

MORPHOMETRIC AND MECHANICAL CHARACTERISTICS OF LEG BONES IN AUTOCHTHONOUS NAKED NECK BREEDS OF CHICKENS IN SERBIA

D. Vitorović¹, Z. Pavlovski², Z. Škrbić², M. Lukić², V. Petričević², I. Adamović¹

¹Faculty of Agriculture, Department of Animal Science, 11080, Belgrade-Zemun, Republic of Serbia

²Institute of Animal Husbandry, 11080, Belgrade-Zemun, Republic of Serbia

Corresponding author: vitdu@agrif.bg.ac.rs

Original scientific paper

Abstract: The purpose of this study was to estimate the morphometric and mechanical parameters of femur and tibiotarsal bone in male and female chickens of three Serbian autochthonous naked neck breeds (white, black and gray) and compared these values with chickens of commercial naked neck hybrid Farm Q. Chickens were reared in extensive system and fattening lasted 98 days (14 weeks). The bone length, weight, cross sectional diaphyseal geometry (total area, medullar area, cortical area) and bone breaking force were determined. Between the varieties of autochthonous naked neck breeds, the presence of significant difference was not established. Average bone mass and length, of femur in male chickens were 13.6 g and 8.2 cm and for tibiotarsal bone, 19.5 g and 11.7 cm. In a female chickens those values were 10.6 g and 7.8 cm for femur and 15.9 g and 11.0 cm for tibiotarsus. In a male chickens average breaking force of femur (36.1 kg) and tibiotarsus (31.6 kg) were higher than those in a female chickens (27.0; 29.6 kg, respectively). In comparison with chickens of commercial naked neck hybrid (Farm Q), chickens of three Serbian autochthonous naked neck breeds have had significantly lower ($P < 0.05$) bone mass, cross sectional diaphyseal area and cross sectional medullar area. Bone length and cross sectional cortical area were not significantly differed. However, tibiotarsal strength, expressed as bone breaking force, were significantly ($P < 0.05$) higher in a chickens of autochthonous naked neck breeds .

Key words: naked neck, chicken, bones, morphometric, strength

Introduction

Bone morphometric and mechanical parameters have been used as indicator of bone status in nutritional and genetic research of poultry (*Patterson et al., 1986; Vitorović et al., 1995; Zhang and Coon, 1997; Cubo and Casinas, 1998;*

Cestin and Sorensen, 1999; Crespo et al., 2000; Yalcin et al., 2001; Škrbić, 2007). There are a little information about bone quality of Naked Neck chickens.

Over the last 3 decades, a considerable portion of avian genetic stocks has disappeared (*Fulton, 2006*). The poultry breeding industry is concerned about the loss of the reservoir of genetic variability. The current status of preservation, which must utilize live animal stocks, has contributed to the loss of genetic resources.

The Naked Neck is the only breed of chicken that is naturally devoid of feathers on its neck and vent. The breeds are fairly common in Europe today. Domestic Naked Neck chickens, reared in Serbia for long time, are considered as domestic hen. They originate from primitive hens crossed with various foreign breeds of which the effect Transylvanian naked neck hen is most obvious. *Pavlovski et al. (2009)* initiated a study which would contribute to better understanding of potential meat production of different varieties of domestic naked neck chickens.

The purpose of this study was to estimate the morphometric and mechanical parameters of femur and tibiotarsal bone in male and female chickens of three Serbian autochthonous naked neck breeds and comparison of these values with tibiotarsus of chickens of commercial naked neck hybrid Farm Q. Fattening lasted 98 days (14 weeks).

Materials and Methods

Investigation was carried out on chickens of domestic breed – naked neck of various plumage colors: white (W – 28 chickens), black (B – 38 chickens) and gray (G – 38 chickens) and commercial naked neck hybrid Farm Q. Chickens were reared in extensive system. Fattening lasted 98 days (14 weeks) and composition of mixture used in the research was the same to the work of *Pavlovski et al. (2009)*. At the end of fattening period (98 days) 6 male and 6 female birds, of each breed, were slaughtered and right femur and tibiotarsal bones were removed and used for morphometric and mechanical investigation

The bone length was measured with a dial caliper and bones mass were weighed on precision balance. Prior to breaking, on each bone, at the midpoint of diaphysis, outside diameters were measured in antero – posterior (AP) and latero – medial (ML) directions. The breaking force was measured by three-point bending test, using IPNIS apparatus, with 4 cm of supports distance (*Mašić and Pavlovski, 1994*). After breaking, diameter measurements were made inside of the midshaft of diaphysis, in antero – posterior (ap) and latero – medial (lm) directions. Because the transverse section through the femoral and tiobiotarsal diaphysis approximates an ellipse, the following parameters were calculated:

TA – Total area (cross sectional diaphyseal area) ; $TA = \pi/4 (AP \times LM)$;

MA – Medullar area (cross sectional medullar area); $MA = \pi/4 (ap \times lm)$;
 CA – Cortical area (cross sectional cortical area); $CA = TA - MA$.

Data was analyzed using the method of variance analysis ad Tukey test (Stat.Soft, Inc. STATISTICA, version 6).

Results and Discussion

In the Table 1 and 2, average values of measuring of morphometric and mechanical parameters of femoral and tibiotarsal bones in male and female naked neck chickens are presented. In regard to all bone parameters it was established that male chickens have higher values in relation to female chickens. However, between the varieties of naked neck breeds, the presence of significant difference was not established.

In a male chickens, average bone mass and length, of femur were 13.6 g and 8.2 cm and for tibiotarsal bone, 19.5 g and 11.7 cm. In female chickens those values were 10.6 g and 7.8 cm for femur and 15.9 g and 11.0 cm for tibiotarsus. Comparing obtained results with results of tibiotarsus in broiler chickens (Farm Q) it can be concluded that tibiotarsal mass of chickens of autochthonous Serbian naked neck breed was significantly ($p < 0.05$) lower (19.5 and 15.9 g versus 26.4 g and 19.3 g). In a case of bone length these differences were not significant.

Table 1. Morphometric and mechanical parameters of femoral bone in male and female naked neck chickens of various feather colours

Breed	Sex	Mass, g	Length, cm	TA, mm ²	MA, mm ²	CA, mm ²	Breaking force, kg
W	M	12.8 ± 0.5	8.3 ± 0.2	49.1 ± 1.5	26.2 ± 2.1	22.6 ± 3.3	38.0 ± 6.5
	F	10.3 ± 0.3	8.1 ± 0.2	41.1 ± 2.2	22.4 ± 3.2	18.7 ± 1.8	26.5 ± 5.3
B	M	14.1 ± 0.6	8.1 ± 0.3	42.6 ± 2.5	28.3 ± 2.4	21.1 ± 3.6	37.1 ± 4.8
	F	11.4 ± 0.3	7.8 ± 0.4	40.2 ± 1.8	23.3 ± 3.5	16.9 ± 2.5	26.9 ± 5.2
G	M	14.0 ± 0.5	8.3 ± 0.2	51.6 ± 2.3	28.5 ± 5.2	23.1 ± 5.4	33.2 ± 5.7
	F	10.0 ± 0.3	7.6 ± 0.1	38.4 ± 2.5	23.6 ± 5.4	18.3 ± 4.5	27.7 ± 7.4
All colours	M	13.6 ± 0.5	8.2 ± 0.2	47.8 ± 2.3	27.7 ± 5.2	22.3 ± 5.4	36.1 ± 5.7
	F	10.6 ± 0.3	7.8 ± 0.1	39.9 ± 2.5	23.1 ± 5.4	18.0 ± 4.5	27.0 ± 7.4

Means ± Standard deviation; M – male, F - Female

Table 2. Morphometric and mechanical parameters of tibiotarsal bone in male and female naked neck chickens of various breeds

Breed	Sex	Mass, g	Length, cm	TA, mm ²	MA, mm ²	CA, mm ²	Breaking force, kg
W	M	19.3 ± 0.7	12.3 ± 0.3	36.9 ± 2.1	20.3 ± 5.7	16.7 ± 4.5	29.4 ± 3.2
	F	17.4 ± 0.6	11.6 ± 0.2	33.5 ± 2.3	18.4 ± 5.6	16.2 ± 4.4	27.2 ± 2.5
B	M	17.8 ± 0.7	11.3 ± 0.4	35.3 ± 3.1	19.1 ± 4.8	16.5 ± 5.3	34.1 ± 3.1
	F	16.0 ± 0.5	10.8 ± 0.3	32.1 ± 2.7	16.0 ± 7.1	16.1 ± 5.4	32.5 ± 4.1
G	M	21.4 ± 0.8	11.6 ± 0.7	39.4 ± 3.6	22.9 ± 5.3	15.0 ± 4.7	31.2 ± 3.3
	F	14.2 ± 0.7	10.6 ± 0.5	30.5 ± 4.7	17.3 ± 3.8	13.2 ± 6.2	29.0 ± 3.1
All breeds	M	19.5 ± 0.6	11.7 ± 0.7	37.2 ± 3.6	20.8 ± 5.1	16.1 ± 4.2	31.6 ± 3.3
	F	15.9 ± 0.7	11.0 ± 0.5	32.0 ± 4.7	17.2 ± 4.8	15.2 ± 5.2	29.6 ± 3.4
Farm Q	M	26.4 ± 0.8*	12.5 ± 0.6	49.3 ± 3.8*	30.6 ± 5.2*	18.7 ± 4.1	25.8 ± 3.1*
	F	19.3 ± 0.6*	11.6 ± 0.4	41.8 ± 4.5*	26.7 ± 5.2*	14.9 ± 5.6	19.8 ± 3.2*

Means ± Standard deviation; M – male, F – female

* Significant differences ($P < 0.05$)

The parameters of diaphyseal cross sectional geometry of autochthonous naked neck chickens were lower than those of broiler chickens. The average values of total cross sectional diaphyseal area and cross sectional medullar area were significantly ($P < 0.05$) lower in autochthonous naked neck breeds of chickens than in commercial Farm Q hybrid chickens. In a cross sectional cortical area there were no significant differences.

In a male chickens average breaking force of femur (36.1 kg) and tibiotarsus (31.6 kg) were higher than those in a female chickens (27.0; 29.6 kg, respectively). Comparing obtained results with results of broiler chickens it can be concluded that tibiotarsal braking force of chickens of autochthonous Serbian naked neck breed was significantly ($P < 0.05$) higher than in the broilers of Farm Q naked neck hybrid.

Conclusion

In a male of autochthonous naked neck chickens, average bone mass and length, of femur were 13.6 g and 8.2 cm and for tibiotarsal bone, 19.5 g and 11.7 cm. In female chickens those values were 10.6 g and 7.8 cm for femur and 15.9 g and 11.0 cm for tibiotarsus.

In a male chickens average breaking force of femur (36.1 kg) and tibiotarsus (31.6 kg) were higher than those in a female chickens (27.0; 29.6 kg, respectively).

Between the varieties of autochthonous naked neck breeds, the presence of significant difference was not established.

Comparing obtained results with results of tibiotarsus in commercial broiler naked neck chickens (Farm Q) it can be concluded that tibiotarsal mass, cross sectional diaphyseal and medullar area of chickens of autochthonous Serbian naked neck breed was significantly ($p < 0.05$) lower but in a cross sectional cortical area there were not significant differences.

Chickens of autochthonous naked neck breeds have stronger tibiotarsus than chickens of commercial Farm Q hybrid.

Acknowledgment

This paper is a part of the Project EVB: TR – 20021 financial supported by Ministry of Science and Technological Development of the Republic of Serbia.

Morfometrijske i mehaničke osobine kostiju nogu kod pilića autohtonih rasa gološijana u Srbiji

D. Vitorović, Z. Pavlovski, Z. Škrbić, M. Lukić, V. Petričević, I. Adamović

Rezime

Cilj ispitivanja je bio da se ustanove morfometrijske i mehaničke osobine kostiju nogu (butna kost i golenjača) pilića tri autohtona varijeteta gološijana koji se gaje u Srbiji (beli, crni i sivi) i poređenje tih rezultata sa parametrima golenjače komercijalnog hibrida gološijana Farm Q. Pilići su gajeni u ekstenzivnim uslovima a period tova je trajao 98 dana (14 nedelja). Na desnoj butnoj kosti i golenjači određivani su masa, dužina, parametri geometrije preseka dijafize (površina preseka dijafize, površina preseka medularne šupljine i površina preseka korteksa) i sila loma. Između varijeteta autohtonih pilića gološijana nije ustanovljeno postojanje značajnih razlika u osobinama kostiju ali su muški pilići ispoljili veće vrednosti u odnosu na ženke. Prosečne vrednosti mase i dužine butne kosti, kod muških pilića su iznosile 13.6 g i 8.2 cm a golenjače 19.5 g i 11.7 cm. Kod ženki ove vrednosti su prosečno iznosile, za butnu kost 10.6 g i 7.8 cm a za golenjaču 15.9 g i 11.0 cm. Vrednosti sile loma ispitivanih kostiju su pokazale da autohtoni gološijani imaju dobru čvrstoću kostiju. Kod mužjaka, prosečna sila loma butne kosti (36.1 kg) i golenjače (31.6 kg) su bile veće nego kod ženki (20.0 kg - butna

kost; 29.6 kg – golenjača). U poređenju sa pilićima komercijalnog hibrida glošijana Farm Q, pilići autohtonih varijeteta su imali značajno ($p < 0.05$) manju masu golenjače, površinu preseka dijafize i medularne šupljine. Dužina kosti i površina preseka korteksa se nisu značajno razlikovale. Međutim, čvrstoća golenjače, izražena kroz silu loma, bila je značajno ($P < 0.05$) veća kod pilića autohtonih varijeteta gološijana.

References

- CESTIN C., SORENSEN P. (1999): Different commercial broiler crosses have different susceptibilities to leg weakness. *Poult. Sci.*, 78, 1085-1900.
- CRESPO R., STOVER M., TALOR K., CHIN R., SHIVAPRASAD H. (2000): Morphometric and mechanical properties of femora in young adult male Turkey with and without femoral fractures. *Poult. Sci.*, 79, 602-608.
- CUBO J., CASINAS A. (1998): Biomechanical significance of cross-sectional geometry of avian long bones. *European Journal of Morphology*, 36, 1, 19-28.
- FULTON J. (2006): Avian genetic stock preservation: An Industry Perspective. *Poult. Sci.*, 85, 227-231
- MAŠIĆ B., PAVLOVSKI Z. (1995): Dostignuća i perspektiva selekcije kokoši brojlerskog tipa. *Biotechnology in Animal Husbandry*, 11, 47-53.
- PATTERSON H., COOK E., CRENSHAW D., SUNDE L. (1986): Mechanical properties of the tibiotarsus of broilers and poults loaded with artificial weight and fed various dietary protein levels. *Poult. Sci.*, 65, 1357-1364.
- PAVLOVSKI Z., ŠKRBIĆ Z., LUKIĆ M., VITOROVIĆ D., PETRIČEVIĆ V. (2009): Naked neck - autochthonous breed of chickens in Serbia: Carcass characteristics. *Biotechnology in Animal Husbandry*, 25, 1-2, 1-10.
- ŠKRBIĆ Z. (2007): Efekti gustine naseljenosti i svetlosnog programa na proizvodne i klanične osobine brojlerskih pilića različitog genotipa. Doktorska disertacija. Poljoprivredni fakultet, Beograd.
- VITOROVIĆ D., POPOV-RALJIĆ J., MITROVIĆ S. (1995): The effect of age and rearing system on bone strength of broiler chicks. *Biotechnology in Animal Husbandry*, 11, 1-2, 21-26.
- ZHANG B., COON C., (1997): The relationship of various tibia bone measurements in hens. *Poult. Sci.*, 76, 1698-1701.
- YALCIN S., OZKAN S., COSKUNER E., BILGEN G., DELEN Y., KURTULUMUS Y., TANYALCIN T. (2001): Effects of strain, maternal age and sex on morphological characteristics and composition of tibial bone in broilers. *Br. Poult. Sci.*, 42, 2, 184-190.