

## BREEDING GOALS AND SELECTION EFFORT IN THE BREEDING OF LIPIZZAN HORSES IN THE STUD FARM VUČIJAKA FROM 1946 TO 2015

Biljana ROGIĆ\*, Božo VAŽIĆ, Đorđe SARAJLIĆ

<sup>1</sup> University of Banja Luka, Faculty of Agriculture, Banja Luka, Republic of Srpska, BIH

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The Lipizzan horse belongs to the oldest European horse breeds. In the year 1946 the Bosnian Lipizzan state stud farm Vučijak, located next to the town Prnjavor, was founded. The foundation stock originated from the Croatian state stud farms Lipik and Đakovo, and from private owners in Croatia. The breeding goal of Vučijak was to obtain a Lipizzan horse of a smaller body frame suitable for driving and the use as pack horses. The aim of this study was to compare anatomical body measurements of the founder animals with measurements of actual breeding population. From in total 41 horses (10 stallions and 31 mares) following body measurements were taken: height at withers (measured by tape), circumference of chest and circumference of cannon bone forelimb. All horses was 4 years or older at the time of measuring. In order to compare the actual breeding population with the foundation population we extracted comparable data of 17 stallions and 36 mares from the stud book. On the basis of the morphological measures, compactness and bonines index were calculated. The results showed that today's Lipizzan horse of the Vučijak stud are smaller in height at whithers and circumference of chest, while the circumference of cannon bone is larger than documented for founders. The t-test showed a statistically significant difference in the height at whithers and circumference of cannon bone. On the basis of the obtained results, it can be concluded that today's Lipizzan from the Bosnian stud farm Vučijak have a smaller body frame, which confirmed selection success.

*Keywords:* Lipizzan horse, morphological body measurements, stud farm Vučijak

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*Corresponding author:* Biljana Rogić, University of Banja Luka, Faculty of Agriculture, Bulevar vojvode Petra Bojovića 1a, Banja Luka, Republic of Srpska, Bosnia nad Hercegovina  
[biljana.rogic@agro.unibl.org](mailto:biljana.rogic@agro.unibl.org), Phone: 0038765286564

## INTRODUCTION

The Lipizzan horse belongs to the oldest European horse breeds, and it is a result of strict, systematic selection throughout almost 450 years. Currently, Lipizzan horses are bred in state-owned stud farms in Austria (Piber), Hungary (Szilvasvarad), Slovenia (Lipica), Croatia (Lipik, Đakovo), Slovakia (Topolcianky), Italy (Monterotondo), Romania (Fagaras, Beclean), Bosnia and Herzegovina (Vučijak) and Serbia (Karadjordjevo), as well as by private owners all over the world. According to the Lipizzan International Federation (LIF), the roof organization of international Lipizzan breeders, in addition 20 breeding organizations from Europe, America, Australia and Africa are registered. The total estimated number of Lipizzan horses comprises 10766 individuals (LIF, 2012). Considering that all private bred Lipizzan horses are originating from state-owned nucleus herds which are bred in closed herds on a long term, the genetic diversity of this breed can be considered small (ZECHNER *et al.*, 2001).

The morphological differences between the horses from different stud farms, depend on the breeding goals, which differ from one country to another, or from stud farm to stud farm. ZECHNER *et al.* (2002) notes that the breeding goals of the stud farms have been different and are partly changing over time. The primary goal of the Austrian stud farm of Piber is to provide horses for classical dressage for the Spanish Riding School in Vienna, the Hungarian stud farm in Szilvasvarad has specialized in breeding of top horses for carriage driving. The Slovenian, Slovakian and Croatian stud farms are breeding riding horses while the Romanian studs providing stallions for improvement of the local farm horse population. The Italian population at Monterotondo is kept as a genetic reserve. In the Croatian breeding of Lipizzan horses two breeding goals are existing: in Đakovo and in private breeding the so-called driving type is favoured, in Lipik the so-called classical type is emphasised (ČAČIĆ and ČURIK, 2014).

According to PRAČEK (1999) breeding of the Lipizzan horses in the Former Republic of Yugoslavia in the 1970s was planned and arranged in three directions: for dressage riding (Lipica), driving and carrying (Bosnia and Herzegovina) as well as instead and field works (Slavonia, Posavina, Vojvodina and parts of Serbia). The state-owned stud farm Vučijak was founded in 1946s in Prnjavor municipality. The primary goal of establishing the stud was to improve the existing horse population in North Bosnia. According to PRAČEK (1999) breeding goal of foundig stud farm Vučijak was to create a horse for driving and carrying, respectively to produce a horse with smaller body frame suitable for driving and carrying. Soon the breeding of Lipizzans spread to other parts of Bosnia and Herzegovina, thanks to the stud farm Vučijak and its continuous work directly influenced the breeding quality of private breeders (STOJANOVIĆ, 2006). The process of the formation of the nucleus herd of the stud farm Vučijak lasted from 1946 to 1952. The foundation stock originated from the Croatian state stud farms Lipik and Đakovo, and from private owners in Croatia. Subsequently, stallions and mares from Slovenia and Serbia were integrated in the stud population.

ZECHNER *et al.* (2001) notes that one part of characterization of a breed involves the morphological study of horses. The analysis of morphological measurements of European Lipizzan horse populations have been the subject of multiple scientific studies (ZECHNER *et al.*, 2001; RASTIJA *et al.*, 2004; BABAN *et al.*, 2006; PALLOTINO *et al.*, 2015; DRUML *et al.*, 2016), as well as in many other horse breeds (SEDEK, 2006; BENE *et al.*, 2013, 2014; PADILHA *et al.*, 2017; GOMEZ *et al.*, 2009; MARTINSON *et al.*, 2014; JENSEN *et al.*, 2016). However, only few studies about conformation traits and body measurements of Lipizzan horses from stud farm Vučijak have been published recently (RASTIJA *et al.*, 1991; VAŽIĆ *et al.*, 2016).

The aim of our study was to collect and compare the data of body measurements from Founder animals from 1946 with horses from the actual breeding population of Vučijak. Furthermore we aimed to evaluate the selection effort, which was made throughout the last 70 years of breeding.

#### MATERIALS AND METHODS

Morphological measurement of in total 41 horses (10 stallions and 31 mares) were taken at the stud farm Vučijak. The horses were measured by the measuring tape, and following traits were recorded: height at withers (distance from the highest point of the withers to the ground), circumference of chest (circumference around the chest behind the front legs) and circumference of cannon bone forelimb (smallest circumference of cannon bone of the forelimb). All horses was 4 years or older at the time of measuring. From the stud book of the same three morphological measures from 17 founder (stallions and 36 mares were included. On the basis of the measurements following indices were calculated by NIKOLIC and SIMOVIC (1985):

1. Index of compactness = (circumference of cannon bone/height of withers) x 100, and
2. Index of bonines = (circumference of chest/height of withers) x 100.

In order to test the differences of five morphological traits between both samples we performed a ANOVA and a t-test using statistical package STATISTICA 8.0

#### RESULTS AND DISCUSSION

Table 1 shows the mean values of the body measurements (height at withers, circumference of chest and circumference of cannon bone) of the founder population and the actual population.

*Table 1. The difference in the body measures between founders and today's horses in the stud farm Vučijak, cm*

	height at withers		circumference of chest		circumference of cannon bone	
	t Value		t value		t value	
	mean	t-test	mean	t-test	mean	t-test
founder stallions	160.41		178.24		19.79	
actual stallions	159.20	0.50	176.90	0.57	20.30	0.98
founder mares	157.50		175.00		19.01	
actual mares	154.60	2.47*	175.32	0.18	19.52	2.68**
founder horses total	158.43		176.04		19.26	
actual horses total	155.78	2.40*	175.71	0.23	19.71	2.14*

\* Level of significance 0.05; \*\* level of significance 0.01

Based on the body measurements, it can be concluded that for a period of 70 years, the height at withers for stallions has been reduced by 1.21 cm. According to the T-test this difference was not significant. The actual breeding mares have a lower height at withers by 2.90 cm, and this difference was statistically significant. The average height at withers of all horses from the actual population of Vučijak was significantly lower by 2.65 compared to the founder

sample. Considering the circumference of chest, the actual breeding population sample was characterized by smaller values compared to the founder population sample, whereas this difference was not significant. The cannon bone circumference of the actual breeding horse sample of Vučijak was significantly higher than in the founder population sample. This difference was highly significant for mares, whereas in stallions no significant difference could be found.

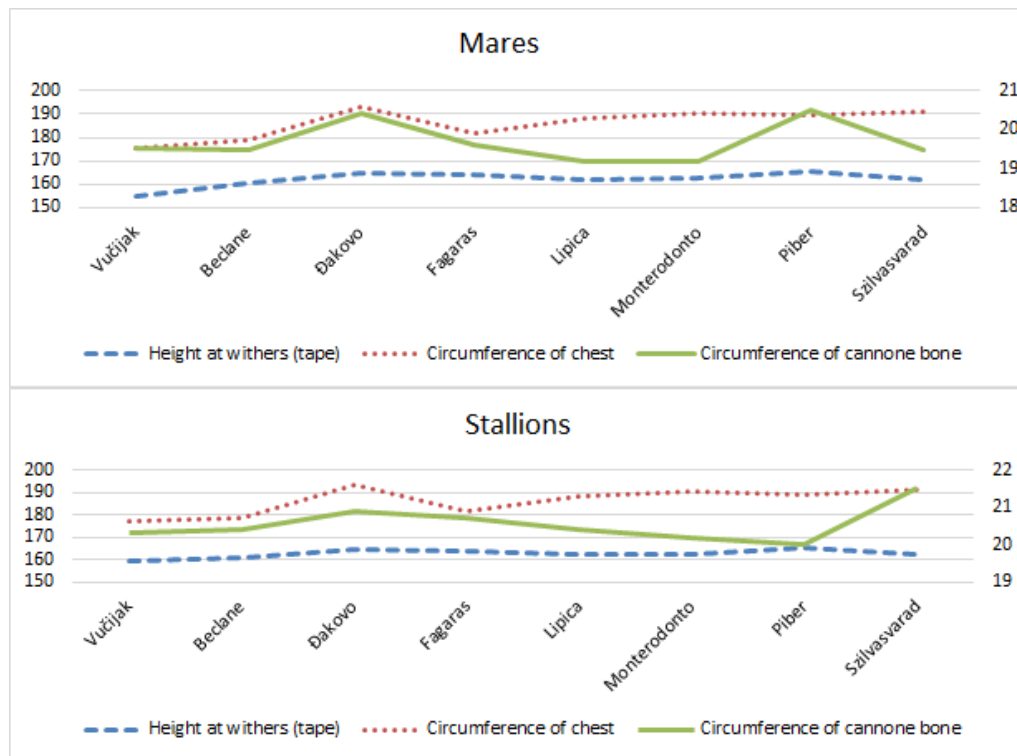


Figure 1. Differences in the body measures between studs: mares and stallions

ZECHNER *et al.* (2001) performed a morphological characterization of Lipizzan horses from eight state-owned stud: Beclane, Fagaras, Đakovo, Monterodonto, Lipica, Piber, Szilvasvarad and Topolcianky. This research included all state-owned stud farms except those from Serbia and Bosnia and Herzegovina. Comparing our measure with results ZECHNER *et al.* (2001) we can conclude that mares and stallions from Vučijak, both founder and actual, have a smaller height at withers and chest circumference, while the circumference of cannon bone fits within the range of values reported (Fig. 1). It indicates that Lipizzan horses of Vučijak are smaller than other Lipizzan horses in European stud farms, which is in accordance with the findings of VAŽIĆ *et al.* (2016). Our measures of height of withers and circumference of chest

were comparable with the results of RASTIJA *et al.* (1991), only circumference of cannon bone was slightly higher in our study.

According to SADEK *et al.* (2006) the boniness index is related to the thickness of the horses bones in comparison with its height and this index can reflect the capacity of the horse in all gaits, jumping and in carrying a rider while remaining well balanced. The compactness index gives information on the degree of compactness of the trunk and the relation between body girth and length.

Table 2. The difference in the compactness and boniness index between founder population sample and to actual breeding population sample in the stud farm Vučijak

	Boniness index		Compactness index	
	Mean	T value t-test	mean	T value t-test
founder stallions	12.34		111.18	
actual stallions	13.05	1.67	111.18	0.00
founder mares	12.08		111.19	
actual mares	12.62	4.98**	111.39	1.81
founder horses total	12.16		111.18	
actual horses total	12.72	3.95**	112.85	1.77

\* Level of significance 0.05; \*\* level of significance 0.01

The results in table 2 show that the boniness index was higher in the actual population sample. The differences were statistically highly significant for mares and the total samples. Differences in index of compactness was not found, and the horses were quite uniform regarding this trait. SADEK (2006) reported that compactness in Arabian horses comprised 119, which is higher than Lipizzan horses (111). Also he reported that boniness index was 12.4, which indicates that actual breeding population of Bosnian Lipizzans have a higher index (12.7) than Arabian horses.

#### CONCLUSION

From our results we can conclude, that Lipizzan horses of the stud farm Vučijak are smaller than Lipizzans from other European stud farms. Based on the body measurements, the height at withers has been reduced within the period of last 70 years. Today's horses have a higher circumference of cannon bone than founder animals. Our results show that the body frame of the Lipizzan horses was reduced in the period from 1946 to 2015, which was in accordance with the selection goal of Lipizzan breeding of the stud farm Vučijak.

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## UZGOJNI CILJEVI I SELEKCIJSKI USPEH U GAJENJU LIPICANCA NA ERGELI VUČIJAK OD 1946. DO 2015. GODINE

Biljana ROGIĆ, Božo VAŽIĆ, Đorđe SARAJLIĆ

<sup>1</sup> Univrzitet u Banjoj Luci, Poljoprivredni fakultet, Republika Srpska, BIH

### Izvod

Lipicanac je jedna od najstarijih evropskih rasa konja, a na ergeli Vučijak datira od 1946. godine. Kao osnivači nukleusa ergele Vučijak u to doba su dovezeni pastuvi i kobile iz državnih ergela Lipik i Đakovo, kao i privatnih poseda sa područja Hrvatske. Selekcijski cilj osnivanja ergele je bio da se dobije lipicanski konj manjeg okvira podesan za vuču i nošenje tereta. Cilj ovoga rada bio je poređenje pastuva i kobila koji su dovedeni na ergelu Vučijak prilikom njenog osnivanja i pastuva i kobila koji se danas nalaze na ergeli. Merenje pastuva i kobila je urađeno na ergeli Vučijak. Ukupno je izmereno 41 grlo i to 10 pastuva i 31 kobila i za svaku životinju izmjerena je visina do grebena, obim grudi i obim cjevanice. Sve izmerene zivotinje su završile svoj rast i razvoj. Takođe, iz matičnih listova 17 pastuva i 36 kobila koji su dovedeni na ergelu su uzete mere: visina grebena, obim grudi i obim cjevanice. Na osnovu temeljnih mjera izračunati su: indeks koščatosti i indeks masivnosti. Rezultati su pokazali da današnji konji ergele Vučijak imaju manju visinu grebena i obim grudi, dok je obim cjevanice nešto veći u odnosu na dovedene konje. Utvrđena je statistički značajna razlika u visini grebena i obimu cjevanice kod današnjih konja u odnosu na konje osnivače ergele. Na osnovu dobijenih rezultata može se zaključiti da je današnji lipicanac ergele Vučijak manjeg okvira, čime je ostvaren selekcijski uspjeh.

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