

# MORPHOMETRIC SIMILARITIES AND DIFFERENCES BETWEEN TREE GENOTYPE OF PRAMENKA SHEEP FROM CENTRAL BOSNIA

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**Abstract.** Morphometric characterization of three strains: Dub, Privor and Kupres was done in order to obtain the genetic characterization of autochthonous sheep strains in Central Bosnia. Total of 205 ewes and rams was measured in order to determine similarities and differences between them. The eight, most important, morphometric trait were determined: wither height, rump height, body length, shoulder width, chest depth, hip width, chest perimeter and shin perimeter. Ewes of Dub Pramenka in relation to Privor and Kupres strains had pronounced morphometric measures, and established differences were statistically significant and highly significant. Statistically significant differences in all measures was observed between rams, expect for hip width. The obtained results show a significant difference in morphometric measures of three autochthonous Pramenka strains from Central Bosnia.

**Key words:** sheep, autochthonous Pramenka strains, Central Bosnia, morphometric characterization, differences

## Introduction

The highest percentage of sheep breeding from Bosnia and Herzegovina is based on autochthonous Pramenka sheep. The most important Pramenka strain is Dub, Kupres and Privor. They inhabit the area of Central Bosnia. The sheep are traditionally bred in extensive husbandry, on large pastures without supplemented feed in highland areas. Pramenka strains are mainly bred for lamb meat and milk, which is processed to traditionally cheese.

The places that are inhabited by Dub Pramenka sheep are municipalities that are linked to Vlašić Mountain, as follows: Teslić, Kotor Varoš, Kneževo, Travnik and Zenica. During the summer Dub Pramenka are on the large pastures of Vlašić Mountain. The largest percentage of sheep bred for fresh milk, which is processed

to famous Vlašić (Travnik) cheese. Type of sheep productions has been nomadic and it remains in the narrow area of Dub Pramenka breeding. In the former Yugoslavia, the sheep were moved from Vlašić Mountain in the lowland areas (Vojvodina, Posavina and Slavonia) at end of autumn. This type of sheep breeding and crossbreeding with Tsigai, the autochthonous sheep from Vojvodina, influenced on the morphometry of Dub Pramenka.

Privor Pramenka inhabits the municipality of Gornji Vakuf and parts of Bugojno and Prozor. The common name of this area is Privor, and because that she named Privor Pramenka. During the summer Privor Pramenka moving to pasture of Vranica Mountain. They graze on large pastures, milked and from milk are made cheese and cream. At the end of autumn sheep were returned to the lowlands in the countryside and kept in barns. Privor Pramenka in contrast to Dub Pramenka, do not been nomadic, but they have barn and facilities for preparing and storing food for the coming winter.

Kupres Pramenka inhabits Kupres plateau, which is a located at an altitude of 1,100 to 1,200 m above sea level. Kupres fields and the surrounding mountains abound with large number of pastures where sheep graze. A small number of farmers from Kupres milked sheep and preparing milk products, they mainly selling lambs which quality of meat is well known, particularly in Western Herzegovina and Dalmatia. The system of sheep production in Kupres is differs from the system in Vlašić and Privor. In the summer sheep are kept outside of the barns, on the pasture near the farm, and farmers preparing food from meadows and fields, that is used for feeding over the winter.

Variability and differentiation of various Pramenka strains from Balkan has been the subject of numerous studies which have used different methods, from morphometry, polymorphism of hemoglobin to methods of molecular genetics. *Vazić et al. (2015)* investigated the polymorphism of hemoglobin in three Pramenka strains (Dub, Kupres, Privor). The results showed that all three stains have similar frequencies of genotypes polymorphism, or there is not statistically significant difference in polymorphism of hemoglobin. In addition, according the research of genetic variability using microsatellites, *Činkulov et al. (2008)* report that Dub Pramenka compared to the other Pramenka strains of Balkan Peninsula such as Svrljig, Bardoka, Piva and Racka showed no significant genetic distance. *Čurković et al. (2016)* was researched genetic diversity and structure of 18 sheep breeds from Balkan Peninsula and Central and North-western Europe, including seven Pramenka strains from Croatia and Bosnia and Herzegovina. The results also showed low genetic differentiation of Pramenka strains. Morphometric characterization of Pramenka also was a subject of many authors. For example, *Antunović et al. (2013)* and *Vazic et al. (2017b)* measured Dub, *Šmalcelj (1937)* and *Vazic et al. (2016)* Privor, *Ivanković et al. (2009)* and *Vazic et al. (2017a)* Kupres Pramenka. However, in the current literature there is not a paper that describes morphometry of all three Pramenka strains from Central Bosnia.

Therefore, the aim of this study was, on the basis of morphometric measures, compare the ewes and rams of all three Pramenka strains and according that to identify the similarities and differences between them.

## **Material and methods**

Total of 205 ewes and rams was measured, of which there were: 80 sheep of Dub (68 ewes and 12 rams), 63 sheep of Privor (53 ewes and 10 rams) and 62 sheep of Kupres Pramenka (56 ewes and 6 rams). All the animals have completed their growth and development (over 4 years old). The eight, most important, morphometric trait were determined: wither height, rump height, body length, shoulder width, chest depth, hip width, chest perimeter and shin perimeter. Measuring of the height, length and width were taken by Ludtin's stick, and the scope was taken by ribbons. All sheep have completed their growth and development. Sheep were taken randomly from the flock. Obtained morphometric measurement between strains was compared using analysis of variance with unequal number of repetitions where is calculated F- test, and differences between measurements were tested with t-test.

## **Results and discussion**

The most common three Pramenka strains from Central Bosnia are grown almost under the same agro-ecological conditions. They are characterized by excellent adaptation to harsh climatic conditions and their resistances to disease. The difference between these strains is in different type of productions. Dub pramenka has been nomadic, but Privor i Kupres Pramenka all year spent on the Privor, respectively Kupres Mountain. Table 1 shows morphometric similarity and differences between ewes of three Pramenka strain of Central Bosnia.

**Table 1. Morphometric similarity and differences between ewes of three Pramenka strains of Central Bosnia**

Measurements	Strain	$\bar{x}$	F <sub>calc.</sub>	X <sub>i</sub> -X	X <sub>i</sub> -X	t <sub>calc.</sub>	
Wither height	Dub	73,37	10,65**	3,66**	3,09**	4,21**	3,55**
	Privor	70,28		0,57		0,61	
	Kupres	69,71					
Rump height	Dub	73,72	6,67**	3,15**	2,38**	3,50**	2,61**
	Privor	71,34		0,77		0,80	
	Kupres	70,57					
Body length	Dub	74,66	4,84**	1,82*	1,62	2,49*	2,16*
	Privor	73,04		0,20		0,26	
	Kupres	72,84					
Shoulder width	Dub	22,72	23,32**	1,60**	1,89**	5,33**	6,30**
	Privor	20,83		-0,29		0,91	
	Kupres	21,12					
Chest depth	Dub	34,50	45,31**	2,52**	2,01**	9,00**	6,67**
	Privor	32,49		0,51		1,70	
	Kupres	31,98					
Hip width	Dub	21,95	41,25**	1,67**	1,29**	8,35**	6,45**
	Privor	20,66		0,38		1,90	
	Kupres	20,28					
Chest perimeter	Dub	98,72	76,66**	7,97**	9,83	9,49**	11,43**
	Privor	88,89		-1,86*		2,07*	
	Kupres	90,75					
Shin perimeter	Dub	9,31	96,72**	1,40**	0,86**	14,00**	8,60**
	Privor	8,45		0,54**		4,91**	
	Kupres	7,91					

\*level of significant 0,05, \*\*level of significant 0,01

The results showed statistically significant difference between ewes of Pramenka strains. Dub Pramenka sheep had larger measurements than the other two strains. T-test showed that the differences between Dub Pramenka ewes on one side and Privor and Kupres on the other hand, statistically significant higher. The values of t-test indicate a certain uniformity of morphometric measurements between Privor and Kupres Pramenka. Statistically highly significant differences was found only for the shin perimeter, and statistically significant differences for the chest perimeter. Dub, Privor and Kupres Pramenka compared to autochthonous sheep from Croatia are much more developed than the following: Lika Pramenka, Dubrovnik Ruda, Krč sheep, Raška sheep, Cres sheep and Dalmatian Pramenka (Mioč et al., 1998; Mioč et al., 2003; Mioč et al., 2004; Pavić et al., 2005; Pavić et al., 2006; Širić et al., 2009). Pramenka strains from Central Bosnia had lower wither height only from Istria sheep (73.51 cm) (Mikulec et al., 2007), which is caused by crossing autochthonous Istria Pramenka with a different imported races, primarily Italian.

The rams of this strain are strong animals with robust skeleton. The carcass of rams characterized with emphasized depths and very modest widths. Table 2 shows morphometric similarity and differences between rams of three Pramenka strain of Central Bosnia.

**Table 2. Morphometric similarity and differences between rams of three Pramenka strain of Central Bosnia**

Measurements	Strain	$\bar{x}$	F <sub>calc.</sub>	X <sub>i</sub> -X	X <sub>i</sub> -X	t <sub>calc.</sub>	
Wither height	Dub	79,92	13,08**	4,59**	6,12**	3,19**	4,94**
	Privor	73,80		-1,53		1,06	
	Kupres	75,33					
Rump height	Dub	80,16	8,86**	3,83**	5,36**	2,51**	4,09**
	Privor	74,80		-1,53		0,96	
	Kupres	76,33					
Body length	Dub	80,42	4,01*	2,59	4,62*	1,21	2,51*
	Privor	75,80		-2,03		0,92	
	Kupres	77,83					
Shoulder width	Dub	23,75	4,47*	-0,58	2,45*	0,51	2,52*
	Privor	21,30		-3,03*		2,58*	
	Kupres	24,33					
Chest depth	Dub	36,17	5,55*	1,67	2,67**	1,77	3,34**
	Privor	33,50		-1,00		1,03	
	Kupres	34,50					
Hip width	Dub	22,91	3,16	0,91	2,11*	0,93	2,51*
	Privor	20,80		-1,20		1,19	
	Kupres	22,00					
Chest perimeter	Dub	103,25	9,74**	4,75	12,15**	1,47	4,40**
	Privor	91,10		-7,40*		2,22*	
	Kupres	98,50					
Shin perimeter	Dub	10,91	16,98**	1,58**	1,81**	4,05**	5,45**
	Privor	9,10		-0,23		0,57	
	Kupres	9,33					

\*level of significant 0,05, \*\*level of significant 0,01

For all measures results of F-test showed that there is statistically significant difference between Pramenka strain rams, except for hip width. Dub Pramenka rams have pronounced almost all measures in relation to the rams of Privor and Kupres Pramenka, except for shoulder width, which was highest in Kupres Pramenka rams. According the morphometric measurements Kupres Pramenka rams are larger than Privor Pramenka rams. Compared with the rams of Croatian autochthonous breeds, especially at wither height, it can be concluded that Dub Pramenka rams, which is not case with Privor and Kupres Pramenka, have height values, even from Istrian Pramenka (*Mikulec et al., 2007*). Privor and Kupres Pramenka rams have greater wither height than the Lika, Rab, Paški and Cres rams (*Mioč et al., 1998; Mioč et al., 2006; Pavić et al., 2005; Pavić et al., 2006*).

The results of morphometric variability indicate significant differentiation between three Pramenka strains from Central Bosnia. Despite the significant differences in phenotype, the results of genetic differentiations using modern methods indicate a low differentiation between the genotypes. *Ćurković et al. (2016)* report that the minimum genetic differentiation was observed between the seven Pramenka strains, which are in conformity with the results of *Činkulova et al. (2008)* and *Važić et al. (2015)*. The explanation in the low genetic differentiation between Pramenka strains can be found in similar agro-ecological conditions in which they are bred, in the geographical nearby as well as the mixing populations through a long history of seasonal migration. On the other hand, *Ćurković et al. (2016)* also reported that seven Pramenka strains from Croatia and Bosnia and Herzegovina, including Dub, Privor and Kupres, displayed the highest allelic and genetic diversity.

Initiated public interest in the early nineties, encouraged the responsible authorities to accede to the inventory of genetic resources and their inclusions in the system of support and sustainability (*Caput et al., 2010*). In this sense Pramenka as autochthonous sheep breed from Bosnia and Herzegovina has a significant place. In support of this is the conclusion of *Ćurković et al. (2016)*, who recommends that preserve of Pramenka strains should be conserved with a high global priority to ensure sustainable sheep breeding in the future. According to numbers in Central Bosnia is the most common Dub Pramenka, which is rapidly expanding in the Kupres and Privor breeding area. Farmers from the Privor and Kupres area go to Vlačić and buying Dub Pramenka rams, and they are used for breeding in their own flock. In addition, a number of farmers from the municipality of Travnik over the summer graze their sheep in the field of breeding Privor and Kupres Pramenka, where there is an exchange between the local sheep flock and flock received from Travnik. Long term, the application of unplanned animal crossing well lead to Privor and Kupres Pramenka strains should be converted to Dub strain. For fear that this way will lead to disappearance of origin genome of Kupres and Privor Pramenka strain it is necessary to take certain conservation measures in order to preserve this population from extinction.

## Conclusion

Based on the results for the eight most important body measurements, it can be concluded statistically significant difference between three Pramenka strains from Central Bosnia, especially for ewes. Also the application of unplanned animal crossing long-term leading to disappearance of origin genome of Kupres and Privor Pramenka strain. According the importance of the total genetic variability of Pramenka sheep it is necessary as soon as possible to take certain conservation measures in order to preserve this population from extinction.

## Sličnost i razlike morfometrije tri genotipa pramenke centralne Bosne

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### Rezime

U cilju genetičke karakterizacije autohtonih sojeva pramenki srednje Bosne urađena je morfometrijska karakterizacija tri soja: dupskog, privorskog i kupreškog. U radu je ukupno izmereno 205 ovaca i ovnova sa ciljem utvrđivanja sličnosti i razlika između istih. Uzimane su osnovne morfometrijske mere koje se najčešće koriste pri naučnim istraživanjima: visina grebena, visina krsta, dužina trupa, širina grudi iza lopatica, dubina grudi, širina kukova, obim grudi i obim cevanice. Analizirane morfometrijske mere naglašenije su kod ovaca dupske pramenke u odnosu na ovce privorske i kupreške pramenke, a utvrđene razlike statistički su značajne i visoko značajne. Između ovnova istraživanih sojeva zabeležena je statistički visoko značajna razlika za sve mere, osim za širinu kukova. Dobijeni rezultati ukazuju na značajnu razliku u morfometriji između tri soja pramenke srednje Bosne.

**Ključne reči:** ovce, autohtoni sojevi pramenke, Centralna bosna, morfometrijska karakterizacija, razlike

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