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LINEAR TYPE TRAIT ANALYSIS IN COLDBLOOD BREEDS: CZECH-MORAVIAN BELGIAN HORSE AND SILESIAN NORIKER

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ABSTRACT

The linear type description in 580 horses of Czech-Moravian Belgian horse (CMB) and in 282 horses of Silesian Noriker (SN) was evaluated using a linear model with fixed effects: sex, year of birth, sire line and sire. Both breeds were evaluated separately. Basic traits of the linear type description such as the mean, variation coefficient and the number of utilized score were determined. In this work, an incomplete use of the variability scale has been ascertained for the linear type trait description of exterior in the genetic sources in CMB and SN horses. None of the monitored traits has used a complete scale of developmental stages (1-9). Statistical differences between the sexes have been found only for 4 traits in CMB horses and for 5 traits in SN horses. No statistically significant differences in age during the evaluation were found in most cases. Both effects (sex and age with evaluation) have not been significant for the majority of linear type traits in both files of statistical significance and were not significant in breeding and selection of CMB and SN on the basis of linear type trait analysis. On the contrary, statistically significant differences in the effect of the year of birth have been found for 14 traits in CMB and for 16 traits in SN. The year of birth shows statistically significant influence on the formation of morphology in both breeds. In fathers and paternal lines in CMB and SN, significant intra-population phenotype variability has been ascertained.

Key words: Czech-Moravian draft horse; Silesian Noriker; analysis of linear type description

INTRODUCTION

Czech-Moravian Belgian horse (CMB) and Silesian Noriker (SN) belong together with Old Kladruber horse and Hutsul horse to the genetic sources of horses in the Czech Republic. These breeds belong to the coldblood horses. CMB has been formed in the area of the Czech Republic for the last app. 120 years on the basis of imports of mostly original draft stallions, less frequently of Belgian stallions. CMB is of middle, square frame, earlier maturity. Active population of CMB in 2008 was composed of 50 stallions and 1050 mares. SN was originated within the last approximately 100 years on the basis of imports of original coldblood and Bavarian coldblood stallions. SN is of longer frame, later maturity. Active population in 2008 was composed of 40 stallions and 835 mares. Both breeds have been acknowledged as separate since 1991. In 1998, in both breeds a linear type trait analysis for an exterior description was introduced.

A linear description system is routinely used mainly in cattle, where a number of analyses were done (Bouška *et al*., 2008; Veselá *et al*., 2005 Brothostone, 1994). In horses, a body conformation was evaluated by a score system at first, while the linear description was introduced later. Linear description and description of morphological structure in horse breeds were studied by Jakubec *et al*. (1999; 2007) in Old Kladruber horse, Pretorius *et al*. (2004) in Friesian horses, Zechner *et al*.

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(2001) and Baban *et al*. (1998) in Lipizzan horses, Molina *et al*. (1999) in Andalusian horses, Samoré *et al*. (1997) in Hafling breed, Hartman *et al*. (1994) in riding horses, and by Van Bergen and Van Averdonk (1993) in Shetland pony. Koenen *et al*. (1994) investigated the relationship between body conformation and performance in Dutch warmblooded horses. Schlote *et al*. (2002) studied the development of standardization for the conformation evaluation in horses by computing technology. Andrejsová *et al.* (2008) analyzed performance tests in Old Kladruber horse.

The aim of this work was to perform a linear type trait analysis of Czech-Moravian Belgian horse and Silesian Noriker with regards to their belonging to paternal line, sex, year of birth and age at the analysis.

MATERIAL AND METHODS

580 individuals of Czech-Moravian Belgian horse (CMB) and 282 individuals of Silesian Noriker (SN) described within the years of 2001 – 2005 have been analyzed in this work. The database was provided by the Horse Breeder's association of the Czech Republic (ASCHK, www.aschk.cz). 22 traits of morphological structure have been described by means of linear type traits: type, range, nobility, neck length, neck tethering, withers length, topline length, topline form, loin length, loin form, croup length, croup slope, shoulder-blade, foretoes, forehoof, hind-limbs posture, fetlock, back hoof, body width, shape of croup, spaciousness of pace and spaciousness of gallop. To describe development of traits, a linear scale from 1 to 9 was used. Four body parameters in absolute values (in cm) were also included in the monitoring (in cm): withers height - stick (HWS), withers height - ribbon (HWR), chest circumference (CC) and circumference of front shin (CFS).

For the estimation of basic population parameters all traits were analyzed by the least-squares analysis using the GLM procedure of programmed package SAS (SAS, 2005). The following linear model with fixed effects was used for the analysis:

$$Y_{ijklmn} = \mu + SEX_i + YEARB_j + AGEC_k + LIN_l + SIRE_{ml} + e_{ijklmn}$$

where:

Y_{ijklmn} - observation of a linear type description,
μ- overall mean,
SEX_i - fixed effect of the *i*-th sex,
$YEARB_j$ - fixed effect of the *j*-th year of birth,
$AGEC_k$ – fixed effect of the *k*-th age of classification,
LIN_l - fixed effect of the *l*-th line of sire,
$SIRE_{ml}$ – fixed effect of the *m*-th sire at *l*-th linie of sire.

Differences between the least-squares means were tested at the significance level (error probability) of $P < 0.05$ (*), $P<0.01$(**) and $P<0.001$ (***).

RESULTS AND DISCUSSION

Basic characteristics of monitored traits are shown in tables 1 and 2 – the mean, standard deviation, variation coefficient, minimum, maximum and range of utilized score. These parameters have been estimated for both populations of horses (CMB a SN) regardless of individual factors. Mean values in CMB (table 1) were estimated for a linear type trait analysis in the range of 4.45 for length of neck to 6.70 for length of croup. A standard deviation was estimated for CMB in the range of 0.51 to 1.17. In SN (table 2), a mean value of development stages ranged between 4.72 for the shape of spine to 6.68 for spaciousness of pace, standard deviation in SN was estimated in the range of 0.43 to 1.17. It is apparent from the values, that both for CMB and SN central stages of development have been used for a linear type trait analysis.

Furthermore, it is apparent from the results of investigation that during linear type trait analysis of both breeds of coldblood horses a complete range of scale 1 – 9 was not used. In CMB (table 1), the highest 8 utilized score are used only in 3 traits (14%); in 4 traits (18%) only 5 utilized score have been used. The greatest representation was exhibited in 7 stages scale (46%). In SN (table 2), the greatest scale of 7 utilized score was used only in 4 traits (18%), and in 6 traits (27%) the lowest scale of 5 utilized score was used. The greatest representation in SN was exhibited in scale of 6 utilized score (55%). The development stage 1 was not used for a linear type trait description of both breeds (CMB and SN). The reason for this fact is that described files have been formed by breeding animals and extreme development of traits (mostly serious morphological disorders) is already pre-selected. Individuals with serious morphological defects were not selected for parents of the next population and, therefore, a linear type trait description is not performed in them. These low description scales of the trait development can significantly influence evaluated traits of linear analysis in both breeds.

According to values of variation coefficient (CV%), traits for a preliminary selection of selection criteria can be chosen. Therefore, it can be supposed, that a high phenotype variation is determined by a high genetic variability. In CMB breed (table 1), the highest variability is exhibited in the following traits of a linear analysis: length of withers (21.07 %), shoulder-blade (20.85 %) and type (19.50 %). In breeds assigned to genetic sources, however, it is stabilization of the breed at stake, the main goal and the parents of the next generation should be selected with mean development of traits with regards to CV%. In SN (table 2), similar to CMB, the

Table 1: Basic population parameters for CMB

Number	Trait	Mean	Standard deviation	Variation coefficient	Minimum	Maximum	Utilized scores
1	Withers height - stick	160.06	3.84	2.39	148.00	173.00	-
2	Withers height - ribbon	171.76	4.35	2.53	158.00	187.00	-
3	Chest circumference	204.32	10.54	5.16	180.00	250.00	-
4	Circumference of front shin	22.98	0.93	4.08	19.00	27.00	-
5	Type	6.01	1.17	19.50	2.00	9.00	8.00
6	Range	5.75	0.84	14.70	3.00	8.00	7.00
7	Nobility	5.31	0.97	18.23	2.00	8.00	8.00
8	Neck length	4.45	0.80	18.07	2.00	7.00	6.00
9	Neck tethering	6.19	1.02	16.49	3.00	9.00	7.00
10	Withers length	4.59	0.96	21.07	2.00	8.00	7.00
11	Topline length	5.64	0.78	13.77	4.00	8.00	5.00
12	Topline form	4.48	0.68	15.29	2.00	7.00	6.00
13	Loin length	5.43	0.65	11.87	4.00	8.00	5.00
14	Loin form	4.90	0.51	10.38	3.00	7.00	5.00
15	Croup length	5.22	0.96	18.43	2.00	8.00	7.00
16	Croup slope	6.10	0.91	14.96	3.00	9.00	7.00
17	Shoulder-blade	5.59	1.17	20.85	3.00	8.00	6.00
18	Foretoes	4.80	0.65	13.56	2.00	8.00	7.00
19	Forehoof	5.21	0.82	15.74	2.00	9.00	8.00
20	Hind-limbs posture	5.63	1.01	17.99	3.00	9.00	7.00
21	Fetlock	5.21	0.67	12.85	2.00	8.00	7.00
22	Back hoof	4.97	0.48	9.62	3.00	7.00	5.00
23	Body width	6.05	1.08	17.95	3.00	9.00	7.00
24	Shape of croup	6.70	0.81	12.11	4.00	9.00	9.00
25	Spaciousness of pace	5.89	1.07	18.08	3.00	9.00	7.00
26	Spaciousness of gallop	5.92	1.06	17.86	3.00	8.00	6.00

Table 2: Basic population parameters for SN

Number	Trait	Mean	Standard deviation	Variation coefficient	Minimum	Maximum	Utilized scores
1	Withers height - stick	159.43	3.47	2.18	148.00	171.00	-
2	Withers height - ribbon	170.56	3.89	2.28	158.00	182.00	-
3	Chest circumference	202.89	9.59	4.73	170.00	230.00	-
4	Circumference of front shin	23.46	0.99	4.26	21.00	27.50	-
5	Type	6.40	1.08	16.89	3.00	9.00	7.00
6	Range	6.16	0.93	15.16	4.00	8.00	5.00
7	Nobility	5.03	1.00	19.88	3.00	8.00	6.00
8	Neck length	4.98	0.84	16.89	3.00	8.00	6.00
9	Neck tethering	5.68	0.91	15.99	3.00	9.00	7.00
10	Withers length	5.05	0.86	17.04	3.00	7.00	5.00
11	Topline length	5.86	0.77	13.19	3.00	8.00	6.00
12	Topline form	4.72	0.60	12.78	3.00	7.00	5.00
13	Loin length	5.66	0.67	11.75	3.00	7.00	5.00
14	Loin form	4.90	0.45	9.38	3.00	7.00	5.00
15	Croup length	5.62	0.86	15.41	3.00	7.00	7.00
16	Croup slope	6.08	0.82	13.58	3.00	8.00	6.00
17	Shoulder-blade	5.72	1.14	19.94	3.00	8.00	6.00
18	Foretoes	4.96	0.49	9.81	2.00	7.00	6.00
19	Forehoof	5.04	0.66	13.11	3.00	8.00	6.00
20	Hind-limbs posture	5.58	0.85	15.30	3.00	9.00	7.00
21	Fetlock	5.13	0.61	12.02	3.00	8.00	6.00
22	Back hoof	5.03	0.43	8.65	2.00	7.00	6.00
23	Body width	6.46	0.99	15.32	4.00	9.00	6.00
24	Shape of croup	6.65	0.82	12.42	5.00	9.00	5.00
25	Spaciousness of pace	6.68	1.17	17.59	4.00	9.00	6.00
26	Spaciousness of gallop	6.64	1.12	16.86	4.00	9.00	6.00

greatest variability has been estimated in shoulder-blade (19.94 %), in blood traits (19.88 %) and spaciousness of pace (17.59 %). The lowest variability has been shown in measures of morphology. This corresponds to the fact that measure values of these traits are not exhibited on the scale of linear analysis. In comparison to the results of a phenotype variability reported by other authors (Jakubec *et al.* (2007) in Old Kadruber horse, Koenen *et al.* (1995) in Dutch warmblood riding horse, Van Bergen and Van Arendonk (1993) in Shetland pony), both breeds (CMB and SN) exhibited lower values of variation coefficient in all traits of a linear analysis. In contrast, our estimated variation coefficients reached higher values than stated by Molina *et al.* (1999). The ascertained lower variability values in CMB and SN can be influenced by the use of both lower utilized score for individual traits, when individuals with significant defects are excluded from breeding and also these lower variable values are caused by targeted stabilization of external manifestation in both breeds.

For the estimate of basic population parameters of traits of a linear analysis in CMB and SN, the effect of the year of birth was preferred to the year of description. When including the effect of the year of birth to the model, higher values of determination coefficient and lower values of residual error were estimated, oppositely to the model including effect of the year of description (not published). These values point out higher suitability of a model with the effect of the year of birth. Both effects cannot be included in the model because it was necessary to analyze the effect of age in an evaluation which is a combination of the two effects.

Estimates of basic parameters of a linear analysis and morphology for stallions and mares in CMB and SN are listed in tables 3. It follows from the results that in CMB for most traits (21 of 26) ascertained differences in mean values (LSM) between stallions and mares are not statistically significant. The differences in LSM are either significant or highly significant for 5 traits, while for 4 traits there are physical measures (withers height - stick and ribbon, circumference of shin a chest circumference), whilst in stallions higher values of body measures were found. For traits of linear description statistical differences have been found only for one trait (forehoof). Forehoof is significantly softer and longer in stallions, whereas in mares it is more abrupt. Similarly, in SN for a majority of traits (20 of 26), the estimated differences in means (LSM) between stallions and mares are non-significant. The differences in LSM are either significant or highly significant for 6 traits. For 3 traits of a body measures had stallions exhibited higher values than mares (withers height - stick and ribbon, circumference of shin). For traits of a linear description, statistical differences were found only in three traits (hind-limbs posture, back hoof a shape of croup). In SN, hind-limbs posture was more sickle hocked (6.21), back hoof sharper and shape of croup was more splitting in stallions (7.42) rather than in mares, where a posture of hind-limbs is more open (5.26), back hoof duller and shape of croup more roof-like (6.80). Significant or highly significant differences both in CMB and SN have been caused by a sexual dimorphism. It follows from the results that the differences between stallions and mares are mostly in ranges which include measurable traits. For the traits of a linear analysis, the values of individuals of both sexes were directly comparable. These conclusions correspond to the requirement on a concurrent type of stallions and mares. Furthermore, it follows from the results that it is not necessary to conduct correction to sex in traits of morphology. Statistically significant differences in morphology between the stallions and mares have been proved by McManus *et al.* (2005).

For the year of birth, differences between means in CMB (table 4) have been ascertained in 12 of 26 traits from important to highly important. It only deals with traits of a linear description. For body measures, statistically significant differences in individual years in CMB have not been found. In SN (table 5), statistically significant or highly significant differences have been found for 15 of 26 monitored traits. These results can be caused by the fact that in individual years, there were different nutritional and on-site meteorological conditions, which can be manifested in a formation of morphology. Thus, there were significant differences in both breeds (CMB and SN) among individual years.

At the age at description in CMB (table 4) four statistically significant differences have been found, of which 2 traits belong to the group of bodily measures (circumference of chest and of shin) and 2 to the group of the linear type description (length of withers and spine). The differences between means according to the age at description in chest circumference and the length of withers are highly significant and for the circumference of shin and length of spine they are significant. In SN (table 5), statistical differences were found only in 2 traits, which belong again to the group of linear type trait description (type and shape of croup). These results indicate that for a majority of traits of linear type trait description in CMB and SN a stage of development of trait from the age of 3 years remains relatively constant to older age. Despite the fact that long-term differences could have been expected in SN – reaching maturity on the 5th year – compared to CMB reaching maturity on the 3rd year.

Table 3. Least squares means (LSM) and standard errors (SE) for the sex

Number	Trait	ČMB				Sig.	SN				Sig.
		Stallion		Mare			Stallion		Mare		
		LSM	SE	LSM	SE		LSM	SE	LSM	SE	
1	Withers height - stick	163.82	1.29	160.61	0.56	*	163.01	1.38	159.49	0.67	*
2	Withers height - ribbon	174.95	1.48	171.81	0.64	*	175.10	1.56	171.18	0.76	*
3	Chest circumference	214.13	3.59	206.56	1.56	*	209.94	3.72	204.48	1.82	n.s.
4	Circumference of front shin	24.60	0.30	23.07	0.13	***	25.96	0.31	23.58	0.15	***
5	Type	6.48	0.45	5.96	0.21	n.s.	6.24	0.43	6.86	0.21	n.s.
6	Range	5.76	0.31	5.65	0.14	n.s.	5.66	0.36	6.09	0.18	n.s.
7	Nobility	5.26	0.33	5.35	0.14	n.s.	5.45	0.40	5.21	0.20	n.s.
8	Neck length	4.57	0.27	4.39	0.11	n.s.	5.49	0.32	5.17	0.16	n.s.
9	Neck tethering	5.97	0.31	6.04	0.13	n.s.	5.68	0.33	5.81	0.16	n.s.
10	Withers length	4.35	0.29	4.35	0.12	n.s.	5.07	0.30	5.00	0.15	n.s.
11	Topline length	5.45	0.26	5.26	0.11	n.s.	5.18	0.30	5.67	0.15	n.s.
12	Topline form	4.42	0.23	4.46	0.10	n.s.	4.82	0.24	4.84	0.12	n.s.
13	Loin length	5.52	0.21	5.23	0.09	n.s.	5.27	0.26	5.69	0.13	n.s.
14	Loin form	4.92	0.17	4.98	0.07	n.s.	5.13	0.19	5.03	0.09	n.s.
15	Croup length	5.10	0.32	5.04	0.13	n.s.	5.45	0.35	5.77	0.17	n.s.
16	Croup slope	5.92	0.31	5.92	0.13	n.s.	6.14	0.32	6.09	0.16	n.s.
17	Shoulder-blade	4.88	0.36	5.25	0.15	n.s.	5.70	0.42	5.95	0.21	n.s.
18	Foretoes	4.67	0.22	4.82	0.09	n.s.	4.87	0.20	5.11	0.10	n.s.
19	Forehoof	4.66	0.28	4.66	0.12	*	4.87	5.17	0.27	0.13	n.s.
20	Hind-limbs posture	4.90	0.34	5.36	0.14	n.s.	6.20	0.34	5.25	0.17	**
21	Fetlock	5.33	0.25	5.15	0.11	n.s.	5.50	0.28	5.02	0.14	n.s.
22	Backhoof	5.15	0.17	5.01	0.08	n.s.	5.69	0.19	5.06	0.09	**
23	Body width	5.51	0.38	6.18	0.16	n.s.	6.55	0.38	6.39	0.19	n.s.
24	Shape of croup	6.40	0.27	6.49	0.12	n.s.	7.42	0.31	6.79	0.15	*
25	Spaciousness of pace	6.60	0.39	6.03	0.15	n.s.	7.16	0.58	6.37	0.23	n.s.
26	Spaciousness of gallop	6.00	0.39	6.12	0.15	n.s	7.24	0.55	6.66	0.22	n.s.

where: Sig. - Level of significance, n.s. – not significant, *P < 0.05, **P<0.01 and ***P<0.001

From tables 4 and 5 differences in sire lines are also apparent. In CMB, highly significant differences (P < 0.01) have been ascertained for 10 traits and for 3 traits - significant differences (P < 0.05) which represents 50% of total number of traits. These are mainly traits of linear description (10 traits). From body measures, statistical differences have been found only in chest circumference. In SN, highly significant (P < 0.01) differences have been found only for 3 traits and significant differences (P < 0.05) also for 3 traits of totally 26 traits, i.e. 23 %. In comparison to CMB, differences have been found in body measures (4 traits). From the traits of a linear description differences have been found in the length of neck, setting of neck and the length of withers. It follows from the results that in SN breed there is a higher variability within the range of individual sire lines in comparison to CMB. In sire line, mainly in CMB but also in SN, significant intra-population phenotype variability has been ascertained, from which it is possible to believe in high intra-population genetic variability. This high intra-population genetic variability is necessary to preserve in both breeds as genetic sources.

The differences between the means of sires in CMB breed were highly significant for 15 traits (P<0.01, P<0.001) and significant (P<0.05) for 8 traits, i.e. 23 traits of totally 26, i.e. 89%. On the contrary in SN, differences in means of sires have been found only for 6 traits - highly significant (P<0.01; P<0.001) and for 6 traits - significant, i.e. for 12 traits out of totally 26, i.e. 46.15 %. A linear type description was done totally in 50 sires of CMB breed with a minimum number of 5 offspring and a maximum number of 36 offspring and in 26 sires of SN breed with a minimum number of 5 offspring and a maximum number of 23 offspring.

Lower number of statistically significant differences between the means of sires in SN is caused by a lower number of individuals in the SN population. This lower number of individuals is caused by a higher relationship of the animals at stake causing similarity of individuals in a population.

Table 4: The level of significance of differences in mean values (LSM) of traits of linear type description for sex, year of birth, year at description, line and father for CMB

Number	Trait	CMB	Level of significance			
		Mean	Year of birth	Age at description	Sire line	Sire
1	Withers height - stick	160.06	n.s.	n.s.	n.s.	**
2	Withers height - ribbon	171.76	n.s.	n.s.	n.s.	**
3	Chest circumference	204.32	n.s.	*	*	**
4	Circumference of front shin	22.98	n.s.	n.s.	n.s.	**
5	Type	6.02	n.s.	n.s.	n.s.	n.s.
6	Range	5.75	n.s.	n.s.	n.s.	*
7	Nobility	5.31	n.s.	n.s.	n.s.	*
8	Neck length	4.45	***	*	*	***
9	Neck tethering	6.19	**	***	***	***
10	Withers length	4.59	***	***	***	**
11	Topline length	5.65	n.s.	n.s.	n.s.	*
12	Topline form	4.45	n.s.	**	**	*
13	Loin length	5.43	**	**	**	**
14	Loin form	4.90	*	n.s.	n.s.	*
15	Croup length	5.23	*	**	**	***
16	Croup slope	6.10	*	n.s.	n.s.	*
17	Shoulder-blade	5.59	*	***	***	***
18	Foretoes	4.80	**	*	*	***
19	Forehoof	5.21	n.s.	n.s.	n.s.	*
20	Hind-limbs posture	5.63	n.s.	***	***	***
21	Fetlock	5.21	n.s.	**	**	*
22	Backhoof	4.97	n.s.	n.s.	n.s.	***
23	Body width	6.05	n.s.	n.s.	n.s.	n.s.
24	Shape of croup	6.70	***	n.s.	n.s.	n.s.
25	Spaciousness of pace	5.89	***	***	***	***
26	Spaciousness of gallop	5.92	***	**	**	***

where: n.s. – not significant, *P < 0.05, **P<0.01 and ***P<0.001

CONCLUSION

In breeding the genetic sources of Czech-Moravian Belgian horse and Silesian Noriker, there has been a qualitative shift using a linear type trait description of morphology - the development of type and individual traits of an exterior can be expressed in opposition to the existing state in numbers. This enables the use of mathematical statistical analysis in the range of breeding process also with regards to sire line and individual sires as a basis for selection proceedings. It has been shown that it is possible to effectively use information on the development of traits in linear analysis in breeding and breeding processing. Until 1998 the exterior of CMB and SN was described only in words.

The differences between the mean values of traits are highly significant or significant in 26.92 % traits of sire lines in CMB and 42.31 % traits in sire lines of SN. Similarly, numbers of differences for individual traits were found also in the year of birth (58% and 61% for CMB and SN). On the contrary, only in 15 % and 19% of traits, statistical differences in sex and 15% and 8% in breeds CMB and SN, respectively, were found. In paternal lines in both breeds, intra-population phenotype variability was found, from which it is possible to judge also about an intra-population genetic variability.

This work demonstrates that in majority of traits in linear type trait description it is not necessary to perform correction to sex and age at evaluation.

And the last but not least, low usability of utilized score for linear description of exterior in gene reserves of CMB and SN horses has been found. This is caused by a pre-selection of described individuals.

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Table 5: The level of significance of differences in mean values (LSM) of linear type traits description for sex, year of birth, age at description, line and father for SN

Number	Trait	SN	Level of significance			
		Mean	Year of birth	Age at description	Sire line	Sire
1	Withers height - stick	159.43	n.s.	n.s.	*	n.s.
2	Withers height - ribbon	170.56	n.s.	n.s.	*	n.s.
3	Chest circumference	202.89	n.s.	n.s.	*	*
4	Circumference of front shin	23.45	n.s.	n.s.	**	***
5	TYPE	6.40	***	*	n.s.	***
6	RANGE	6.16	***	n.s.	n.s.	**
7	Nobility	5.04	n.s.	n.s.	n.s.	n.s.
8	Neck length	4.98	***	n.s.	n.s.	*
9	Neck tethering	5.68	***	n.s.	***	***
10	Withers length	5.05	***	n.s.	**	n.s.
11	Topline length	5.86	*	n.s.	n.s.	*
12	Topline form	4.71	n.s.	n.s.	n.s.	*
13	Loin length	5.66	**	n.s.	n.s.	n.s.
14	Loin form	5.62	**	n.s.	n.s.	n.s.
15	Croup length	4.90	*	n.s.	n.s.	n.s.
16	Croup slope	6.08	***	n.s.	n.s.	n.s.
17	Shoulder-blade	5.72	***	n.s.	n.s.	**
18	Foretoes	4.96	n.s.	n.s.	n.s.	n.s.
19	Forehoof	5.04	n.s.	n.s.	n.s.	n.s.
20	Hind-limbs posture	5.58	n.s.	n.s.	n.s.	**
21	Fetlock	5.14	n.s.	n.s.	n.s.	n.s.
22	Backhoof	5.03	n.s.	n.s.	n.s.	*
23	Body width	6.47	**	n.s.	n.s.	n.s.
24	Shape of croup	6.65	***	*	n.s.	n.s.
25	Spaciousness of pace	6.68	*	n.s.	n.s.	*
26	Spaciousness of gallop	6.64	**	n.s.	n.s.	n.s.

Where: n.s. – not significant, *P < 0.05, **P<0.01 and ***P<0.001

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