HERITABILITY ESTIMATES FOR BIOMETRIC MEASURES OF THE PANTANEIRO HORSE

ESTIMATIVAS DE HERDABILIDADE PARA CARACTERÍSTICAS BIOMETRICAS DO CAVALO PANTANEIRO

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ADDITIONAL KEYWORDS

Animal genetic resources. Genetic correlation. Inbreeding coefficient. Genetic variances.

PALAVRAS CHAVE ADICIONAIS

Consanguinidade. Correlações genéticas. Recursos genéticos animais. Variabilidade genética.

SUMMARY

This study used data registered in the Brazilian Pantaneiro Horse Association, in the period of 1972 to 2000. Fifteen linear biometric measures taken at registration (Wither height, back height, croup height, midback height, head length, neck length, back-loin length, croup length, shoulder bone length, head width, chest width, hip width, shin bone perimeter and thorax perimeter), on 2248 registered animals were analyzed using the MTDFREML program to estimate genetic and phenotypic variances as well as hertabilities, genetic and phenotypic correlation between the traits of interest. The factors sex, month, year of register and age were fitted as fixed effects in the model. In general the coefficient of variation for these traits was low (2 to 8 percent) which may indicate selection problems in the future. The heritabilities evaluated lay between 0.27 (head width) and 0.83 (thorax perimeter). The inbreeding coefficient was in general low with a mean level of 8 percent, for the animals that showed inbreeeding (1 percent). The genetic correlations were high between all 15 linear biometric measures, except for traits that correlation with the thorax perimeter that were low and sometimes negative.

RESUMO

O cavalo Pantaneiro tem importância econômica e social para a região do Pantanal, pois é um animal utilizado para o manejo de gado e meio de transporte, principalmente nas áreas alagadas. Este trabalho avalia a variação genética de 15 características biométricas medidas pela Associação Brasileira de Criadores do Cavalo

Pantaneiro (ABCCP), na idade de registro. Estas medidas foram analisadas através do programa MTDFREML, onde os fatores sexo, idade e mês e ano de registro foram incluídos como efeitos fixos no modelo. As características medidas apresentaram estimativas de herdabilidade variando de 0.27 (largura da cabeça) a 0.83 (perímetro torácico). É importante notar que os coeficientes de variação destas características são muito baixos (2 a 8 p.100), podendo indicar problemas no futuro. Os coeficientes de consangüinidade destes animais foram muito baixos, em média 8 p.100 para os animais que tiveram consangüinidade (1 p.100). É importante salientar que em 50 p.100 dos dados analisados não havia informações de um ou ambos progenitores, portanto, os níveis atuais podem estar mais elevados. Observou-se altas correlações genéticas entre as medidas com exceção do perímetro torácico que apresentou correlações baixas e negativas com as demais características medidas. Os resultados indicaram que a população registrada do cavalo Pantaneiro apresenta níveis razoáveis de variação genética, portanto, para a manutenção da variabilidade desta população, cuidados são necessários.

INTRODUCTION

The Pantanal is a vast floodplain, situated in the center-west region of Brazil, and characterized by distinct rainy and dry seasons. In this region, beef cattle are the main economic source of income. The Pantaneiro horse is well adapted to the bioclimatic conditions of this region, and become an important economic and social factor, both for the cattle industry and regional transportation (Santos *et al.*, 1992).

The Pantaneiro horse had its probable origin from Iberian horses introduced by Spanish settlers, specially in the 16th and 17th centuries, and by Portuguese settlers in the 18th century (Santos *et al.*, 1992). As a consequence of natural selection for more than two centuries, with little or no human interference, an animal well adapted to the environment appeared.

At the end of the 19th century, the population of the breed was severely reduced mainly due to Peste das cadeiras (*Trypanossomiasis*). Later, other menaces to survival appeared, mainly indiscriminate crossbreeding and more recently Infectious Equine Anemia (AIE). Only in 1972, with the creation of the Brazilian Pantaneiro Horse Breeders Association (ABCCP), was the breed standardized through by uniting the different phenotypes. The ABCCP still has an open book for the registration of horses. In the Pantanal, there is an estimated population of 119000 horses, mainly crossbred animals. Of these, there are about 1600 mares and 300 males registered in the ABCCP, and the bulk of these are in the Poconé sub-region, whose breeders collaborated in the creation of the ABCCP. Since the endangered status of animal breeds is determined by the size of breeding stock (Bodó, 1990), the Pantaneiro horse is classified as vulnerable, and measures must be taken to prevent a further decrease in the population.

This work makes the first estimates of heritabilites and genetic correlations between biometric measures taken on these horses at registration.

MATERIAL AND METHODS

Data from 2035 animals were used,

registered in the genealogical registration book of the Brazilian Pantaneiro Horse Breeders Association (ABCCP) in the period from 1972 to 2000. Fifteen linear measures (withers height, back height, croup height, midback height, head length, neck length, back/loin length, croup length, shoulder bone length, head width, chest width, hip width, shin bone perimeter and thorax perimeter) were analyzed using the MTDFREML program (Boldman *et al.*, 1995) to estimate genetic and phenotypic variances as well as hertitabilities and genetic and phenotypic correlations between the traits of interest. The general model for this analysis was

$$Y = X\beta + Z_1\alpha + e$$

where Y is a vector (N x 1) of animal observations;

β is the fixed effects vector, associated with the incidence matrix X;

α is the vector of direct genetic effects, associated with the incidence matrix, Z1;

e is the random error effects matrix.

RESULTS AND DISCUSSION

Heritability estimates for the fifteen traits studied are presented in **table I** along with genetic correlations between these traits. The estimates vary

Table I. *Heritability estimates (diagonal) and genetic correlation (below diagonal) on 15 linear measures of the Pantaneiro horse.* (Estimativa da heritabilidade (diagonal) e correlação genética (diagonal abaixo) de 15 medidas lineares do Cavalo Pantaneiro).

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15
V1	0.55														
V2	1	0.38													
V3	1	1	0.68												
V4	1	1	1	0.69											
V5	1	1	1	1	0.72										
V6	1	1	1	1	1	0.27									
V7	1	1	1	1	1	1	0.51								
V8	1	1	1	1	1	1	1	0.59							
V9	1	1	1	1	1	1	1	1	0.61						
V10	-1	0.15	1	1	0.54	-0.16	-1	-0.26	0.06	0.83					
V11	1	1	1	1	1	1	1	1	1	-1	0.53				
V12	1	1	1	1	1	1	1	1	1	-1	1	0.61			
V13	1	1	1	1	1	1	1	1	1	-0.95	1	1	0.52		
V14	1	1	1	1	1	1	1	1	1	-0.98	1	1	1	0.67	
V15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0.5

V1=head length; V2= neck length; V3= croup length; V4= shoulder bone length; V5= body length;V6= head width; V7= chest width; V8= hip width ; V9= back--loins length, ; V10= thorax perimeter; V11= shin bone perimeter; V12= withers height; V13= croup height; V14= back height; V15= midback height.

between 0.27 (head width) and 0.83 (perimeter of thorax). Dorsal-lombar length and shoulder height presented the same heritability estimate (0.61). It is possible that the selection directives used by the Pantaneiro horse breeders along with the population structure contributed to the high heritabilities encountered here. Heritability estimates for size traits in horses is somewhat scarce, particularly in Brazil. Motta and Giannoni (1994), studying the Mangalarga breed, found heritability estimates for head, neck and shoulder traits of 0.68, 0.75 and 0.44 respectively. Motta (1995) also studied race performance, independent of the means of measurement and found low to medium values for heritabilities. In studies carried out by Zamborlini (1996) on the Mangalarga Marchador breed, heritability estimates for body measures of between 0.38 (hip height) and 0.68 (neck length), with a mean heritability of 0.58. Costa *et al.* (1998), studying the Brazilian Pony estimated heritabilities between 0.24 (neck length) a 0.52 (shoulder height).

With the Andalusian horse (Molina *et al.*, 1999) the heritabilities obtained for body measurements were moderate to high (0.35 to 0.95), with estimates for conformation scores having lower values (0.03-0.50) while estimates of heritability ranged from 0.02 to 0.53 in the Haflinger horse (Samore *et al.*, 1997). These were somewhat higher than those found in the Dutch Warmblood Riding Horse population (Koenen *et al.*, 1995) where the heritabilities of 26 linear conformation score traits ranged from 0.09 to 0.28.

It can be noticed that the tendency in most cases is towards medium to high heritability while individual values within breeds vary greatly due to different selection criteria and management systems within each breed. As several different technicians carry out the registration, errors in the measurement may have occurred and should be taken into consideration.

Several measures of genetic correlation were found to be high, except those correlated with the perimeter of the thorax, where the results were in general low and sometimes negative. Other noted a similar tendency towards high genetic correlations between linear measures in horses. In the Brazilian Pony Breed, genetic correlations varied between 0.32 and 1.00 (Costa *et al.*, 1998), the lowest between dorsal-lumbar length and chest width while the largest was between neck length and body length. For the Mangalarga Marchador Zamborlini (1996), found genetic correlation between the height of the shoulder and hip height of (0.90) and hip height and body length of (0.70). In general these results indicate that selection for one of these traits will result in an increase in the general size of the breed. These high correlations may be due to the same few genes acting on these traits but more likely are due to the low coefficient of variation for the traits measured and may be related to individual preferences of the technicians who took the measurements. The correlation between hip and shoulder heights in this study was 1.00. This is important since the animal depends on these traits for resistance to long arduous treks. Disequilibria may cause an opening of the joints in the anterior and posterior limbs, thereby damaging the skeleton

of the animal (Zamborlini, 1996). The phenotypic and genetic correlations estimated within the Andalusian horse (Molina *et al.*, 1999) were all positive. The genetic correlations in this case ranged between 0.11 and 0.94 for body measurements and between 0.12 and 0.91 for conformation scores.

Inbreeding coefficients were low, with a mean of 8 percent for five animals that were inbred. This may be due to the fact that many animals lack a complete parentage and also the first registers of parentage began in 1991. This means that few generations were available and this may not represent a true picture of what is occurring within the breed. The coefficient of variance for all traits was in general low (2 a 8 percent), which may indicate future problems with lack of variance within the breed. This was also found by Miserani *et al.* (2002) on an earlier group of data on this breed and may also be a reflection of the low number of stallions registered by the Breeder's Association (according to Santos *et al.* (2000), 300 males were registered between 1971 and 2000) or the fact that the limits for registration are not adequate to the reality of the breed. The overall body shape is referred to as conformation. It is basically the result of many heritable traits, although environmental factors help shape the horse's body.

Although concepts of perfect conformation vary among breeds, all breed registries agree that the overall quality and balance of a horse's build should be symmetrical and proportional to its size (Martin *et al.*, 1978). Fontes *et al.* (1986) established the pattern for the Panta-neiro horse. For registration, the males must have at minimum of 1.40 cm and females 1.35 cm.

In terms of performance, specific favorable traits may outweigh the lack of perfection in other traits. In general, the Pantaneiro horse has body characteristics developed through natural selection. According to Martin *et al.* (1978), a horse should be judged by his ability to perform desired movements and functions, particularly if he is being selected for purposes other than breeding. When a breeder has set his goals and established minimum standards for desirable traits, he should make a more detailed study of pedigree, performance and conformation.

Today, the breeders are interested in selecting the Pantaneiro horse for expositions and auctions. Therefore the emphasis is on correct conformation and they have changed the natural environment, especially the diet, sometimes, without adequate criteria. The evaluation of genetic merit of the Pantaneiro horse population should include adaptability to the local environment, resistance against diseases and other traits balanced according to the intended use (Santos *et al.*, 2000). Bodó (1990) considers that the harmonization of selection and preservation is difficult and that they may be totally opposed to each other.

CONCLUSION

Heritability estimates found in this study were moderate to high, varying from 0.27 to 0.83, meaning that these traits should respond to mass selection. Most of the genetic correlations were

also high except for correlations with the perimeter of the thorax. The high genetic correlation means that selection for one traits should result in an increase in the other traits of interest. Inbreeding levels were low and careful control of this factor is necessary to maintain these levels.

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