ESTIMATES OF GENETIC PARAMETERS FOR AGE AT FIRST CALVING AND SCROTAL CIRCUMFERENCE IN A BEEF CATTLE CROSSBRED POPULATION

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INTRODUCTION

The anticipation of age at first calving can have an important effect on the efficiency and profitability of beef cattle production. The heifers that begin reproductive life at early ages can have a longer productive life (Martin et al. 1992).

The age at first calving is an easy trait to measure and does not demand a differentiated management to be obtained. However, the short breeding season, and the producer’s habit of specify an age or weight to expose heifers to the first mate, probably reduces the additive variance and heritability for this trait. Sexual precocity has been selected through indicative traits such as scrotal circumference. This trait has a moderate heritability can be easily measured in large herds and it is associated with puberty of males and females.

The aim of this study was to estimate genetic parameters for age at first calving and scrotal circumference in a crossbred population involving Angus, Hereford and Nelore breeds.

MATERIAL AND METHODS

Scrotal circumference (SC) and age at first calving (AFC) records obtained between 1981 and 2000, from two breeding programs, located in 8 different states of Brazil, were used. Natura Group provided Angus and Nelore breeds data while data of Hereford and Nelore breeds came from Delta G Connection Group.

Only one estimate of individual heterosis was obtained for the two groups of data considering them as European-Zebu crossing. The effect of individual heterozigosity was included in the model as covariable to estimate heterosis.

Preliminary statistical analysis for fixed effects, were carried out by the minimum squares method, using GLM procedure of SAS (Statistical Analysis System, 1998). Analysis for AFC were performed using 96.145 heifers offspring of 999 sires and 75.904 dams. Females that failed to calve until 40 months of age received a fixed value of 52 months for AFC. Records from 19.957 yearling bulls, born between 1991 and 2000, from 693 sires and 17.843 dams, were used for the scrotal circumference analysis.

The models for AFC and SC traits included fixed effects of contemporary group (CG), the linear effect of individual heterozigosity (Hi) and genetic composition (fraction of genes of Angus breed (CA) and fraction of genes of Hereford breed (CH). For AFC the model included, in addition, linear and quadratic effects of age of dam (AD) as covariable. For SC two models
were used: 1- the linear and quadratic effects of age of bull (AGE) and yearling weight (YW), were added to the model; 2- YW was excluded from the model.

The contemporary group (CG) for both traits was defined by the following variables: year, season, herd and management group of birth, weaning and yearling. In addition mating type (artificial insemination, single mating or multiple sires) was included for AFC contemporary group. CG with less than 10 animals and/or including only animals with the same genetic composition were deleted. Variance components were estimated by restricted maximum likelihood applying an animal model single-trait analysis, using MTDFREML algorithm (BOLDMAN et al., 1993).

RESULTS AND DISCUSSION

Age at First Calving. Age at first calving mean was 31 months. The age of dam effect (linear and quadratic) did not significantly influence AFC (P<0.05). This result agrees with that reported by Smith et al. (1989) analysing age at puberty and age at first calving in Angus, Hereford and Red Angus breeds.

Age at first calving was significantly affected by CG, Hereford composition and individual heterozygosity (P<0.05). Regression coefficient for additive effect of Hereford breed (-1.16) indicated more precocity for Hereford than for Nelore breed. On average, Hereford purebred animals calved 35 days earlier than Nelore purebred animals. An unexpected positive regression coefficient for additive effect of Angus breed (+0.57) occurred. This indicated that Nelore breed was 17 days, on average, more precocious than Angus breed. These results may be explained by differences in environmental conditions. Animals from Natura group are located mainly at Central-Brazil, a tropical region with high temperatures. In this region the environmental conditions may favour the Nelore breed. In contrast, Delta G Connection Group animals are located mainly at South of Brazil. This region is characterised by temperate climate and pastures and, in this case, the environmental conditions may have favoured Hereford animals.

Estimated heterosis was 3%, i.e. F1 animals calved, on average, about 15 days earlier than Nelore heifers. The low heterosis could be an effect of nutrient restrictions.

Scrotal Circumference. Scrotal circumference mean was 29 cm with a standard deviation of 3.6 cm. All the effects included in the model of analysis, significantly influenced (P<0.001) SC. The additive effect estimates for AC and HC, 4.01 and 2.83 respectively, indicated that British breeds had larger SC compared to Nelore purebred animals.

Estimated heterosis was –0.33 (1.14%) with yearling weight in the model of analysis and was +0.95 (3.27%) without YW in the model. Probably, including YW in the model, part of the genetic differences among breeds for SC is removed due to the genetic correlation between SC and YW. Future research is necessary to verify this result.
Genetic parameter estimates. Variance component and heritability estimates for age at first calving and scrotal circumference are on table 1. The $h^2$ estimate for AFC was low. Similar heritability estimates have been reported by Garnero et al. (1999) and Dias (2000) for Nelore breed (0.15 and 0.16, respectively). This low heritability estimate could be partially attributed to management practices. Most of the farmers apply a short breeding season and specify a certain age and/or weight to mate the heifers. Furthermore, limited nutrient availability in some regions, may have contributed to increase environmental variation in these data. Lately, other traits, such as probability of pregnancy, that overcome some of these difficulties, have been used for genetic evaluation of beef cattle (Eler et al., 2002).

Table 1. Variance components and heritability estimates for age at first calving (AFC) and scrotal circumference (SC)

<table>
<thead>
<tr>
<th>Traits</th>
<th>$\sigma_a^2$</th>
<th>$\sigma_e^2$</th>
<th>$h^2$ ($\pm$ SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFC</td>
<td>3.91</td>
<td>35.26</td>
<td>0.10 $\pm$ 0.01</td>
</tr>
<tr>
<td>SC (without YW)</td>
<td>1.46</td>
<td>5.08</td>
<td>0.22 $\pm$ 0.03</td>
</tr>
<tr>
<td>SC (with YW)</td>
<td>1.36</td>
<td>4.14</td>
<td>0.25 $\pm$ 0.03</td>
</tr>
</tbody>
</table>

$\sigma_a^2$ additive genetic variance; $\sigma_e^2$ residual variance; $h^2$ heritability, SE standard error; YW covariable.

The $h^2$ estimates for SC were moderate. Estimates obtained by the two models were similar. However, the environmental and additive genetic variances increased by 22.7% and 7.3%, respectively, when YW was removed from the model. Dias (2000), for SC of Nelore bulls, also found that including YW as covariable in the model increased heritability estimates.

CONCLUSIONS
Additive genetic variance indicated that direct response to selection for age at first calving would be inefficient. Scrotal circumference genetic variances and estimated heterosis were different depending on the inclusion or not of YW in the model. Future work shall verify if SC adjusted or not for YW are the same trait and their relationships with AFC.

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