		
	Control group(Lc)	Group Lexp. <sub>1</sub>	Group Lexp. <sub>2</sub>	Control group(Lc)	Group Lexp. <sub>1</sub>	Group Lexp. <sub>2</sub>
Water $\bar{x} \pm s\bar{x}$ (%)	73.40 $\pm 0.20$	72.58 $\pm 0.10$	74.30 $\pm 0.27$	73.78 $\pm 0.33$	73.02 $\pm 0.22$	74.65 $\pm 0.37$
CV%	0.62	0.33	0.81	1.02	0.67	1.13
Statistic significance	*Lc-Lexp. <sub>1</sub> ; Lexp. <sub>1</sub> -Lexp. <sub>2</sub>			NS		
Dry matter $\bar{x} \pm s\bar{x}$ (%)	26.60 $\pm 0.18$	27.42 $\pm 0.14$	25.70 $\pm 0.23$	26.22 $\pm 0.31$	26.98 $\pm 0.28$	25.35 $\pm 0.37$
CV%	1,71	0,85	2,31	2,84	1,73	3,26
Statistic significance	*Lexp. <sub>1</sub> - Lexp. <sub>2</sub>			*Lexp. <sub>1</sub> - Lexp. <sub>2</sub>		
Proteins $\bar{x} \pm s\bar{x}$ (%)	24.15 $\pm 0.18$	25.05 $\pm 0.14$	22.42 $\pm 0.23$	23.49 $\pm 0.31$	24.36 $\pm 0.28$	21.91 $\pm 0.37$
CV%	1.66	1.29	2.30	2.98	2.53	3.78
Statistic significance	*Lc- Lexp. <sub>1</sub> ; Lexp. <sub>1</sub> - Lexp. <sub>2</sub>			*Lc- Lexp. <sub>1</sub> ; Lexp. <sub>1</sub> - Lexp. <sub>2</sub>		
Lipids $\bar{x} \pm s\bar{x}$ (%)	0.95 $\pm 0.03$	0.69 $\pm 0.02$	1.43 $\pm 0.03$	1.06 $\pm 0.03$	0.78 $\pm 0.03$	1.60 $\pm 0.05$
CV%	6.28	7.44	4.02	6.30	8.58	7.13
Statistic significance	*Lc-Lexp. <sub>1</sub> ;Lc-Lexp. <sub>2</sub> ;Lexp. <sub>1</sub> -Lexp. <sub>2</sub>			*Lc-Lexp. <sub>1</sub> ;Lc-Lexp. <sub>2</sub> ;Lexp. <sub>1</sub> -Lexp. <sub>2</sub>		
Minerals $\bar{x} \pm s\bar{x}$ (%)	1.07 $\pm 0.03$	1.10 $\pm 0.05$	1.06 $\pm 0.04$	1.14 $\pm 0.04$	1.16 $\pm 0.06$	1.09 $\pm 0.06$
CV%	6.63	9.85	8.65	7.76	11.63	13.18
Statistic significance	NS			NS		

MANN WHITNEY test: NS- no significant differences  $p > 0.05$ ; \* significant differences  $p \leq 0.05$ ;

\*\* distinguished significant differences  $p \leq 0.01$ ; \*\*\* high significant differences  $p \leq 0.001$

In tab. 3 are presented results on the chemical composition of meat in the upper thigh muscles.

For the meat at thigh (tab. 3), water content had values from 71.31% at females in control group (Lc) to 72.70% at males in group Lexp.<sub>1</sub>, and dry matter content was from 27.30% at males in Lexp.<sub>1</sub> group to 28.69% at females from control group Lc.

For the thighs, lipids content was between 6.86 to 8.43% at males and between 7.94 to 9.74% at females. Analysis of variance revealed the presence of significant

differences (p≤0.05) between mean values obtained at males and females and between the three groups studied.

The thighs meat had medium content of total protein substances between 17.52 to 19.08 at females and between 17.72 to 18.96% at males. The highest content of total protein substances had the Lexp.<sub>1</sub> group (18.96% at males and 19.08% at females), while the Lexp.<sub>2</sub> group had recorded the lowest values (17.72% at males and 17.52% at females).

Table 3-The chemical composition of meat from the thighs

Specification	Males			Females		
	Control group (Lc)	Group Lexp. <sub>1</sub>	Group Lexp. <sub>2</sub>	Control group (Lc)	Group Lexp. <sub>1</sub>	Group Lexp. <sub>2</sub>
Water $\bar{x} \pm s\bar{x}$ (%)	72.39 ±0.53	72.70 ±0.51	72.33 ±0.81	71.31 ±0.68	71.62 ±0.57	71.41 ±0.66
CV%	1.65	1.56	2.52	2.13	1.77	2.08
Statistic significance	NS			NS		
Dry matter $\bar{x} \pm s\bar{x}$ (%)	27.61 ±0.53	27.30 ±0.51	27.67 ±0.81	28.69 ±0.68	28.38 ±0.57	28.59 ±0.66
CV%	4.32	4.15	6.59	5.30	4.46	5.18
Statistic significance	NS			NS		
Proteins $\bar{x} \pm s\bar{x}$ (%)	18.32 ±0.66	18.96 ±0.61	17.72 ±0.74	18.50 ±0.68	19.08 ±0.75	17.52 ±0.82
CV%	8.01	7.19	9.30	8.16	8.78	10.49
Statistic significance	NS			NS		
Lipids $\bar{x} \pm s\bar{x}$ (%)	7.72* ±0.17	6.86* ±0.23	8.43* ±0.21	8.73 ±0.33	7.94 ±0.21	9.74 ±0.26
CV%	5.01	7.47	5.46	8.38	5.91	5.86
Statistic significance	*Lc-Lexp. <sub>1</sub> ;Lc-Lexp. <sub>2</sub> ;Lexp. <sub>1</sub> -Lexp. <sub>2</sub>			*Lc-Lexp. <sub>1</sub> ;Lc-Lexp. <sub>2</sub> ;Lexp. <sub>1</sub> -Lexp. <sub>2</sub>		
Minerals $\bar{x} \pm s\bar{x}$ (%)	0.93 ±0.02	0.99 ±0.02	0.92 ±0.02	0.92 ±0.01	0.97 ±0.02	0.89 ±0.02
CV%	5.69	5.20	3.80	3.59	5.53	4.24
Statistic significance	NS			NS		

MANN WHITNEY test: NS- no significant differences p>0.05; \* significant differences p≤0.05; \*\* distinguished significant differences p≤0.01; \*\*\* high significant differences p≤0.001

Data on the chemical composition of meat from the shank are shown in tab. 4.

The proportion of the water of the shank was more higher with up to 1.08% for males compared with females that have a more higher content of dry matter (up to +1,08).

The lipids percentage in the shanks has ranged at minimum 5.02% at samples collected from males group Lexp<sub>1</sub> up to maximum 8.14% at females of Lexp<sub>2</sub> group. As reflected in the tab. 4, differences between

the average values for this indicator have statistical significance (p≤0.05).

For the protein substances of the shanks were recorded very small differences between the males and females (less than 1%). If we compare the (3) three groups, is found that at Lexp.<sub>1</sub> group the content of protein is higher compared to control group (up to: 0.73% at males and 0.86% at females) and Lexp.<sub>2</sub> group ( up to: 2.09% for males and 1.90% in females). These differences are not insured in terms of statistic.

The results presented in tab.3 and 4 on the chemical meat composition of the muscles of the thighs and shanks, are in concordance with dates mentioned in the scientific literature [3, 5, 21, 23].

Table 4-The chemical composition of meat from the shanks

Specification	Males			Females		
	Control group (Lc)	Group Lexp. <sub>1</sub>	Group Lexp. <sub>2</sub>	Control group (Lc)	Group Lexp. <sub>1</sub>	Group Lexp. <sub>2</sub>
Water $\bar{x} \pm s\bar{x}$ (%)	71.83 ±0.86	72.33 ±1.01	72.37 ±0.76	71.10 ±0.63	71.75 ±0.90	71.29 ±0.69
CV%	2.66	3.12	2.36	1.98	2.80	2.16
Statistic significance	NS			NS		
Dry matter $\bar{x} \pm s\bar{x}$ (%)	28.17 ±0.86	27.67 ±1.01	27.63 ±0.76	28.90 ±0.63	28.25 ±0.90	28.71 ±0.69
CV%	6.79	8.15	6.17	4.87	7.12	5.36
Statistic significance	NS			NS		
Proteins $\bar{x} \pm s\bar{x}$ (%)	20.42 ±0.70	21.15 ±0.80	19.06 ±0.65	20.25 ±0.68	21.11 ±0.77	19.21 ±0.70
CV%	7.67	8.47	7.59	7.54	8.13	8.09
Statistic significance	NS			NS		
Lipids $\bar{x} \pm s\bar{x}$ (%)	6.13* ±0.22	5.02* ±0.26	7.06* ±0.24	7.12 ±0.21	5.78 ±0.32	8.14 ±0.34
CV%	8.17	11.58	7.54	6.59	12.71	9.45
Statistic significance	*Lc-Lexp. <sub>1</sub> ;Lc-Lexp. <sub>2</sub> ;Lexp. <sub>1</sub> -Lexp. <sub>2</sub>			*Lc-Lexp. <sub>1</sub> ;Lc-Lexp. <sub>2</sub> ;Lexp. <sub>1</sub> -Lexp. <sub>2</sub>		
Minerals $\bar{x} \pm s\bar{x}$ (%)	0.97 ±0.05	1.02 ±0.02	0.92 ±0.02	0.99 ±0.05	1.03 ±0.05	0.91 ±0.02
CV%	10.36	4.23	3.80	11.47	10.68	4.29
Statistic significance	NS			NS		

MANN WHITNEY test: NS- no significant differences  $p > 0.05$ ; \* significant differences  $p \leq 0.05$ ; \*\* distinguished significant differences  $p \leq 0.01$ ; \*\*\* high significant differences  $p \leq 0.001$

## CONCLUSIONS

In the males' case, the pectoral muscles have a greater amount of dry matter, compared with females, the situation is reversed when referring to the thigh and the shanks muscles.

Lipids of the meat had the biggest variation between muscles analyzed, in the pectoral muscles were recorded minimum values (0.69 to 1.60%), and in the thighs was maximum values (up to 9.74%).

The best results for the nutritional value of the meat were recorded at the Lexp.<sub>1</sub> group, which in all cases had highest protein content and lowest percentage of fat in muscle, while Lexp.<sub>2</sub> group had the lowest nutritional value (high proportion of fat and low of protein).

The nutritional value of chicken meat obtained from the three groups was influenced

by the energy and protein level from the recipes administrated in growth period.

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