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Body condition score of Nelore cows and its relation with mature size and gestation length

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ABSTRACT

The objective of this study was to evaluate the genetic variability of body condition score (BCS) in Nelore cows, and analyze its genetic correlations with mature weight (MW), mature height (MH) and gestation length (GL), in order to obtain information supporting the possible use of this score in breeding programs. The BCS was recorded on pregnancy diagnosis and ranged from 1 (very thin) to 5 (extremely fat). Adjusted means for MW, MH and GL according to the BCS classes were obtained using an univariate mixed model for each trait. Bayesian Inference using Gibbs Sampling was applied to estimate (co)variances components and genetic and phenotypic correlations, in two-trait analyses, considering a threshold animal model for BCS and a linear animal model for the other traits. Adjusted means for MW, MH and GL showed significant variation ($p < 0.0001$) among BCS classes, indicating that cows with higher BCS have greater mature size, assessed by MW and MH measures, and longer GL than those with lower BCS. The BCS showed genetic variability, with posterior mean heritability of 0.23 ± 0.05. Genetic correlations between the BCS with MW, MH and GL were 0.41 ± 0.04; -0.06 ± 0.03 and 0.10 ± 0.02, respectively. Selection based on BCS should result in gain for body condition and, by indirect response, in changes in the same direction for cows MW. However, selection for BCS has little or no effect on MH and GL. So that BCS can effectively be used as a selection criterion of beef cows, further studies should be performed in order to obtain genetic associations with other economic traits.

1. Introduction

Body condition score (BCS) is a subjective measure of animal ranking which is obtained by visual inspection of muscle mass and fat cover. Since BCS attribution permits to monitor the composition and energy balance of cows, this trait is commonly obtained in beef cattle herds in Brazil. For breeding programs, BCS may be useful as an indirect selection criterion for reproductive improvement, such as fertility, which is difficult to measure (Pryce et al., 2001; Baldi et al., 2008; Zink et al., 2011). Also, the BCS could be used to evaluate and select beef cows that remain in good condition or have ease of recovery after birth and weaning.

Mature size is an important trait in beef cattle breeding programs because of its strong association with dam maintenance cost (Jenkins and Ferrell, 1994). Supported on experimental results, Ritchie (1995) reiterated that each of beef cattle production system may require a specific biotype. Thus,

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under stress and food scarcity, the medium animal size should be preferred. Furthermore, large females may be less efficient in reproductive and physiological terms (Montaño-Bermudez et al., 1990; Owens et al., 1993) and are undesired, especially in production systems based exclusively on pastures.

One measure commonly used as an indicator of size is mature weight (MW), mainly because of its easy measurement and inclusion in management practices. However, since the weight of animals raised under extensive conditions can exhibit periodic fluctuations, hip height could be included in the measures obtained routinely. At present, indicator traits of mature size, such as weight and height, and the BCS of cows are usually not directly considered as selection criteria for pasture-raised beef cows.

Gestation length, although not exactly a fertility measure, it is closely related to the reproductive period. Cows with shorter gestation have more time to postpartum recovery and are able to conceive earlier (Chud et al., 2014). In addition, shorter gestation periods are associated with lower birth weights and greater calving ease (Hansen et al., 2004; Jamrozik and Miller, 2014). Thus, this trait can be used as an aid in selection process.

In a review study, Roche et al. (2009) reported a relative consistency in the associations among BCS with milk production, fertility and health traits, although the strength of the association may vary. In the same way, Zink et al. (2011) concluded that Holstein dairy cows genetically predisposed for low body condition score were generally inferior in fertility.

Using data from Holstein cattle, Pryce et al. (2000) reported a negative genetic correlation (-0.40) between BCS and first calving interval. Similarly, Pryce et al. (2001), using data from a small experimental herd, found genetic correlations ranging from -0.10 to -0.59 between BCS obtained in week 10 after calving and calving interval for Holstein cows. Considering the difficulty in measuring fertility in cattle and since indicator traits of fertility such as calving interval show low heritability, the authors suggested BCS to be a useful indirect means of selection to improve the fertility of dairy herds.

Vargas et al. (1999) studied BCS of Brahman cows evaluated on a scale from 1 to 9. The authors observed differences in reproductive performance among BCS classes of heifers submitted to first breeding at 2 years of age, with the number of days to calving being higher in heifers with lower scores compared to animals with a BCS of 6 or 7. Using *Bos taurus* crosses, Spitzer et al. (1995) showed that BCS of primiparous cows are related to calf birth weights, interval from calving to the onset of estrus, and pregnancy rate during a breeding season.

In Brazil, using body condition data from 1831 Nelore cows that are part of the selection experiment conducted at the Animal Science Experimental Station in Sertãozinho, Mercadante et al. (2006) obtained genetic correlations of 0.37 ± 0.09 and -0.15 ± 0.10 for BCS with weight and hip height at the beginning of the breeding season, respectively. Furthermore, these authors estimated a favorable genetic correlation (-0.40 ± 0.12) between BCS and days to calving. These findings justify the inclusion of BCS, together with female reproductive traits, in a selection index to increase the fertility of beef cows.

Most of the researches described in the literature for BCS were conducted with *B. taurus* dairy cattle. Studies investigating the BCS of beef cows and their correlations with measures of adult size and gestation length are still limited. Therefore, the objective of the present study was to evaluate the genetic variability in the BCS of Nelore cows, as well as to analyze its genetic correlations with mature weight, mature height and an indirect reproductive trait (gestation length) in order to obtain information supporting the possible use of this score in breeding programs.

2. Material and methods

2.1. Data description

This study was conducted with information from 31,150 Nelore females, daughters of 1616 sires and 27,374 cows, born between 1984 and 2010. The dataset used included information of 260 farms belonging to a single database called Aliança Nelore, which uses standard basic procedures of data collection and storage. The cows were raised in grazing systems and received only salt and mineral supplementation.

Records of body condition score (BCS), mature weight (MW), mature height (MH) and gestation length (GL) were used. The BCS of cows was assigned in pregnancy diagnosis by trained evaluators and were assigned according to the average of the contemporary groups, ranging from 1 (very thin) to 5 (extremely fat). Therefore, the score was relative to each contemporary group, and not an absolute predefined condition.

The MW and MH are measures used to infer about the mature size of cows. A single measurement of each trait was used. The MW was taken using an appropriate electronic weighing balance, in kilogram. The MH, expressed in centimeters (cm), was obtained with a metric tape as the distance from the ground to hip. The GL is the number of days between conception and birth.

2.2. Contemporary groups

The contemporary group (CG) was formed by farm, birth year and year and month of weight or measurement. For GL was also considered the sex of calf in the CG. For all traits, sires with less than four progenies and CG with less than five observations were removed from the final data set. In addition, MW, MH and GL measurements exceeding 3.5 standard deviations above or below the average of the respective CG were eliminated. As proposed by Harville and Mee (1984), records for the categorical trait BCS of CG in which all scores were the same, i.e., groups without variability, were also eliminated. The complete pedigree used to build the relationship matrix contained the animal, sire and dam identifications, consisting of 231,890 animals. A general description of the data set used in this study is shown in Table 1, and the distribution for BCS in Fig. 1.