RESEARCH REGARDING CERTAIN MORPHOLOGICAL ASPECTS OF THE HUTSUL BREED FROM THE LUCINA STUD FARM

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Abstract

The Hutsul breed is the only native horse breed of the Carpathian Mountains, renowned for its remarkable adaptability to the harsh environmental conditions of high-altitude regions. This study aims to evaluate the current morphological profile of the breeding nucleus at the Lucina Stud Farm (Suceava County). Standard somatic measurements (height at withers, chest girth, and cannon bone circumference) and derived body indices (digital-thoracic, cannon bone, and massiveness indices) were analyzed across a sample of 28 horses (14 breeding stallions / sires and 14 broodmares). The results highlight a well-defined sexual dimorphism alongside remarkable morphological homogeneity (V% < 5%), confirming the effectiveness of current stabilizing selection efforts dedicated to preserving the gene pool of this native breed.

Key words: *horses, stud farm, body indices, stallions, broodmares.*

INTRODUCTION

The Hutsul horse represents the only indigenous equine breed of the Carpathian arc, flawlessly adapted to the severe environmental conditions of high-mountain areas. Morphologically, the Hutsul falls into the hypometric breed category, with a standard height at withers ranging between 137 and 147 cm. The exterior is particularly harmonious, characterized by a rectangular body format, a robust constitution, and a compact frame reflecting great physical endurance [1-8]. Historically, breeding objectives aimed at increasing the breed's overall massiveness to meet the demanding requirements for draft work and transport in difficult mountain terrain. However, an overemphasis on this trait risked compromising the breed's characteristic harmony and typicality. Currently, selection and breeding strategies have acquired a strong stabilizing (conservative) character, aiming to preserve the breed's morpho-functional traits unaltered. The objective of this paper is to contribute to the knowledge and evaluation of the current morphological characteristics of the breeding nucleus maintained at the Lucina Stud Farm (Suceava County), the historical sanctuary for the preservation of the Hutsul horse gene pool.

MATERIAL AND METHOD

The research was conducted on a total of 28 Hutsul horses from the Lucina Stud Farm, structured into two equal breeding groups:

- 14 breeding stallions (sires), born between 2001 and 2020, approved for reproduction;
- 14 broodmares, born between 2010 and 2011, belonging to the stud farm's broodmare nucleus.

The morphological evaluation was based on primary biometric data retrieved from annual classification records (Fig. 1). The primary somatic measurements analyzed were: Height at withers (H), Chest girth (CG) and Cannon bone circumference (CC).

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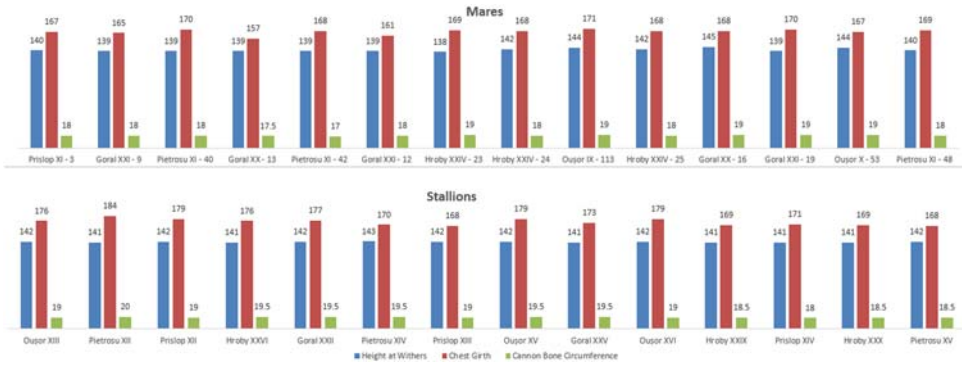


Fig. 1 Variation series of body dimensions in the studied population (cm)

Based on these primary measurements, synthetic body indices were calculated according to standard zootechnical formulas:

- Digital-Thoracic Index (DTI) = (Cannon Bone Circumference / Chest Girth) x 100.
- Cannon Bone Index (CBI) = (Cannon Bone Circumference / Height at Withers) x 100.
- Massiveness Index (MI) = (Chest Girth / Height at Withers) x 100

The statistical processing was performed using the following parameters:

- **Arithmetic Mean ($\overline{x}$):** Represents the central value of the analyzed trait around which individual sample measurements are distributed. The arithmetic mean was calculated using the formula:

$$\overline{x} = \frac{\sum x}{n},$$

where $\sum x$ is the sum of individual values, and n is the total number of observations.

- **Standard Deviation (s):** Serves as a measure of data dispersion relative to the arithmetic mean and expresses the degree of variability of the analyzed trait:
  - $s = \sqrt{s^2}$
- **Standard Error of Mean ($\pm s_{\overline{x}}$):** Indicates the precision with which the sample mean estimates the true population mean, representing the error associated with the arithmetic mean. It was determined using the equation:

$$\pm s_{\overline{x}} = \pm \frac{s}{\sqrt{n}}$$

- **Coefficient of Variation (V%):** A relative indicator of variability that expresses the standard deviation as a percentage of the arithmetic mean, enabling comparisons between traits measured in different units:

$V\% = s/\overline{x} \times 100$.

Variability is categorized as low when V% ≤ 10% (homogeneous population), moderate when V% = 10-20 %, and high when V% > 20% (heterogeneous population).

Additionally, the minimum (Min) and maximum (Max) values were recorded for each parameter to highlight the range of variation of the analyzed traits.

RESULTS AND DISCUSSION

Synthetic analysis of somatic measurements and body indices. The statistical parameters for the primary somatic measurements and calculated body indices across stallions, mares, and the overall population are summarized in Table 1.

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Table 1. Statistical Analysis of Studied Body Measurements and Calculated Body Indices

Descriptors	H (cm)	CG (cm)	CC (cm)	DTI (%)	CBI (%)	MI (%)
Mares (Broodmares)						
$\bar{x}$	140.64	167.00	18.25	10.93	12.98	118.76
$\pm s\bar{x}$	0.41	0.52	0.21	0.16	0.17	0.45
V%	1.64	2.27	3.52	3.22	3.12	2.41
MIN	138.00	157.00	17.00	10.12	12.23	112.95
MAX	145.00	171.00	19.00	11.38	13.77	122.46
Stallions (Sires)						
$\bar{x}$	141.64	174.14	19.07	10.95	13.46	122.95
$\pm s\bar{x}$	0.21	0.60	0.20	0.14	0.17	0.51
V%	0.45	2.94	2.88	2.49	2.84	2.98
MIN	141.00	168.00	18.00	10.53	12.77	118.31
MAX	143.00	184.00	20.00	11.47	14.18	130.50
Total population						
$\bar{x}$	141.14	170.57	18.66	10.94	13.22	120.85
$\pm s\bar{x}$	0.25	0.45	0.16	0.11	0.13	0.37
V%	1.23	3.35	3.86	2.83	3.48	3.20
MIN	138.00	157.00	17.00	10.12	12.23	112.95
MAX	145.00	184.00	20.00	11.47	14.18	130.50

$\bar{x}$ = arithmetic mean; $\pm s\bar{x}$ = standard error of mean; V%=Coefficient of Variation; MIN = minimum value; MAX = maximum value; CG = chest girth; DTI = Digital-Thoracic Index; CBI = Cannon Bone Index; MI = massiveness index.

Height at withers recorded an overall mean of 141.14 ± 0.25 cm, placing the studied nucleus fully within the official breed standard (137-147 cm). Remarkable stability was observed across sexes, with mean values of 141.64 ± 0.21 cm for stallions and 140.64 ± 0.41 cm for mares, demonstrating strict conservation of the hypometric type.

Regarding chest girth, the population average reached 170.57 ± 0.45 cm. Unlike height, sexual dimorphism was pronounced for thoracic development: stallions averaged 174.14 ± 0.60 cm (with an impressive maximum of 184 cm), whereas mares averaged 167.00 ± 0.52 cm (ranging from 157 to 171 cm), emphasizing superior thoracic and respiratory capacity in males.

Cannon bone circumference, an indicator of bone development and structural robustness, yielded a general mean of 18.66 ± 0.16 cm. Stallions exhibited significantly stronger bone structure (19.07 ± 0.20 cm, range 18-20 cm) compared to broodmares (18.25 ± 0.21 cm, range 17-19 cm).

The calculated body indices further define the morpho-functional profile of the herd:

• Digital-Thoracic Index (DTI) showed high proportionality and near-identical values between sexes (10.95 ±

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0.14% in stallions vs. 10.93 ± 0.16% in mares), with a population mean of 10.94 ± 0.11%.

• Cannon Bone Index (CBI) averaged 13.22 ± 0.13%, with higher values in males (13.46 ± 0.17%) than females (12.98 ± 0.17%), confirming greater bone development relative to height.

• Massiveness Index (MI) recorded a general mean of 120.85 ± 0.37%. Significantly higher values in stallions (122.95 ± 0.51%) compared to mares (118.76 ± 0.45%) reflect a deep, well-muscled, and highly compact torso.

The low coefficient of variation (V%) highlights a fundamental trait of the Lucina herd: high morphological homogeneity. For all evaluated measurements and indices, V% remained well below the 5% threshold, ranging between 0.45% and 3.86%. This narrow variation proves the success of the conservative selection strategy applied at the stud farm.

To analyze how genetic bloodlineages influence exterior morphology, primary somatic data were processed individually, calculating exact body indices for sires and broodmares. Comparative analysis of individual data highlights distinct hereditary traits transmitted across traditional genealogical bloodlines:

• Pietrosu Bloodline: Remains the benchmark for massiveness and skeletal development. The sire Pietrosu XII is the most developed individual in the herd, recording peak values for chest girth (184 cm), cannon bone circumference (20 cm), Massiveness Index (130.50%), and Cannon Bone Index (14.18%). Strong bone structure persists in Pietrosu XIV (CBI = 13.64%) and Pietrosu XV (CBI = 13.38%). Broodmares (Pietrosu XI-40, Pietrosu XI-42, Pietrosu XI-48) maintain highly consistent massiveness (MI between 120.86% and 121.43%).

• Ouşor Bloodline: Stands out among broodmares for providing the tallest individuals. Ouşor IX-113 and Ouşor X-53 mares reached the maximum height for females (144 cm), alongside high Digital-Thoracic Index values (11.11% and 11.38%). Among stallions, Ouşor XV displayed exceptional massiveness (MI = 126.06%, CG = 179 cm), while Ouşor XIII and Ouşor XVI maintained elevated Cannon Bone Indices (13.48%).

• Hroby Bloodline: Demonstrates remarkable biometric stability. All three sires (Hroby XXVI, Hroby XXIX, Hroby XXX) share an identical height of 141 cm, with indices varying within very narrow margins (MI 119.86% - 124.82%; CBI 13.12% - 13.83%). Broodmares (Hroby XXIV-23, Hroby XXIV-24, Hroby XXIV-25) provide a uniform maternal foundation with an average Digital-Thoracic Index of 10.92%.

• Goral Bloodline: Exhibits wider morphological variation, ranging from slender to highly massive individuals. Mare Goral XX-16 reached the maximum height of the mare group (145 cm), whereas Goral XX-13 marked the minimum thresholds for chest girth (157 cm) and cannon bone (17 cm), resulting in lower Massiveness (112.95%) and Cannon Bone (12.23%) indices. Conversely, mares Goral XXI-12 and Goral XXI-19 achieved high massiveness (121.58% - 122.30%). The sire Goral XXII confirmed the bloodline's capacity for high massiveness (MI = 124.65%, CBI = 13.73%).

• Prislop Bloodline: Confirms harmonious alignment with standard breed morphology. Sire Prislop XII ranks among the most massive stallions (MI = 126.06%, CBI = 13.73%), while Prislop XIII and Prislop XIV (MI 119.15% - 121.13%) and mare Prislop XI-3 (MI = 117.14%, DTI = 10.98%) maintain an optimal balance between height, thoracic depth, and bone strength.

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CONCLUSIONS

As a result of this study on Hutsul horses from Lucina stud farm, the following conclusions can be stated:

- the overall population averages for height at withers (141.14 cm), chest girth (170.57 cm), and cannon bone circumference (18.66 cm) place the Lucina breeding nucleus strictly within the Hutsul breed standard.
- sexual dimorphism is evident across both primary measurements and derived indices: breeding stallions / sires exhibit higher values for Massiveness Index (122.95% vs. 118.76% in mares) and Cannon Bone Index (13.46% vs. 12.98% in mares), reflecting greater muscular mass and bone density.
- the population Digital-Thoracic Index averaged 10.94%, showing near-perfect parity between sexes (10.95% in stallions, 10.93% in mares) and confirming ideal balance between skeletal bone and thoracic capacity.
- low coefficients of variation (V% < 5%) demonstrate outstanding morphological homogeneity within both stallion and broodmare groups.
- bloodlineage analysis (Pietrosu, Ouşor, Hroby, Goral, Prislop) confirms the preservation of bloodlineage-specific traits, maintaining necessary genetic diversity without compromising breed harmony.
- current stabilizing selection efforts successfully fulfill their preservation objective, safeguarding the genetic heritage and morphological traits of the Hutsul horse at the Lucina Stud Farm.

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