

# MORPHOMETRIC AND BIOMECHANICAL PARAMETERS OF TIBIOTARSUS IN DIFFERENT STRAINS OF BROILERS \*\*

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**Abstract:** One hundred male and one hundred female broiler chicks from different strains : Master Gris, Red Bro, Farm Q and Hubbard Classic, were reared in conventional broiler house system, during first three weeks After the third week, fattening was continued in an extensive free-range rearing system. At the end of experimental period (91 days of age) 10 male and 10 female birds, of each strain, were killed by cervical dislocation and the right tibiotarsal bones were removed and used for morphological and mechanical analysis.

The obtained results showed that there were statistically significant strain differences. Mass, length, breaking force, cross sectional area of diaphysis, medullary cavity area and cortical area, of tibiotarsal bone of Farm Q hybrid chicks were statistically significant lower than that of Hubbard Classic, Master Gris and Red Bro strains in both male and female chicks.

**Key words:** Broilers, strain, tibiotarsus, morphometry, mechanics

## Introduction and literature review

Selection pressure for broilers with larger breast meat resulted in an increase in leg problems (*Nestor and Emmerson, 1990; Lilburn, 1994; Julian, 1998*). Skeletal problems compromise the birds welfare. They also reduce growth, increase mortality and are recognised as one of four major factors affecting the performance of broilers (*Day, 1990*). Market age poultry often suffer from lameness and bone deformities, which can cause bone breakage during catching and transportation and which create problem during processing

(Gregory and Wilkins, 1992; Knowles and Wilkins, 1998). Different methods were used for bone quality assay: bone strength, cross-sectional geometry of long bones and chemical composition of ash (Vitorović, 1992; Vitorović et al., 1995; Cubo and Casinas, 1998; Skrbic, 2007). There are many factors influencing bone quality in broilers. They include a variety of nutritional disorders, infectious diseases, metabolic conditions and toxins (Riddell et al., 1983; Thorp, 1994; Rath et al., 2000). Many of bone disorders have both genetic and nutritional factors controlling their incidence and severity. There are a little reports describing the strain effects on the morphology or mechanical characteristics of broilers bones (Kestin and Sorensen, 1999; Yacin et al., 2001). Over the past decade meat-type chickens have been genetically selected for improving skeletal quality in addition to growth performance (Williams et al., 2000).

The purpose of this study was to estimate the effects of strain on morphological and mechanical properties of tibiotarsal bone in male and female broiler chickens, aged 91 days.

## Material and methods

The experiment was performed on 100 male and 100 female broiler chicks from different strains: Master Gris, Red Bro, Farm Q and Hubbard Classic. The birds were reared in conventional broiler house system, during first three weeks, with controlled standard ambient conditions (feeding, light, temperature). After the third week, fattening was continued in an extensive free-range rearing system. Only, during the night the birds were kept in a house. They were fed grains (corn, wheat and oats) and they also acquire feed by foraging in the backyard. At the end of experimental period (91 days of age) 10 male and 10 female birds, of each strain, were killed by cervical dislocation and the right tibiotarsal bones were removed and used for morphological and mechanical analysis.

The wet bone weight, proximo-distal length and outer diameters (antero-posterior and latero-medial) were measured at the middle of diaphysis. After that, bone breaking force was measured by three-point-bending test, using IPNIS apparatus (Mašić and Pavlovski, 1994). At the middiaphyseal transverse section of each bone, the interior diameters (antero-posterior and latero-medial) were measured. On the basis of the data obtained of outside and interior diameters, the cross sectional diaphyseal area, cross sectional medullary area and cross sectional cortical area of tibiotarsus were calculated, according to Vitorović (1992).

Data for all bone parameters were subjected to Analysis of Variance and differences between the strains were tested by Tukey HSD test, using Stat Soft, Inc (2003), STATISTICA (data analysis software system), version 6.

## Results and discussion

In table 1, results of the measuring of morphometric and mechanical properties of tibiotarsus of male broilers of different strains at the age of 91 days, are presented. In regard to the mass and length of tibiotarsus it was established that Master Gris chickens have statistically considerably ( $p < 0,01$ ;  $p < 0,05$ ) higher values in relation to chickens of Farm Q strain. Between other strains the presence of significant differences wasn't established. Bone breaking force in chickens of Hubbard Classic strain (29,0 kg) was statistically highly significantly ( $p < 0,01$ ) higher, and in chickens of Master Gris strain (27,7) significantly ( $p < 0,05$ ) higher compared to breaking force of tibiotarsus tibiotarsus in chickens of Farm Q strain (25,8 kg). Similar conclusions were made also for geometrical properties of the tibiotarsus diaphysis cross section. The lowest values of the cross sectional diaphyseal area, cross sectional medullary area and cortical area were recorded in chickens of Farm Q strain. They were statistically significantly lower compared to values measured on tibias of other three strains.

**Table 1. Morphometric and biomechanical parameters of tibiotarsus of male broilers, various strains, at 13 weeks of age**

**Tabela 1. Morfometrijske i biomehaničke osobine golenjače muških pilića različitih hibrida, u uzrastu od 13 nedelja**

| Parameter of bone/<br>Osobine kosti  | Strain/Hibrid |                 |              |             |
|--|---------------|-----------------|--------------|-------------|
|  | Farm Q        | Hubbard Classic | Master Gris  | Red Bro     |
| Mass/Masa, g   | 26,4 ± 3,0    | 33,0 ± 4,1      | 38,8 ± 4,1** | 33,0 ± 5,8  |
| Length/Dužina, cm  | 12,5 ± 0,5    | 12,3 ± 0,4      | 3,6 ± 0,4*   | 13,1 ± 0,5  |
| Breaking force/Sila loma, kg   | 25,8 ± 1,4    | 29,0 ± 6,8**    | 27,7 ± 4,5*  | 26,5 ± 5,9  |
| Cross sectional diaphyseal area/<br>Poprečni presek dijafiye, mm <sup>2</sup>          | 49,3 ± 2,2    | 65,4 ± 7,9*     | 73,7 ± 8,1** | 63,4 ± 7,9* |
| Cross sectional medullary area/<br>Poprečni presek medularne šupljine, mm <sup>2</sup> | 30,6 ± 2,3    | 38,3 ± 4,7      | 49,5 ± 6,8*  | 36,2 ± 6,5  |
| Cross sectional cortical area/<br>Površina korteksa, mm <sup>2</sup>                   | 18,7 ± 1,6    | 27,1 ± 3,5*     | 24,2 ± 5,2   | 27,2 ± 5,4* |

Mean  $\pm$  Standard deviation; Singificance of differences : \* -  $p < 0,05$ ; \*\* -  $p < 0,01$   
 Srednja vrednost  $\pm$  Standardno odstupanje; Značajnost razlika : \* -  $p < 0,05$ ; \*\* -  $p < 0,01$

In table 2 results of the measuring of morphometric and mechanical properties of tibia in female chickens of different strains are presented.

Similar conclusions are made like for male chickens. Female chickens of Farm Q strain had tibias with masses, lengths, breaking forces and cross sectional areas which were statistically significantly lower compared to values measured in strains Hubbard Classic, Master Gris and Red Bro. Presence of statistically significant differences in morphometric and mechanical properties of tibia.

**Table 2. Morphometric and biomechanical parameteres of tibiotarsus of female broilers, various strains, at 13 weeks of age**

**Tabela 2. Morfometrijske i biomehaničke osobine golenjače ženskih pilića različitih hibrida, u uzrastu od 13 nedelja**

| Parameter of bone/<br>Osobine kosti  | Strain         |                  |                 |                  |
|--|----------------|------------------|-----------------|------------------|
|  | Farm Q         | Hubbard Classic  | Master Gris     | Red Bro          |
| Mass/Masa, g   | 19,3 $\pm$ 3,1 | 25,9 $\pm$ 2,8*  | 26,5 $\pm$ 5,5* | 26,4 $\pm$ 3,4*  |
| Length/Dužina, cm  | 11,6 $\pm$ 0,4 | 11,8 $\pm$ 0,7   | 12,8 $\pm$ 0,9* | 12,2 $\pm$ 0,3   |
| Breaking force/Sila loma, kg   | 19,8 $\pm$ 3,6 | 26,5 $\pm$ 6,9** | 24,7 $\pm$ 5,7* | 23,6 $\pm$ 7,3   |
| Cross sectional diaphyseal area/Poprečni presek dijafize, mm <sup>2</sup>          | 41,8 $\pm$ 3,2 | 56,0 $\pm$ 5,7*  | 57,9 $\pm$ 7,1* | 49,6 $\pm$ 7,3   |
| Cross sectional medullary area/Poprečni presek medularne šupljine, mm <sup>2</sup> | 26,7 $\pm$ 2,5 | 30,4 $\pm$ 4,2   | 35,7 $\pm$ 4,8  | 27,2 $\pm$ 5,5   |
| Cross sectional cortical area/Površina korteksa, mm <sup>2</sup>                   | 14,9 $\pm$ 1,6 | 27,1 $\pm$ 3,5** | 24,2 $\pm$ 5,2* | 27,2 $\pm$ 5,4** |

Mean  $\pm$  Standard deviation; Singificance of differences : \* -  $p < 0,05$ ; \*\* -  $p < 0,01$   
 Srednja vrednost  $\pm$  Standardno odstupanje; Značajnost razlika : \* -  $p < 0,05$ ; \*\* -  $p < 0,01$

## Conclusion

Based on carried out measurings the following can be concluded:

- The effect of strain on morphometric and biomechanic traits of tibia in broiler chickens is present
- Chickens of Farm Q strain had tibias whose mass, length, breaking force and cross sections of diaphyseal area, medullar area and cortex, were statistically significantly lower compared to chickens of Hubbard Classic, Master Gris and Red Bro strain.
- The stated differences are present in male and female chickens.

## Morfometrijske i biomehaničke osobine golenjače različitih hibrida brojlera

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### Rezime

Po 100 muških i 100 ženskih pilića hibrida Master Gris, Red Bro, Hubbard Classic i Farm Q, je, tokom prve tri nedelje tova, gajeno u zatvorenim objektima sa standardnim uslovima ishrane, napajanja i ambijenta. Posle treće nedelje, pilići su prebačeni u ekstenzivni sistem gajenja sa ispuštima. Tov je trajao 91 dana, kada je izvršeno žrtvovanje životinja. Od po 10 jedinki muškog i ženskog pola, svakog hibrida, uzimana je desna golenjača za morfometrijska i biomehanička ispitivanja.

Dobijeni rezultati su pokazali da između hibrida postoje značajne razlike u osobinama golenjače. Msa, dužina, sila loma i poprečni presci dijafize golenjače, medularne šupljine i površina preseka korteksa, golenjače hibrida Farm Q, bili su statistički značajno manji u odnosu na ostala tri hibrida. Ove razlike su se ispoljile i kod pilića muškog i kod pilića ženskog pola.

**Ključne reči:** brojleri, golenjača, hibrid, morfometrija, čvrstoća

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