

MORPHOMETRIC CHARACTERIZATION OF THE LIPIZZANER HORSE BREED IN THE STUD „VUČIJAK“

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Abstract: The research was conducted on 10 stallions and 31 mares of the Lipizzaner breed in the stud “Vučijak” Prnjavor. In general, 28 morphometric measures of stallions and mares were taken. Morphometric characterization shows that the “Vučijak” stud farm owns Lipizzaner with smaller body form comparing to other Lipizzaner around Europe. The body of the Lipizzaner from “Vučijak” has a rectangle shape which is in accordance with the appearance of the majority of Lipizzaner in Europe. Based on these measures, it is confirmed that there is a statistically significant difference between stallions and mares in: withers height, width of lower jaw, length of neck and shoulders, length of radius, width of chest, length and width of pelvis, volume of front leg tibia, and length of hind leg long pastern (proximal phalanx). Out of all named, in comparison to stallions, mares have bigger morphometric measures of length of shoulders, width of pelvis and length of hind leg long pastern (proximal phalanx). In the remaining 18 measures stallions and mares of the “Vučijak” stud show certain homogeneity.

Keywords: stud Vučijak, Lipizzaner breed, morphometric characterization, stallion, mare

Introduction

The Lipizzaner is one of the oldest European horse breeds. The Lipizzan breed dates back to 1580, when it has been established at Lipizza (now Lipica). They are trained for riding schools, classical dressage and other equestrian sports as well as recreation (*Pallottino et al., 2015*). Lipizzaner has had a specific development: due to desires of the Habsburgs, high number of different breeds participates in its perfectly composed creation. From Andalusian Baroque stallions it gets tranquility and obedience, from Arabian stallions it gets loyalty, from Italian stallions it gets graciousness and from Karst stallions it gets stamina and firmness. The strict systematic selection during 450 years of its existence, as well as breeding the same breed on a higher number of stud farms with different purpose, results in higher number of lines and genera and higher phenotype diversity.

Lipizzaner horse have been previously studied with respect to morphometric variability (Zehner et al., 2001a, 2001b; Zehner 2001c; Rastija et al., 1991, 2004; Zohmann et al., 2001). The most famous Lipizzaner stud are: Baclean, Đakovo, Fagaras, Monterotondo, Piber, Szilvasvarad and Topol'cianky. Zehner et al. (2001b) have done a morphometric characterization of Lipizzaner breeds from all seven stud. Characterization and comparison of horses from different stud farms is done on the basis of 37 morphometric measures and formed angles. Its conclusion is that there are 34 differences out of 37 measures for mares and 29 differences out of 37 measures for stallions. The extremes of morphometric results are horses from Piber and Szilvasvarad; their breeding is different which brings to morphometric differences between them.

The stud "Vučijak" is the only Lipizzan stud in Bosnia and Herzegovina, founded in 1946. Reproductive material has been taken from breeding stables in Croatia. The purpose of founding stud has been to enrich the existent horse population of horses in northern parts of Bosnia and Herzegovina. Soon enough, breeding of Lipizzaners spread to almost entire Bosnia thanks to selective work at the "Vučijak" stud. Praček (1999) notes that the breeding of Lipizzaners in Yugoslavia in 1970s has been planned in three directions: classical dressage (Lipica), driving and weight carrying (Bosnia) and field works (Slavonia, Posavina, Vojvodina and other parts of Serbia).

The aim of this work is a morphometric characterization of Lipizzan horses from the stud "Vučijak" and finding differences in morphometric measures between stallions and mares.

Material and methods

Morphometric measures are taken at the stud "Vučijak". Ribbon and height measuring stick have been used for measuring. On each individual animals 28 physical measures has been found, following the standard procedure which was developed by Oulehla (1996). Every measured animal has finished its development. Horses have been brought on flat and sturdy base and held by the workers of the haras. They have all been measured by one person. In general, 41 animals (10 stallions and 31 mares) have been measured, i.e. around 54% of all horses predicted for further reproduction by the Commission for the annual overview of the haras. Statistical data is done in ANOVA program, and the difference in morphometric measures between stallions and mares is tested by t-test. The difference between environments is tested for probability of 0.05 and 0.01.

Results and discussion

Results of morphometric characterization of stallions and mares in the stud "Vučijak" can be seen in tables 1 and 2. In comparison to mares, stallions have bigger measures for: height at withers (tape), width of head (lower jaw), length of

neck and length of upper arm 2. Beside these, stallions have bigger measures for: length of rearquarters, circumference of cannon bone (metacarpal), width of chest, and the found difference is statistically relevant. In comparison to stallions, mares have more emphasized length of shoulders, length of pastern (hind leg) and width of hips. The difference between the first two measures is statistically of high importance, while for the third it is statistically relevant. The differences for other found measures between stallions and mares are not statistically relevant. *Rastija et al. (1991)* claim that the height at withers (tape) for stallions at the stud Vučijak has been between 148.00 and 161.67 cm, unevenly and significantly lower than for stallions at the Đakovo in Croatia. The same author claims that the circumference of chest for stallions at the stud Vučijak has been between 158.00 and 188.33 cm, while the volume of tibia has been between 19.69 and 20.00 cm. The average value for the first two morphometric measures in this research is in the range of these values. The only difference is the circumference of cannon bone (20.03 cm) which is above the range given by the same author.

Table 1. Morphometric characteristics of stallions on the stud "Vučijak", cm (n=10)

Morphometric measurements	X	S	V	Relative measurement, %
Height at withers (measuring stick)	148.80±1.02	2.23	1.58	100
Height of back	140.40±1.32	4.19	2.98	94.35
Height of rump	148.20±0.95	3.10	2.03	99.60
Body length	153.50±1.85	5.85	3.18	103.16
Length of forequarters	36.40±0.81	2.59	7.11	24.46
Length of barrel	69.70±1.01	3.19	4.57	46.84
Length of rear quarters	51.50*±0.74	2.36	4.64	34.61
Depth of chest	66.70±0.84	2.66	3.98	44.82
Width of chest	39.30* ±0.57	1.82	4.63	26.41
Width of hips	48.20*±0.95	3.01	6.24	32.39
Width of thurls	50.00±0.47	1.49	2.92	33.60
Length of neck	76.50**±1.05	3.34	4.63	51.41
Length of shoulder	56.90**±1.01	3.21	5.64	38.24
Height at withers (tape)	159.80**±1.39	4.41	2.75	107.39
Circumference of chest	176.90±1.57	4.97	2.80	118.89
Circumference of cannon bone (metacarpal)	20.03*±0.52	1.65	8.12	13.46
Circumference of cannon bone (metatarsal)	21.60±0.33	1.07	4.95	14.52
Length of head	52.89±0.57	3.28	6.21	35.54
Width of head (lower jaw)	17.30**±0.51	1.63	9.42	11.63
Length of upper arm 1	34.00±0.64	2.05	6.02	22.85
Length of upper arm 2	40.00**±0.64	2.05	5.20	26.88
Length of forearm	38.40±0.76	2.41	6.27	25.81
Length of cannons (front leg)	21.10±0.67	2.13	10.09	14.18
Length of pastern (front leg)	15.40±0.40	1.26	8.18	10.35
Length of thigh	40.80±0.55	1.75	4.28	27.42
Length of second thigh	42.80±0.80	2.52	5.88	28.76
Length of cannons (hind leg)	26.40±0.54	1.71	6.47	17.74
Length of pastern (hind leg)	15.01**±0.17	0.56	3.70	10.15

If we compare morphometric measurements of stallions in the Vučijak with the stallions of other Lipizzan stud by various authors it can be found that the stallions of the Vučijak have smaller shape. *Rastija et al. (2004)* claim that the height at withers for the stallions from Đakovo, measured with stick, has been 159.20 cm, and with ribbon, 168.10 cm. The body length has been 155.45 cm, depth chest 72.30 cm, circumference of chest 184.25 cm and circumference of cannon bone 21.22 cm. According to *Zechner (2001c)* research, the greatest height at withers is noted for the stallions of the Szilvasvarad haras (158.20 cm), followed by the stallions from Topol'cianky (156.80) and Fagaras (156.80), while the smallest measure is in the Piber (153.60). The same author finds that the stallions from Topol'cianky have the longest body (165.20 cm), followed by those from Szilvasvarad (163.10), Đakovo (161.10), while those from Monterotondo have the shortest body (155.20). Found differences between the horses from Vučijak and other Lipizzan stud farms is in accordance with *Zehner et al. (2001a, 2001b) and Zehner (2001c)* where the differences in morphometric measurements between horses of different stud farms are credited to different goals of breeding. Horses from the Vučijak have rectangle shape of the body, which is in accordance with the mentioned research where authors have found that horses from different Lipizzan stud have rectangle body shape and that the difference in the body length and height at withers is between 3 cm and 8 cm. Only the horses from the Monterotondo haras are not in that frame. *Sölkner et al. (2001a)* claim that Lipizzan stables in Slovenia, Croatia and Slovakia breed modern horses for riding while those in Romania breed studs for improvements in field works.

Table 2. Morphometric characteristics of mares on the stud "Vučijak", cm (n=31)

Morphometric measurements	X	S	V	Relative measurement %	Ratio studs-mares
Height at withers (measuring stick)	147.12±0.61	3.44	2.32	100	98.87
Height of back	142.14±0.57	3.20	2.24	96.61	101.24
Height of rump	149.41±0.56	3.14	2.10	101.56	100.82
Body length	154.61±0.85	4.73	3.05	105.09	100.72
Length of forequarters	36.58±0.47	2.66	7.28	24.86	100.49
Length of barrel	72.74±0.91	5.09	6.99	49.44	104.36
Length of rear quarters	49.19±0.74	2.36	4.64	33.43	95.51
Depth of chest	67.03±0.52	2.92	4.35	51.68	100.49
Width of chest	36.90±0.60	3.37	9.13	25.08	93.89
Width of hips	50.83±0.49	2.78	5.46	34.55	105.46
Width of thurls	48.48±0.42	2.36	4.86	32.95	96.96
Length of neck	66.45±0.77	4.32	4.96	45.17	86.86
Length of shoulder	61.63±0.83	4.63	7.58	41.89	108.31
Height at withers (tape)	154.67±0.78	4.34	2.80	105.13	96.79
Circumference of chest	175.32±1.37	7.63	5.25	119.17	99.11
Circumference of cannon bone (metacarpal)	19.51±0.14	0.82	4.20	13.26	97.40
Circumference of cannon bone (metatarsal)	21.80±0.16	0.94	4.31	14.82	35.39
Length of head	50.12±0.59	3.30	6.58	34.07	94.76
Width of the head (lower jaw)	15.45±0.24	1.33	8.60	10.50	89.31
Length of upper arm 1	32.64±0.24	1.37	4.19	22.18	96.00
Length of upper arm 2	37.06±0.28	1.61	3.44	25.19	92.65
Length of forearm	37.80±0.42	2.35	6.21	25.69	98.44
Length of cannons (front leg)	21.87±0.39	2.18	9.96	14.86	103.64
Length of pastern (front leg)	15.25±0.25	1.41	9.24	10.37	99.02
Length of thigh	39.45±0.52	2.94	7.45	26.81	96.69
Length of second thigh	44.41±0.51	2.86	6.43	30.18	103.76
Length of cannons (hind leg)	24.96±0.49	2.76	11.05	16.96	94.54
Length of pastern (hind leg)	17.00±0.29	1.64	9.28	11.55	113.26

Mares, just like stallions, in comparison to other Lipizzan mares, have smaller body frame. The average height at withers measured with stick is 147.12 cm, while the average height at withers measured with ribbon is 154.67 cm. Mares from the Vučijak have rectangle body shape which proves that the body length is 154.61 cm, which is more than height at withers by 7.49 cm, and that is in accordance with *Zehner et al. (2001a, 2001b); Zehner (2001c) and Zohmann et al. (2001)*. Depth of chest for mares from Vučijak is 67.03 cm in average, while the circumference is 175.32 cm. According to *Zehner et al. (2001a)* the greatest height at withers is noted for mares from the Piber (156.80 cm), followed by those from Đakovo (155.40) and Fagaras (154.70), while the smallest is noted for mares from Szilvasvarad (153.20) and Lipica (153.20). The same author concludes that

the longest body is found for mare from Piber (164.80 cm), and the shortest for mares from Lipica (158.50 cm). The results of the measurements of mares at the Đakovo, according to *Rastija et al. (2004)*, exceed the morphometric measures of mares at the Vučijak found in this research, which is also confirmed by the research from *Baban et al. (2006)*. According to these authors, the values measured with ribbon: height at withers, circumference of chest and circumference of cannon bone are: 164.73 cm, 185.68 cm and 20.83 cm – significantly higher than the results in this work.

Sölkner et al. (2001a) give three basic measures (height at withers, circumference of chest and circumference of cannon bone) of mares from seven Lipizzan horse stables: Beclean (153.70 - 178.90 -19.50), Fagaras (154.70 - 181.60 - 19.60), Đakovo (155.40 - 193.30 - 20.40), Lipica (153.20 - 188.00 -19.20), Piber (153.30 - 190.10), Szilvasvarad (156.80 - 189.30 - 20.50), Topol'canky (153.20 - 191.40 - 19.50). Mares from these Lipizzan horse stables are higher at withers and have bigger circumference of chest than mares from Vučijak. On the other hand, mares from Vučijak have bigger circumference of cannon bone (front leg) than mares from Beclean, Lipica and Topol'canky. According to *Čačić (2003)*, the fundamental morphometric measures of Lipizzan horses from Croatia are: height at withers (with measurement stick) – 150.38 cm, height at withers (tape) – 160.59 cm, circumference of chest – 184.50 cm and circumference of cannon bone – 19.39 cm. Following the morphometric measurements of the horses from the Vučijak in this work, it can be claimed that the Lipizzaner from Prnjavor is the most similar to Lipizzaners from Croatia.

Sölkner et al. (2001a) and *Sölkner (2001b)* find that the basic population of Lipizzaners is in numerous, mostly big and state-owned, stud farms (Lipica in Slovenia, Đakovo in Croatia, Piber in Austria, Beclean, Fagaras and Simbata de Jos in Romania, Monterotondo in Italy, Szilvasvarad in Hungary and Topol'canky in Slovakia) and private breeding farms around the world. Besides the mentioned Lipizzan studs, we can add Karađorđevo (Serbia), Lipik (Croatia) and Vučijak (Republic of Srpska, Bosnia and Herzegovina) as significant horse farms for the breeding of this breed. Lipizzan horses from Lipik have been saved at Karađorđevo during the tragic wars in former Yugoslavia, which is commendable, knowing how small population of Lipizzaners is. This is confirmed by *Habe et al. (2002)*, emphasizing the history of breeding of Lipizzaners and small number of such horses.

Morphometric differences between the horses from different stud depend on the goals of breeding which differs from one country to another or even one stud to another. In Hungary and Romania, they breed bigger and rougher horses with emphasized length of format, capable of field working and equestrian sports. Italians have no specific goal in Lipizzan breeding and they aim at preserving the lines and genera which they have. Austrians and Slovenians breed Lipizzaners for general dressage for the needs of the Spanish Riding School of Vienna, Austria.

Slovakians aim to breed a heavier Lipizzaner in order to use it for work and riding and other needs. Croats aim to breed a Lipizzaner which would be bigger and used for riding and cart driving.

These researches show the morphometric differences between the Lipizzaner from Vučijak and Lipizzan horses from other notable stud in Europe. It is similar with smaller stud, as it was aimed at the Vučijak in Prnjavor.

Conclusion

In conclusion, according 28 taken measurements there is a statistical difference between stallions and mares in 10 measurements: height at withers (tape), width of head (lower jaw), length of neck, length of upper arm 2, length of rearquarters, width of chest, length of pastern (hind leg), circumference of cannon bone (metacarpal), width oh hips and lenght of shoulders. Out of 10 named measurements, in comparison to stallions, mares have bigger morphometric measures of length of shoulders, width of hips and length of pastern (hind leg). In the remaining 18 measures there is no specific differences noted between stallions and mares. Lipizzaner of the Vučijak has a rectangle body shape, which is in accordance with the appearance of Lipizzaners in the most of European stud farms. Horses from Vučijak are smaller than other Lipizzan horses in Europe, which is in accordance with the breeding aim of this stud farm, which is to create a smaller horse for field works and carrying weight.

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Morfometrijska karakterizacija lipicanera ergele "Vučijak"

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Rezime

Istraživanje je sprovedeno na 10 pastuva i 31 kobili rase lipicanera na ergeli "Vučijak" Prnjavor. Ukupno je izmereno 28 morfometrijskih mera na konjima navedene ergele. Morfometrijska karakterizacija je pokazala da ergela Vučijak poseduje lipicanera manjeg okvira tela u odnosu na druge konje poznatih ergela lipicanera u Evropi. Pored toga telo lipicanera iz Prnjavora ima izgled pravougaonika, što je u saglasnosti sa izgledom tela lipicanera većine drugih ergela lipicanera iz Evrope. Na osnovu izmerenih morfometrijskih mera utvrđeno je da

postoji statistički značajna razlika između pastuva i kobila na mere: visina grebena (merena pantljikom), širina donje vilice, dužina vrata, dužina ramena, dužina nadlaktice 2, širina grudi, dužina karlice, širina karlice, obim cevanice prednje noge, dužina kičične kosti zadnje noge. Od svih navedenih morfometrijskih mera, kobile su imale veće mere: dužina ramena, širina karlice i dužina kičice zadnje noge u odnosu na pastuve. Na ostalih 18 mera pastuvi i kobile ergele Vučijak su pokazali određenu homogenost.

References

- BABAN M., ČURIK I., MAIĆ B., RASTIJA T., ČAČIĆ M., MIJIĆ P. (2006): Morfološka svojstva đakovačkog lipicanca. *Krmiva*, 48, 3, 113 – 119.
- ČAČIĆ M. (2003): Fenotipske i genetske odlike lipicanaca u zemaljskom uzgoju Republike Hrvatske. Agronomski fakultet Sveučilišta u Zagrebu. Magistarski rad.
- HABE F., BODO I., BREM G., SÖLKNER J., DOVČ P., KAVAR T., MARTI E., LAZARY S., ZOCHMANN F., ZECHNER P. (2002): Maintenance of the Lipizzan Horse and Copernicus project. *Dnevi Kobilarne Lipica "Biotechnical Diversity in the Lipizzan Horse Breed"*, 27. 9. - 6. 10. 2002.
- OULEHLA J. (1996): Zuchterische Standards in der Lipizzanerpfede-Population. *Habilitationsarbeit*, Brno-Piber.
- PALLOTTINO F., STERI R., MENESATI P., ANTONUCCI F., COSTA C., FIGORILLI S., CATILLO G. (2015): Comparison between manual and stereovisino body traits measurements of Lippizzan horses. *Computers and electronics in agriculture*, vol. 118: 408-413.
- PRAČEK A. (1999): Lipicanski konj. *Slobodno kmetijstvo* 32 (6), 298-302.
- RASTIJA T., BABAN M., KNEŽEVIĆ I., MANDIĆ I., ANTUNOVIĆ T. (1991): Komparacija tjelesnih mjera lipicanaca po linijama u ergeli Đakovo i Prnjavor. *Poljoprivredne aktuelnosti*, 39 (3-4): 679-684.
- RASTIJA T., BABAN M., ANTUNOVIĆ Z., MANDIĆ I. (2004): A Comparison nad development of morphometric characteristics of stallions and mares on the lipizzaner stud of Đakovo. *Acta Agriculturae Slovenica*, 195 – 200.
- SÖLKNER J. (2001b): Inbreeding genetic variability and important ancestors of Lipizzan horses from national studs of middle and southeastern Europe 52nd Annual meeting of the European Association for Animal production (EAAP), Budapest.
- SÖLKNER J., ZECHNER P., ZOHMANN F., ACHMANN R., BODO I., MARTI E., HABE F., BREM G. (2001a): Analysis of diversity and population structure in the Lipizzan horse breed based on pedigrees and morphometric traits. In: 52th Annual Meeting of the European Association for Animal Production (EAAP), Budapest, 8 - 26, Hungary.

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- ZECHNER P. (2001c) Analyse der morphogischen Ähnlichekeit von Lipizzanem aus Staatsgestüten Mittel-und Südosteuropas. In: 52th Annual Meeting of the European Association for Animal Production (EAAP), Budapest, 26, Hungary.
- ZECHNER P., ZOHMANN F., SÖLKNER J., BODO I., HABE F., BREM G. (2001a) Morphological description of the Lipizzan horse population. *Livestock Production Science*, 69, 2, 163 – 177.
- ZECHNER P., ZOHMANN F., SÖLKNER J., BODO I., HABE F., BREM G. (2001b): Morphological description od the Lipizzan population: 2) Multivariate analysis of studmeans and stallion lines. In: 52th Annual Meeting of the European Association for Animal Production (EAAP), Budapest, 8-26, Hungary.
- ZOHMANN F., ZECHNER P., SÖLKNER J., BODO I., HABE F., BREM G. (2001): Morphological description of the lipizzan population: 1) Studmeans, repeatabilities and heritabilities for 37 morphometric measures. In: 52th Annual Meeting of the European Association for Animal Production (EAAP), Budapest, 26, Hungary.

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