ESTIMATES OF GENETIC CORRELATIONS BETWEEN CARCASS AND GROWTH TRAITS AND SCROTAL CIRCUMFERENCE IN NELORE CATTLE

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INTRODUCTION

The demand for high quality meat and the competition with other protein sources imposes the introduction of new technologies in the Brazilian beef cattle system of production. Most of breeding evaluation programs in Brazil, have given emphasis to records of weights and scrotal circumference (SC) at different ages, ignoring carcass traits (CT) and other growth traits. Carcass traits can be quickly determined by real-time ultrasound, without the need to slaughter the animals and without assigning visual scores, being therefore, an objective process, enabling estimates of genetic values in young animals before the first mating. Herring *et al*. (1998) pointed out that this technique is an objective and accurate tool in the selection for muscling, subcutaneous fat, marbling and retail beef yield. Considering the possibility of reaching new markets and the increasing demand for better meat quality, CT and hip height (i.e., frame score) certainly should be included in the Brazilian breeding programs. In this way, the objective of the present work was to study how these traits respond to selection and their possible genetic correlations with weight and SC at different ages.

MATERIAL AND METHODS

Data. The present work was developed with breeders from the Program of Genetic Improvement of the Nelore Breed - Nelore Brazil (PGINB). Carcass traits (CT) evaluated were, longissimus muscle area (ULMA) and backfat thickness (UBF), both measured between the 12th and 13th ribs, and rump fat thickness (URF) measured at the juncture of the *Gluteus medius* and *Biceps femoris* muscles, between the hooks and the pins. Images were collected using an Aloka 500V, with a 17.2-cm, 3.5-MHz probe (Aloka Co. Ltd., Tokyo, Japan) and an acoustic coupler with an image capture system (Blackbox, Biotronics, Inc., Ames, IA, EUA). On the date of scanning the weight (WS) and hip height (HH) were also obtained. Carcass traits, HH and WS were measured from 2002 to 2004, in approximately 2,590 animals, with ages varying from 450 to 599 days, males and females, distributed on ten ranches across six Brazilian states. Also, records of standardized weight at 120, 210, 450 and 550 days of age (W120, W210, W450 and W550) and standardized scrotal circumferences at 365, 450 and 550 days of age (SC365, SC450 and SC550) were obtained from the PGINB data set, with animals born from 1998 to 2003 on all of the ranches. In the verification of the data, records three standard deviations greater or lesser than their respective contemporary group (CG) means for any trait were judged to be outliers and deleted. In general, CG that contained less than five animals were eliminated. Contemporary groups were defined as animals of the same year and season of birth, herd, sex and management group.

Statistical analyses. The components of variance were estimated with the MTDFREML (Multiple Trait Derivative - Free Restricted Maximum Likelihood) software, developed by Boldman *et al*. (1995), in two and three-trait analyses using an animal model. The relationship matrix for each trait had ancestors that were traced back three generations to generate a pedigree matrix of 36,133 animals. The model for all traits included random animal genetic effect and GC as fixed effect. For traits measured until one year of age, as W120 and W210, random effects of maternal genetic and permanent environment were added to the model. The covariates, age of animal at scanning (linear effect - 450 to 599 days) and age of dam (linear and quadratic effects - 23 to 283 months) were considered for UBF, URF, HH and WS. For ULMA only age of animal at scanning covariable was kept in the model. The fixed effect of the class of dam (six classes), was included in W120 and W210 models. Scrotal circumferences were analyzed considering or not the standardized-weight at the respective ages as covariable (linear and quadratic effects) in the model.

Using the genetic and phenotypic parameters estimated in this work, direct and correlated responses between some traits were predicted. The same intensity of selection for males and females, that is i=1 (38% of individuals selected for reproduction), was used.

RESULTS AND DISCUSSION

The heritability (h^2), environmental correlation and genetic correlation (r_g) estimates are presented in Tables 1 and 2. The h^2 (Table 1) were of moderate to high indicating that these traits should respond to selection. Several authors have reported estimates of h^2 close to these values for *Bos taurus* as well as *Bos indicus* (Reverter *et al*., 2000, Cyrillo *et al*., 2001, Wilson *et al*., 2001a and b and Sainz *et al*., 2003).

Table 1: Estimates of heritability (diagonal), environmental (below) and genetic (above) correlations in Nelore cattle

Traits	ULMA	UBF	URF	HH	SC365	SC450	SC550
ULMA (cm^2)	**0.35**	0.06	-0.04	0.05	-0.11	0.00	0.00
UBF (mm)	0.19	**0.52**	0.74	-0.32	0.14	0.14	-0.12
URF (mm)	0.16	0.48	**0.40**	-0.41	0.10	0.11	0.00
HH (cm)	0.27	0.35	0.39	**0.63**	-0.19	-0.24	0.00
SC365 (mm)	-0.01	-0.34	-0.13	-0.04	**0.48**	0.96	0.76
SC450 (mm)	0.03	-0.46	-0.17	0.18	0.72	**0.53**	0.91
SC550 (mm)	0.26	-0.05	0.17	0.13	0.46	0.71	**0.42**

The genetic correlation estimate between ULMA and the two traits of subcutaneus fat were low, close to zero, indicating that these traits are determined by different groups of genes, and the selection for ULMA should not cause antagonism in the genetic improvement of UBF and URF. When there is interest in selecting for subcutaneus fat as well as for ULMA, it would be better to use an economic selection index incorporating these traits, as appropriate to the selection objectives specific for the production system and/or market.

Table 2: **Estimates of genetic correlations in Nelore cattle**

Traits	ULMA (cm^2)	UBF (mm)	URF (mm)	HH (cm)
WS (Kg)	0.58	0.19	-0.09	0.72
W120 (Kg)	0.53	-0.03	-0.12	0.68
W210 (Kg)	0.62	-0.11	-0.09	0.64
W450 (Kg)	0.64	0.00	0.02	0.58
W550 (Kg)	0.64	0.06	0.03	0.59

The UBF and URF are determined, largely, by the same groups of genes, however, selection for URF should produce a correlated genetic gain in UBF, that would be only 63% of the gain that would be obtained by direct selection for UBF. Therefore, selection for both traits (UBF and URF) is required, particularly because subcutaneus fat has shown little uniformity on the carcass. The estimates of r_g between the CT are in agreement with others described in the literature (Reverter *et al*., 2000, Wilson *et al*., 2001a and b and Sainz *et al*., 2003). The r_g of HH with ULMA was close to zero and negative and moderate with UBF and URF. These results indicate that selection for taller animals tend to produce animals with less subcutaneous fat, i.e. later-maturing in terms of carcass finish. Waldner *et al.* (1992) estimated r_g between ULMA and HH similar to this study, however, the r_g between HH and UBF reported by those authors was close to zero (-0.07).

The r_g between CT and scrotal circumference standardized for weight at different ages (365, 450 and 550 days of age) were close to zero, indicating that selection for these CT will not result in antagonistic effects on SC and vice versa. Considering that SC is used as an indicator trait for sexual precocity, it could be expected that sexually precocious animals would begin carcass fat deposition earlier. Thus, a positive r_g between SC and subcutaneous fat would be anticipated, at least at younger ages, but this was not confirmed by the present study (Table 1). The r_g between CT and SC estimated in this study agreed with those reported by Wilson *et al.* (2001b) in *Bos taurus*, around 0.06.

When SC was not adjusted for weight, the estimated of r_g (not shown) with traits of subcutaneous fat (UBF and URF) changed very little staying close to zero. Larger changes were obtained in the estimates of the r_g of SC at 365 and 450 days of age with ULMA, 0.28 and 0.24, respectively. These values are similar to those described by Johnson *et al.* (1993) for Brangus breed animals.

Weights at the different ages genetic correlation estimates (Table 2) were moderate and positive with ULMA and close to zero with subcutaneous fats (UBF and URF). Genetic correlation estimates described in the literature, between CT and weight on scan date, at both yearling and weaning ages, are close to those estimated in the present study (Waldner *et al*., 1992 and Wilson *et al*., 2001a and b). The r_g estimates obtained in this study indicated that selection for weight should increase ULMA in the medium or long term, as a correlated response. However, faster responses to increase ULMA will be obtained by direct selection for this trait, e.g. selecting for W210 or W550, the correlated responses for ULMA should be 39% and 24% smaller than the responses expected from direct selection for ULMA. Nevertheless, selection intensity should be larger for weight, given that weight measurements are easy and of low cost, allowing a larger number of animals to be recorded.

CONCLUSION

The heritabilities estimated in the present study indicate that these carcass traits and hip height show genetic variability in Nelore breed and could be included in animal breeding programs. There are no genetic antagonisms between weight, scrotal circumference and carcass traits. The long term selection for weight should increase longissimus muscle area and selection for increasing hip height might decrease subcutaneous fat as correlated responses. Therefore, to obtain animals with moderate stature, better yield grade and carcass fat cover, it is necessary to develop an economic selection index incorporating these traits.

ACKNOWLEDGEMENTS

This work was supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq-Brasil), AVAL, PRONEX, Universidade Estadual Paulista (UNESP / Jaboticabal-SP), Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) and Associação Nacional de Criadores e Pesquisadores (ANCP / Ribeirão-Preto-SP). The authors express their appreciation to Bacuri, OMB, HORA, Rancho da Matinha, Colonial, São Dimas, Remanso, Passa Quatro and Santa Marta ranches for the use of their data to conduct the analysis.

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