STUDY ON SLAUGHTER ANALYSIS, PHYSICO-CHEMICAL CHARACTERISTICS AND MICROMORPHOLOGICAL FEATURES OF NORTH CAUCASIAN BRONZE TURKEY MEAT

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ABSTRACT

The present study aimed at compare the meat performance, physico-chemical properties of skeletal muscles in North Caucasian bronze turkeys. North Caucasian bronze (NCB) turkeys were reared using the adopted technology in the breeding turkey farm at the Agricultural Institute – Stara Zagora, on deep permanent litter. The feeding was ad libitum, with compound feeds according to the age of birds. The study comprised 3 male and 3 female North Caucasian bronze turkey poults at 16 weeks of age. At slaughter, edible offal (liver, heart, spleen and gizzard) were removed after the feet, feathers and heads. The cleaned carcass without the neck and edible offal represented the dressed carcass (grill). After 24-hour cooling at 0-4 ^{0}C the carcasses were cut. Twelve slaughter parameters were determined after evisceration and weighing of internal organs: liver, spleen, proventriculus, heart, intestines (g). They served for calculation of the slaughter yield.

The difference between slaughter yields between males and females: 76.48% and 74.19±3.25% respectively, was insignificant ($p>0.05$). This tendency for superiority of males was preserved for all parts of the body. The chemical analysis showed higher content of fat and ash in breast muscles of female turkeys. There were no differences in the amount of protein and fat in thighs. Eicosatrienoic and arachidonic fatty acids were not found in the breast meat of male and female NCB turkeys. Breast meat of both genders had statistically significantly higher content of P, K, Mg. The thigh muscles of males and females had higher Zn ($p<0.01$) and Fe ($p<0.001$) content than white breast meat.

Key words*: turkey, broiler, growth, way of breeding, slaughter analysis, production system water-holding capacity*

Modern turkey industry is a branch of poultry farming which develops at very high rates. The performance of genetic selection for rapid growth and the transition from whole carcasses processing to deep processing methods, enterprises are more commonly facing problems with meat quality. The selection is based on improvement of meat traits of domesticated turkeys from different breeds and strains (**Oblakova, 2005. Oblakova, et.al 2009).** Modern retail market demands require also various strategies for selection of material for production of broilers and turkeys. Despite the changing demands, the broiler chicken industry aims at attaining a definite weight at a given age and also to produce birds within a narrow weight range at the age of slaughter (**Emerson, D. A., 1997**). In turkeys, things are different: the aim is to obtain a specific weight for carcass cuts at a given age. Turkeys attain are marketed at an age corresponding to 60% of sexual maturity whereas this value for broilers is 30%.

The increased demand and interest to turkey meat on retail markets necessitates the complete characterisation and comparison of its general meat traits to those of broiler chicken meat. Because of the annual marketing of turkey meat, a transition from grazing on pastures to industrial production systems was made. **İsguzar E., (2003)** studied carcass traits and meat quality при Bronze and White turkeys. **Marquez at al., (1983)** performed a comparative study between White and Bronze turkeys at 25 weeks of age are reported live weights of 12300 to 10610 g for males and 7490 to 7910 g for females. In the view of **Aksoy, (1996)** male and female of Bronze turkeys aged 24 weeks weighed 10575 and 6877 g respectively.

Bakalivanova (2000) and Bakalivanova et al. (2001) established a greater proportion of breast from the total carcass weight in turkeys – 31.72% compared to that in broiler chickens –

29.28%. **Alvarado and Sams (2004**) investigated the water holding capability (WHC%), colour and drip loss after cooking and demonstrated that they were influenced by the storage temperature, cooling and other technological parameters. **Ngoka, D. A., et.al (1982**) studies the effects of age, gender and preslaughter factors on meat quality and its chemical properties and reported WHC% of 25.49% for fed birds and 32.31% for birds fasted before the slaughter. The parameter is influenced by preslaughter challenge and became 30.80%, compared to WHC of meat in unstressed birds 26.91%. Having studied the meat quality of turkey strains, **Dransfield and Sosnicki**, **(1999)**, **Santé etc.,(1991), Fernandez etc. (2001)**, **Rammouz etc. (2004)** reported that meat pH decreased most rapidly in the the line selected for rapid growth. According to **López P. E., (2011)** the content of polyunsaturated fatty acids in the thigh of local Mexican turkeys depended on the gender. The polyunsaturated fatty acids content in layers varied from 21 to 28% whereas in male birds it was 24%. Werner and al. (2008) reported that breast meat protein in different turkey genotypes were from 24.9% in BUT6 and 25.9%. in Kelly BBB. The ash content in the breast meat of wild female turkeys was 0.64% **(López P. E. 2011)** whereas in males - 0.84% ($p<0.05$).

The present study aimed at compare the meat performance, physico-chemical properties of skeletal muscles in North Caucasian bronze turkeys.

Material and Methods

The study comprised 3 male and 3 female North Caucasian bronze turkey poults at 16 weeks of age and was conducted during October 2006 - April 2007. North Caucasian bronze (NCB) turkeys were reared using the adopted technology in the breeding turkey farm at the Agricultural Institute – Stara Zagora, on deep permanent litter. The feeding was ad libitum, with compound feeds according to the age of birds

Table No1 - Contents of nutrients in feed for broiler poults

Age, weeks	crude protein %	metabolizable energy, кcal/kg	fibres %	Lysine %	Met. +cystine %	Ca %	Assimilated P%
0-4	28.05%	1574.064	2.78	1.74	0.67	1.41	0.85
5-8	26.85	1770.25	2.91	1.67	0.66	1.33	0.75
9-12	22.065	3109.65	3.85	1.37	0.61	1.152	0.63
14-16	19.28	2380.29	2.81	1.143	0.54	1.108	0.605

After 12-hour fasting, the birds were stunned and slaughter as required by **Ordinance 22 of the Ministry of Agriculture and Food (2005)** г. for minimisation of animal suffering during slaughter or killing.

Slaughter analysis and chemical analyses were performed in the Meat and Meat products unit at the Faculty of Agriculture, Trakia University – Stara Zagora. At slaughter, edible offal (liver, heart, spleen and gizzard) were removed after the feet, feathers and heads. The cleaned carcass without the neck and edible offal represented the dressed carcass (grill). After 24-hour cooling at 0-4 ^{0}C the carcasses were cut. Twelve slaughter parameters were determined after evisceration and weighing of internal organs: liver, spleen, proventriculus, heart, intestines (g). They served for calculation of the slaughter yield.

Samples for physico-chemical analyses of breast and thigh muscles for determination of water, proteins, fat, ash and water holding capacity (WHC) were collected 24 hours after slaughter. The content of water, proteins, lipids, ash was assayed as per **Pojarskaia (1964**). The amino acid content was determined by ion-exchange column chromatography as per **Moore and William H.**

Stein, **(1948)**. Trace elements and macroelements were assayed by atomic absorption spectrophotometry (**AOAC, 2007).**

Fatty acid composition of triglycerides of red and white meat samples was determined after extraction of lipids by the method of **Bligh and Dyer, (1959)**. Triglycerides were separated by means of thin-layer chromatography on silicagel and mobile phase diethyl ether as per **Dimov and Dimitrov (1978).** Fatty acids were methylated in 2% sulfuric acid and anhydrous solution as per **Angelov (1994**). Triglyceride quantity and quality were assayed by gas chromatography with metal column with Supelcoport 100/200 mesh as stationary phase.

Water holding capacity values were determined by the 24th post slaughter hour (pH24) WHC (%) of whole meat were analysed by the 24th post slaughter hour on samples from *m. Pectoralis superficialis*, *m. Pectoralis profundus* and *m. Femorotibialis*. The analysis was performed by the classical method of **Grau and Hamm (1953**), described by **Zahariev and Pinkas (1979)** and modified by **Petrov (1982)**.

The analysis of results was performed by ANOVA, EXCEL 2010. The so obtained results were statistically processed, the reliability criteria for the arithmetic mean and for arithmetic means obtained for separate results as obtained by **Nikolov and Yablanski (1981**).

Results and Discussion

Table 2 shows data from the slaughter analysis of male and female North Caucasian bronze turkey poults. Higher live weight was recorded in male NCB turkeys – 5.23 kg ($p>0.05$) vs females with 4.47 kg. The experiments with bronze turkeys showed that at 14 and 18 weeks of age, males attained 5.06 and 7.49 kg, whereas females: 3.79 and 4.84 kg respectively **(İsguzar E., 2003)** with slaughter yield between 72.4%-74.0% for males and 73.5%-71.2% for females. In the cited study as well as in our experiments, slaughter yield of male birds from this breed was again higher - 76.48%. The difference vs female birds (74.19%) was not statistically significant. The detailed analysis of the other parameters allowed concluding that these results were valid for all other carcass cuts. The most specific variations were obtained for the liver at $p<0.001$ 128.75 g; proventriculus 17.70 g and legs -211.00 g). The slaughter analysis of BUT-9 broiler turkeys fattened until 16 weeks of age showed that regardless of the fact that dressed weight in males was 7225 g and in females: 5771.66 g ($P\leq0.05$), slaughter yield of female birds was higher – 78.24% vs 74.74% for males (**Oblakova, 2005).**

Male birds were superior to females with respect to several main slaughter traits – preslaughter live weight, grill weight, thigh, wings, proventriculus, liver at a different level of significance.

Table No2 - Slaughter analysis in male and female turkeys at 16 weeks of age

Parameters (g)	female	male
1. Live weight before slaughtering, kg	4.47±0.20	5.23±0.39
2. grill, kg	3.51±0.18	4.07±0.39
3. clean body /after 24 h/,kg	3.32±2.21	4.00±0.38
4. % from live weight	74.27±3.25	76.48±1.34
5. heart, g	20.34±1.44	30.69±2.84*
6. liver, g	65.87±1.21	128.75±11.88***
7. glandular stomach, g	12.14±0.10	17.70±1.69***
8. Muscular stomach (full), g	147.46±7.56	163.17±18.37
9. Muscular stomach (empty),g	105.97±7.12	97.95±5.09
10. intestines, g	231.66±13.33	271.66±28.33
11. Head, g	85.45±4.40	108.94±3.38***
12. thigh, g	122.04±9.03	211.00±3.33***

at $p<0.001$, $p<0.01$, $p< 0.05$

Table No3 - Chemical composition of turkey breast meat

	Water content %	Protein %	Fat %	Ash %	WHC %
NCB ♂	74.42±0.62	22.74±0.82	1.88±0.23	1.25±0.11	23.87±1.46
NCB ♀	74.25±0.61	23.13±0.27	2.87±0.53***	1.39±0.12	22.67±1.31

at $p<0.001$, $p<0.05$

There were no statistically significant differences in the water content of meat between the two genders (Table 3).

The chemical analysis of breast meat of NCB turkeys (Table 3) showed protein content of 22.74% in male birds and 23.13% in female without significant differences. Our data did not differ from those reported by **López P. E.(2011)**, where breast muscles of wild turkeys were outlined with higher values in females – 21.8% vs 18.4% in males ($p<0.05$). Some sources communicated various meat protein levels in domestic turkeys from 21.8% **(Animal Breeders Association in Chile, 2003)**, to 32.4% as per **Mountney et.al (1995)**.

Breast meat was with low fat content, only 2.88% in female turkeys and 1.88% in males. In general, there were differences in the content of fat ($p<0.001$). Female meat fat content was numerically slightly higher although statistically significantly. Comparable results were reported by **Kocak, (1984)**: fat content of bronze turkey breast meat 1.3%; and 4.2% in thigh meat.

Ash content (Table 3) of breast meat in female NCB turkeys was higher ($p>0.05$). These results agree with the report of **Werner et. al. (2008**). It should be noted that the values of this parameter were higher than those obtained by **López P. E.(2011)**: 0.64% in female birds and 0.84% in male birds ($p<0.05$).

Depending on the gender of birds, there were no statistically significant differences in the breast meat water content.

Table 3 presents water holding capacity of meat (WHC%). This trait reflects the essential ability of meat to bind water, which is related to several quality parameters as tenderness, juiciness and colour. The analysis has shown that a greater drip loss occurred in female turkeys compared to that in males 22.67% ($p>0.05$).

Table No4- Chemical composition at turkey thigh meat

	Water content %	Protein %	Fat %	Ash %
NCB ♂	73.45±0.60	21.50±0.52	3.99±0.63	1.42±0.12
NCB ♀	74.66±0.49	20.59±0.27	3.71±0.57	1.21±0.13

Protein content of thigh muscles (Table 4) was higher in male NCB turkeys - 21.50%, whereas in females it was 20.59% ($p>0.05$). The results of López P., (2009) established higher thigh muscle protein content in females (19.6%) than in males (18.4%). There were no difference in ash and fat contents of both studied meats between the genders ($p>0.05$) comparably to what was reported by **Vega Niño, López Pérez**.

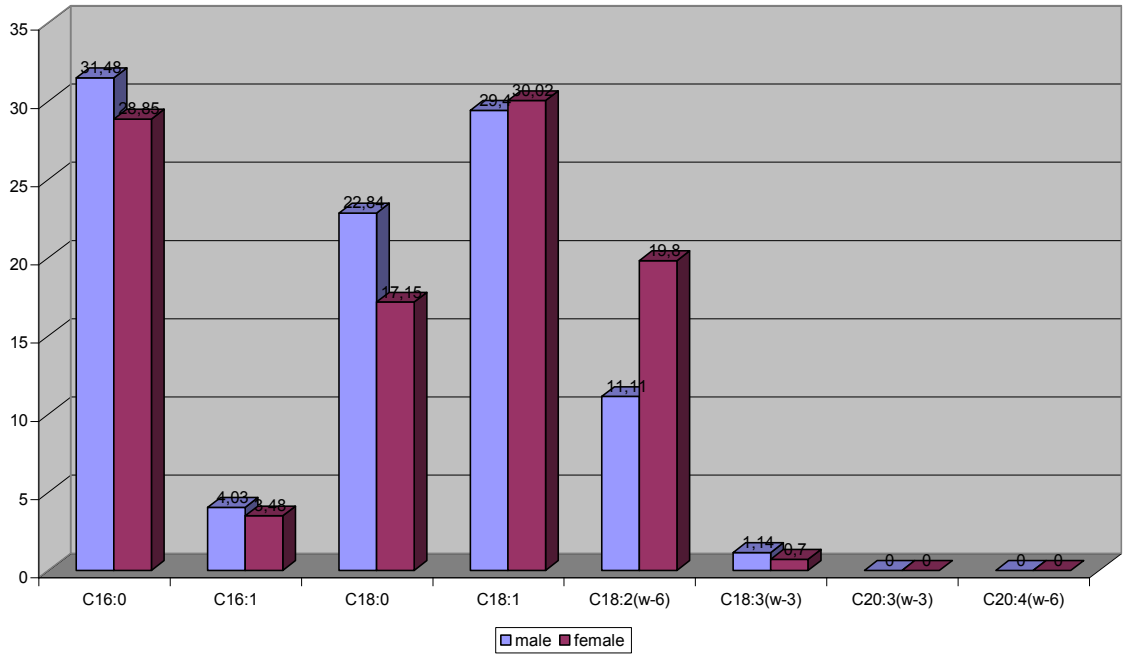
Table 5 presents the total amount of amino acids in breast meat of NCB turkeys from both genders. The content of 17 amino acids was assayed. Glycine and proline are of particular interest for the quality of meat. Glycine content in breast meat of male turkeys was 4.46%, while in females - 4.21%. The differences were insignificant ($p>0.05$) and not gender-related. A similar tendency was observed for breast meat proline content in studied birds. There were small differences with regard to some essential amino acids like methionine and lysine ($p>0.05$). The breast meat methionine content in male NCB turkeys was 1.59 % and higher in females: 1.70 %. Lysine content varied from 10.25% in males to 9.58 % in female turkeys.

Table No5 - Total amino acids in breast muscles of NCB %

Amino acids	male	female
aspartic acid	9.31±0.13	9.45±0.08
threonine	3.27±0.07	3.34±0.07
serine	1.76±0.08	1.80±0.06
glutamic acid	19.08±0.24	18.78±0.06
proline	4.02±0.18	3.82±0.07
cysteine	1.14±0.11	1.11±0.03
glycine	4.46±0.13	4.21±0.08
alanine	5.82±0.07***	5.58±0.01
valine	5.62±0.08	5.67±0.05
methionine	1.59±0.15	1.70±0.04
isoleucine	5.22±0.01	5.19±0.01
leucine	9.21±0.05**	9.07±0.08
tyrosine	2.66±0.07	2.62±0.03
phenylalanine	4.28±0.12	4.50±0.02
histidine	6.01±0.52	6.68±0.18
lysine	10.25±0.18	10.27±0.13
arginine	6.21±0.03	6.14±0.09

At $p<0.01$, $p<0.001$

Figure1- Fatty acide composition in breast muscles-%

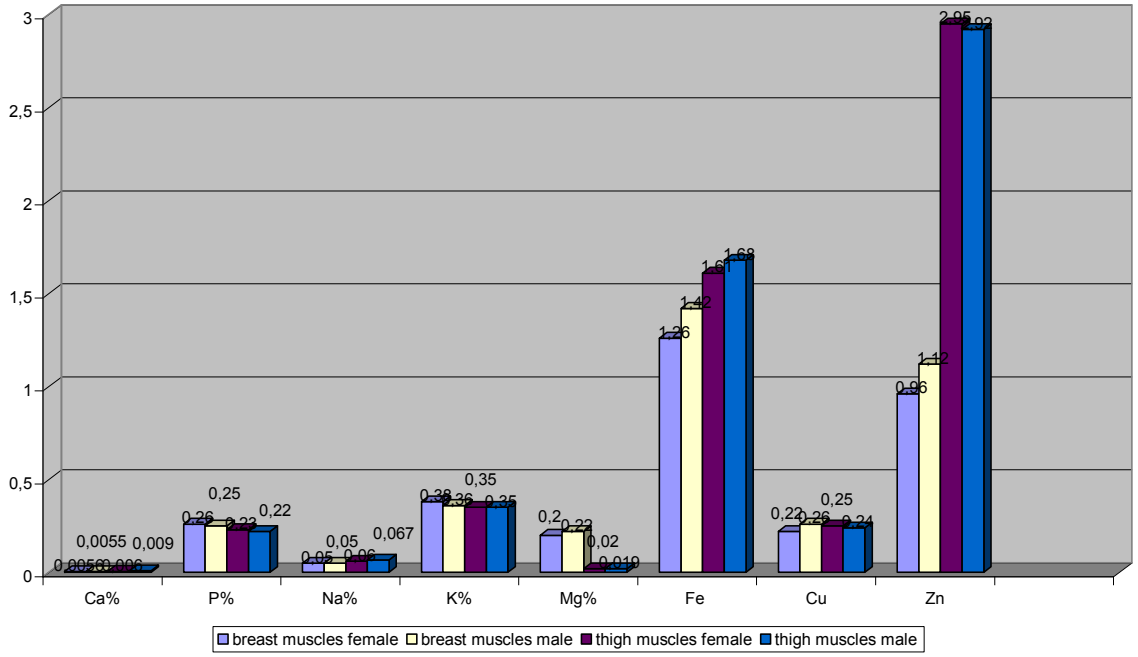


The fatty acid content of triglycerides in NCB turkey breast meat is presented on Figure 1. meat samples from male birds were with higher content of saturated fatty acids –palmitic C16:0 (31.48 % and 28.85% for males and females respectively and stearic C18:0 (22.84 % vs 17.15%). The valuable fatty acids participating in the structure of cell membranes oleic C18:1, linoleic C18:2 (ω-6) were at a greater proportion in the breast meat of female turkeys. eicosatrienoic (C20:3) and arachidonic (C20:4) fatty acids were not found in the breast meat of neither gender.

Feeding broiler chickens various rations supplemented with fish oil resulted in meat palmitic acid contents of 33.82 %, 32.11,% 28.99% **(Lopez-Ferrer S.,2001), for control diet with** 0% (Σ n -3 LC-PUFA 06% of total fatty acids), 2% (Σ n -3 LC-PUFA 4.83% of total fatty acids) and 4% (Σ n -3 LC-PUFA: 9.48% of the total fatty acids) respectively.

The meat mineral substances in NCB turkeys is depicted on Fig. 2. The phosphorus content was higher in the breast and thigh muscles of females (0.26% and 0.23%) than in males (0.25% and 0.22%), but differences were not insignificant. Breast meat phosphorus content was considerably higher than that in red meat in both males and females ($p<0.05$). Potassium concentration was higher in breast meat than in thighs with clear gender-related differences ($p<0.001$). Substantial differences were also established with respect to Mg: 0.20% and 0.21% in breast muscles and 0.02% and 0.019% in thigh muscles in the two genders. Highly significant differences ($p<0.001$) were demonstrated for Fe and Zn content of thighs between the genders.

Figure 2- Mineral contens in NCB turkey meat- %



Conclusion

On the basis of results from the present study on the slaughter analysis and physico-chemical content of neat of North Caucasian bronze turkeys, the following conclusions could be made:

The difference between slaughter yields between males and females: 76.48% and 74.19±3.25% respectively, was insignificant ($p>0.05$). This tendency for superiority of males was preserved for all parts of the body.

The chemical analysis showed higher content of fat and ash in breast muscles of female turkeys. There were no differences in the amount of protein and fat in thighs. Eicosatrienoic and arachidonic fatty acids were not found in the breast meat of male and female NCB turkeys.

Breast meat of both genders had statistically significantly higher content of P, K, Mg. The thigh muscles of males and females had higher Zn ($p<0.01$) and Fe ($p<0.001$) content than white breast meat.

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