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Original scientific paper

CHARACTERISTICS OF MAIN BONE AND CARCASS YIELD IN ZAGORJE TURKEY BREED

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Summary

Zagorje turkey breed is a local Croatian breed with breeding tradition more than five century. Today this breed is in state of renewal and protection. In the year 2009 were 2615 birds and 224 breeders included in herdbook of Zagorje turkey. The aim of this study was to present some morphometric traits of bones *femoris*, *humerus* and *sternum* (weight (W) length (L), circumference (CC) and breadth of corpus (BC) and *epihysis proximalis* (BP) and *epiphisis distalis* (BD), *sternum* breadth). In addition, it was analysed the carcass composition of male and female. The birds (136 birds; 68 ♂ and 68 ♀) were reared in two phases. During the first phase (from 1st day to 8th week of age) the poults were reared indoor under controlled microclimatic conditions and during the second phase (from 8th to 26th week of age) were kept on grassland in outdoor production system. The significant differences ($P \leq 0.05$) were observed in live weight and carcass weight between the male (6.77 kg and 4.59 kg) and female (3.96 kg and 2.68 kg) while the proportion of body parts (breast, thigh, drumstick, thigh loin and abdominal fat) were not different between male and female. As could be expected male turkey showed higher value of all morphometric traits of *femur*, *humerus* and *sternum* than female. These results contribute to knowledge about characteristics of skeleton and carcass composition of Zagorje turkey because there is not data about these traits.

Key words: Zagorje turkey, carcass traits, main bones, morphometric traits.

Introduction

Zagorje turkey breed is a local Croatian breed with breeding tradition of more than 400 years. Traditionally, Zagorje turkey is widespread in northwest part of Croatia in Zagorje region and is kept in outdoor production system. In the recent years, keeping of Zagorje turkey become more popular due to high interest of small family farms to produce turkey meat in outdoor systems respecting high standards of welfare and traditional technology. In comparison to high production hybrids, production results of Zagorje turkey are poorer but beneficial effects are achieved through lower investment in outdoor production and higher market price which can be twice higher than turkey meat from conventional production.

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Typically, rearing takes 6 to 8 mounts to reach the 3.5 to 7 kg of live weight or about 3 to 6.5 kg of carcass weight. At this final weight meat reaches a specific taste which makes it well accepted among consumers in Croatia. In addition to its importance in agricultural, cultural and gastronomy tradition, preservation of Zagorje Turkey breed contributes to higher biodiversity. Therefore, knowledge of phenotypic characteristics contribute to better understanding today's Zagorje turkey what could be used in establishing the standards of some skeletal and carcass traits as a basis for create new trends in breeding and production system which were arise in the past ten years (Mužic et al., 1999; Janječić, 2002). In spite of this, the objective of this study was to examine the morphometric characteristics of main bones (*os humerus*, *os femoris* and *sternum*) and carcass composition in Zagorje turkey.

Material and methods

The experiment was carried out on total 136 birds (68 ♂ and 68 ♀) of Zagorje Turkey breed. The poults include in the study were collected from the private breeders registered in Croatian Agricultural Agency from Zagorje region in Croatia. The rearing process was carried out in two phases; first phase was from 1st to 8th week of age and second phase from 8th to 26th week of age. During the first phase poults were kept under controlled microclimatic conditions as follow: at the beginning (1st day of age) temperature was 35^{o}C and moisture was 70-75% and was decreased to 18-20^{o}C and 65% at the 8th week of age (Mužic and Janječić, 2002). After 8 week of age the poults were replaced outdoor on grassland (0.40 m^2/birds) with small roofed area. Poults were fed with commercial diet as follow: starter from 0 to 4 week of age, grower 4 to 8 week of age and finisher 8 to 26 week of age. The nutritive values of these diets (table 1.) were in accordance with requirements for turkey (Pravilnik, NN/ 26/98, NN112/08).

The live body weight (LW) and carcass weight after slaughter and killing (CW) were recorded individually. By methods of Han and Spindler (1975) the carcass was dissected in parts: breast with bone, breast muscle (fillet) without bone, thigh, drumstick, loin and abdominal fat. The dressing percentage and share (%) of each part in the carcass were calculated. The morphometric characteristics of *os femoris, os humerus* and *sternum* were measured using modified method by Driesch (1976).

Table 1. – DIETS COMPOSITION AND THEIR NUTRITIVE VALUE
Tablica 1. – KEMIJSKI SASTAV I HRANJIVA VRIJEDNOST HRANE ZA PURIĆE

Feed Krmna smjesa	0 – 4 week starter	4 – 8 week grower	8 – 26 week finisher
Maize Kukuruz	40.50	46.00	53.55
Soybean meal (44%) Sojina sačma	36.00	31.00	25.00
Alfaalfa flour Dehidrirana lucerna	-	3.00	5.00
Tosted soybean Tostirano zrno soje	12.00	12.00	10.00
Fish flour Riblje brašno	7.00	3.30	1.00
Ca-carbonate Vapnenac	2.00	2.00	2.00
Mono-CaP	1.40	1.60	2.00
NaCl	0.40	0.40	0.45
Methionine	0.20	0.20	0.25
VAM*	0.50	0.50	0.50
Nutritive value *Hranjiva vrijednost*			
Metabolic energy MJ/kg Metabolička energija	11.23	11.13	11.21
Crude proteine % Sirovi protien	28.0	24.0	20.0
Total Ukupno	100.00	100.00	100.00

*Vitamin-mineral premix;

The bones *femoris, humerus* and *sternum* were removed from the skeleton and trimmed from muscle, tendon and ligaments. The joint cartilages were not removed from the bones. The measures were done by scale, calliper and measuring tape. The following were measured: the greatest length (GL) of *femoris* and *humerus* as a distance from the distal point of the *epiphysis distalis* to the most proximal point of the *trochanter major* on *os femoris* or *tuberculum majus* on *os humerus*; medial length (LM) of *femoris* as a distance from the most distalis point of condylus medialis to the most proximal point of the *caput*

femoris; breadth of proximal end (BP) of *femoris* and *humerus* as a distance between the most lateral point on *caput femoris* and *trocheanter major* and *tuberculum majus* and *tuberculum minus*, respectively; breadth of distal end (BD) of *femoris* and *humerus* as a distance between the most lateral point on *condylus lateralis* and *condylus medialis* and distance between most lateral point on *epicondylus lateralis* and *epicondylus medialis, respectively;* Diameter (SC) and circumference (CC) of *corpus osis femoris* and *humerus* were measured on the most thickness place of the *diaphisis*; deep of distal end (DD) of *os femoris* and *humerus* as distance from the most cranial to the most caudal point on *epiphysis distalis*. On the *sternum* were measured length (LM) as a distance between from the cranial point of the *manubrium sterni* to the caudal border of the *metasternum* in medial plane; Length of the *crista sterni* (LC) as a distance between from the *apex cristae sterni* to the caudal border of the *metasternum*; breadth of *sternal* "wing" (DL) and distance from the "wing" to *cristae sterni*. Descriptive statistics of all measured data are calculated (PROC UNIVARIATE) and differences between genders were tested by t-test (PROC TTEST) using SAS statistical software (SAS, 2004).

Results and discussion

Zagorje turkey became known in Europe in the thirties of the 20th century when it was exported to many European countries. At that time annual exports counted 50000-70000 birds. This activity ceased at the beginning of the World War II, when the Zagorje turkey fell into oblivion, in the economic, rearing and scientific sense. In the past few years, in Croatia exist projects of preserving, recovering and wide spreading the population of Zagorje turkeys. At the same time there is a growing interest on consuming alternative kind of meat as well as turkey meat from local or «homeland» Zagorje turkey reared in outdoor production system according to traditional technology. In order to enlarge the Zagrorje turkey meat production it is necessary to increase the number of breeders and size of their farms as well get the feeding and rearing technology adapted to traditional free range keeping of Zagorje turkey. In addition, Croatian market preferable lighter carcases between 2 and 3.5 kg. So, carcasses from hens are more appreciated than carcasses from toms. The weights and carcass composition of Zagorje turkey are shown in table 2.

As showed in table 2., in Zagorje turkey breed live body weight and carcass weight was about 1.7 time higher in male than in female, while the proportion of each parts in the carcass are the same (table 2.) in both sexes. These results are comparable with previous results on Zagorje turkey

(Kodinetz, 1940; Mužic, 1999; Janječić, 2002) as well in turkeys from Dalmatian hinterland (Ekert Kabalin et al., 2011) and could be explain as a consequence of traditional breeding and rearing management in the past. In Zagorje turkey differences between male and female in live and carcass weight (1.7) were smaller in comparison to other turkey breeds or hybrids (>2) such as BUT Big 6 or Nicholas (Orbanić, 1994; Kid et al., 1997; Andrassy-Baka et al., 2003). In addition, proportion of each part in the carcass in Zagorje turkey is different in comparison to commercial hybrid (smaller share of breast, thigh and drumstick as well lower dressing percentage). Similar result was observed by Herendy et al. (2003) which reported about higher dressing percentage (13-18%, range between 76.1-83.4%) and higher share of breast (10%, range between 62.9-65.3%) in commercial hybrid BUT than in bourbon turkey reared in extensive system. Dressing percentage in our study (67.9% in male and 67.2% in female) was similar as in wild turkey (67.9%) observed by Večerek et al. (2008).

Table 2. – CARCASS COMPOSITIONS OF ZAGORJE TURKEY BREED.
Tablica 2. – SASTAV TRUPA ZAGORSKOG PURANA

		male		female		P-value
		$\overline{X}$ ± SD	Min-Max	$\overline{X}$ ± SD	Min-Max	
Live weight Masa	kg	6.77±0.59	6.00-7.70	3.96±0.63	3.25-4.10	**
Carcass weight Težina trupa	kg	4.59±0.41	4.10-5.10	2.68±0.39	2.16-2.81	**
Dressing Randman	%	67.87±3.52	64.47-70.15	67.24±1.53	64.60-70.25	NS
Breast* Prsa	%	33.26±2.4	27.50-36.47	31.58±1.15	29.63-33.03	NS
Fillet Prsni mišić	%	23.44±1.87	21.63-26.52	23.87±1.16	21.70-25.09	NS
Thigh Zabatak	%	15.88±0.88	13.96-17.60	16.78±0,64	15.52-17.50	NS
Drumstick Batak	%	13.12±0.85	10.42-14.71	13.13±0.42	12.44-13.75	NS
Wing Krila	%	13.36±0.64	11.46-14.48	13.80±0.64	12.86-15.79	NS
Loin Hrbat	%	22.60±1.39	20.29-24.51	22.30±1.02	20.82-23.95	NS
Fat abd. Trbušna mast	%	1.78±0.56	0.77-2.50	2.41±0.93	0.65-3.99	NS

** P<0.05; NS - non significant; *breast with bone and skin

In previous studies on chickens (Leterrier and Nys, 1992) and pigs (Liu et al., 1999) were reported that bone traits such as weight, diameter or bone-bending resistance of long bones (femur, tibia) may be associated with growth rate and body weight. Some morphometric characteristics of main long bones (*femur* and *humerus*) as well *sternum* in Zagorje turkey is shown in Table 3-5.

Table 3. – MORPHOMETRIC CHARACTERISTICS OF *OS FEMORIS* AT ZAGORJE TURKEY
Tablica 3. – MORFOMETRIJSKE OSOBINE *OS FEMORIS* KOD ZAGORSKOG PURANA

			Male Muško		Female Žensko		P value
			$\overline{X}$ ± SD	Min-Max	$\overline{X}$ ± SD	Min-Max	
Weight Masa	(W)	g	27.02±2.70	22.26-31.47	14.27±0.96	11.98-15.67	**
Greatest length Duljina	(GL)	mm	125.04±2.03	121.00-128.40	107.13±4.45	102.5-117.10	**
Medial length Duljina s unutarnje strane	(LM)	mm	113.37±1.84	111.00-117.00	94.44±1.88	91.40-97.70	**
Smallest breadth of corpus Promjer tijela	(SC)	mm	12.30±0.62	11.00-13.20	10.55±0,74	9.40-11.80	**
Circumference of corpus Opseg tijela	(CC)	mm	45.40±2.59	42.00-50.00	38.50±2.29	35.00-43.00	**
Breadth of proximal end Širina gornjeg okrajka	(BP)	mm	32.61±0.98	31.40-34.50	25.54±1.58	21.70-27.20	**
Deep of proximal end Dubina gornjeg okrajka	(DP)	mm	20.23±0.79	19.00-21.70	18.75±0.94	15.40-17.60	**
Breadth of distal end Širina donjeg okrajka	(BD)	mm	29.12±0.76	27.50-30.00	22.97±0.82	22.00-24.70	**
Deep of distal end Dubina donjeg okrajka	(DD)	mm	22.66±1.27	20.40-24.40	18.76±0.70	17.60-19.70	**

** P<0.05; NS - non significant.

Table 4. – MORPHOMETRIC CHARACTERISTICS OF *OS HUMERUS* AT ZAGORJE TURKEY.
Tablica 4. – MORFOMETRIJSKE OSOBINE *OS HUMERUS KOD ZAGORSKOG PURANA*

			Male Muško		Female Žensko		P value
			$\overline{X}$ ± SD	Min-Max	$\overline{X}$ ± SD	Min-Max	
Weight Masa	(W)	g	17.95±1.25	16.40-20.51	10.30±0.76	8.91-11.60	**
Greatest length Duljina	(GL)	mm	140.11±10.33	131.8-168.10	112.52±1.79	108.50-115.20	**
Smallest breadth of corpus Promjer tijela	(SC)	mm	12.24±1.62	10.40-14.90	9.64±0,90	9.00-12.00	**
Circumference of corpus Opseg tijela	(CC)	mm	44.70±2.63	41.00-48.00	38.22±1.93	36.40-41.00	**
Breadth of proximal end Širina proksimalnog okrajka	(BP)	mm	39.94±1.85	37.00-42.20	31.81±1.09	30.50-33.50	**
Deep of proximal end Dubina proksimalnog okrajka	(DP)	mm	22.78±3.24	20.40-31.60	18.27±1.85	14.70-21.00	**
Breadth of distal end Širina distalnog okrajka	(BD)	mm	29.89±1.10	28.00-31.60	24.56±0.98	23.00-25.90	**
Deep of distal end Dubina distalnog okrajka	(DD)	mm	16.39±1.87	15.40-21.60	13.25±0.87	12.00-15.00	**

** P<0.05;

Table 5. – MORPHOMETRIC CHARACTERISTICS OF *OS STERNUM* AT ZAGORJE TURKEY.
Tablica 5. – MORFOMETRIJSKE OSOBINE *OS STERNUM* KOD ZAGORSKOG PURANA

			Male Muško		Female Žensko		P value
			$\overline{X}$ ± SD	Min-Max	$\overline{X}$ ± SD	Min-Max	
Weight Masa	(W)	g	32.71±1.51	29.13-34.68	19.81±2.49	14.97-23.61	**
Length Duljina	(LM)	mm	189.30±6.62	117.0-200.0	161.90±5.75	150.0-170.0	**
Lenght of *crista sterni* Duljina *crista sterni*	(LC)	mm	141.0±8.19	130.0-155.0	122.67±6.11	109.0-134.0	**
Breadth „wing“ of *sternum* Širina “krila” prsne kosti	(DL)	mm	67.49±1.78	65.00-70.10	53.49±2.06	51.0-56.70	**
distance from „wing“ to *crista sterni* Udaljenost od “krila” do *crista sterni*		mm	89.28±10.05	63.50-101.0	74.53±3.57	68.50-81.80	**

** P<0.05;

As could be expected weight and all measured morphometric traits of bones were higher in male than in female. The differences in weight of both femur and humerus primary comes out of higher breadth of their proximal and distal end. The male Zagorje turkey had about 25 to 30% higher breadth of *epiphisis* on femur and humerus than female, while these differences were smaller for other measures (10-20%). Similar trends were observed on sternum. The heavier sternum (65%) and higher breadth of sternum “wing” (25%) were observed in male than in female.

Conclusion

In Zagorje turkey breed, the *femur*, *humerus* and *sternum* bones were characterized by significantly greater values of all morphometric traits except

the deep of *proximal epiphisis* of os *femoris* in male than in female at the same age.

The significantly differences in morphometric characteristics of main bones could the influence on greater live/carcass weights in males than females. The carcass composition did not showed differences between genders.

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KARAKTERISTIKE GLAVNIH KOSTIJU I TRUPA ZAGORSKOG PURANA

Sažetak

Zagorski puran je Hrvatska autohtona pasmina purana s tradicijom uzgoja duljom od pet stoljeća. Danas je ova pasmina je u stanju obnove i zaštite. U 2009 godini bilo je registrirano u uzgojnim knjigama 2615 ptica i 224 uzgajivača. Cilj ovog rada bilo je prikazati neka morfometrijska svojstva glavnih kostiju i to: bedrene (os femoris), nadlaktične (os humerus) i prsne kosti (sternum; težina (W) duljina (L), opseg (CC) i širinu tijela (BC), proksimalnog okrajka (BP) i distalnog okrajka (BD) te širinu prsne kosti). Nadalje, analiziran je sastav trupa u muških i ženskih purana. Istraživanje je provedeno na 136 purana (68 ♂ ♀ i 68). Purani su držani u prvoj fazi (od 1. dana do 8. tjedna starosti) u kontroliranim uvjetima u zatvorenom prostoru dok u drugoj fazi (od 8. do 26. tjedna starosti) su držani na otvorenom. Značajne razlike ($P \leq 0,05$) u živoj masi kao i masi trupa uočene su između muških (6,77 kg i 4,59 kg) i ženski (3,96 kg i 2,68 kg) jedinki, dok su udjeli pojedinih dijelova trupa (prsa, bedra, batak, zabatak i abdominalna mast) bili isti u oba spola. Kao što se moglo očekivati muški purani imali su veću vrijednost svih morfometrijska obilježja *femura*, *humerusa* i *sternuma* od ženskih. Ovi rezultati daju doprinos boljem poznavanju fenotipiskih odlika (osobine kostura) kao i sastava trupa zagorskih purana.

Ključne riječi: Zagorski puran, morfometrijske osobine kostiju, sastav trupa.

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