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Genetic parameters for test-day milk yield, 305-day milk yield, and lactation length in Guzerat cows

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ABSTRACT

Milk production in tropical environments requires the use of crossbreeding systems including breeds well adapted to harsh conditions, but with lower productivities when compared to specialized breeds. Besides the genetic improvement for milk production, lactation lengths also need to be studied for most of these breeds. Accordingly, genetic parameters were estimated for 305-day cumulative milk yield (MY305), test-day milk yield (TDMY), and lactation length (LL) using information from the first lactations of 2816 Guzerat cows selected for milk production in 28 herds in Brazil. Contemporary groups were defined as herd, year and season of the test for TDMY, and as herd, year and season of calving for MY305 and LL. Variance components were estimated with the restricted maximum likelihood method under a multi-trait animal model. Heritabilities estimated for TDMY ranged from 0.16 to 0.24, and were 0.24 and 0.12 for MY305 and LL, respectively. Genetic correlations were high and positive, ranging from 0.51 to 0.99 among TDMY records, from 0.81 to 0.98 between each TDMY and MY305, and from 0.71 to 0.94 between each TDMY and LL. Genetic parameters obtained in this study indicated the possibility of using test-day records for the prediction of breeding values for milk yield in this population of the Guzerat breed. The use of TDMY as selection criteria would result in indirect gains in MY305 and LL. However, the highest response to selection for MY305 would be obtained by direct selection for this trait.

1. Introduction

The extension of Brazil includes the Equator and the Tropic of Capricorn. Thus, there are regions with tropical, subtropical or temperate climates, the last being only in the extreme south of the country. The topography is variable, but usually suitable for cattle breeding. The predominance of the tropical climate imposes management and breeding techniques that differ from what is used for herds in temperate climates, mainly in regard to the use of pasture based systems. Crossbreeding strategies, including *Bos taurus* and *Bos indicus* breeds, are important to achieve the equilibrium between productivity and adaptability of animals to the harsh conditions prevalent in this country.

Nowadays there are a number of elite zebu (*Bos indicus*) herds in Brazil which can provide crossbreeding schemes with genes contributing to milk yield improvement, in addition to the already expected adaptability to harsh conditions. However, some cows tend to drastically decrease milk yield, or even cease lactation much earlier than 305 days, as opposed to what often happens with

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Bos Taurus breeds in temperate systems. This brings a concern about lactation lengths in production systems using zebu animals, which needs to be properly addressed. As published by Peixoto et al. (2012) in the annual dairy genetic evaluation report for the Guzerat breed in Brazil, for instance, the average lactation length was 273 days.

From the Zebu breeds imported to Brazil, the Guzerat is the second most used in milk production systems. Good adaptability to produce under tropical conditions and a high percentage of solids in its milk are some common features of this breed. In addition, the Guzerat breed is often used in crossbreeding for the formation of animals adapted to the tropical conditions of Brazil which are able to maintain economically viable production levels of milk and meat. The Brazilian Breeding Program of Dairy Guzerat Cattle (PNMGuL) has used cumulative milk yield records truncated at 305 days of lactation (MY305) for the genetic evaluation of milk production, while it has been designed to serve the breeders interest on the dual purpose of the breed (Peixoto et al., 2010).

Test-day milk yield (TDMY) is the measurement of the milk produced by a cow over a period of 24 h (Schaeffer and Jamrozik, 1996). Comparisons between lactations models and test-day models for the genetic evaluation of dairy bulls from European breeds can be found in the literature under various perspectives. Schaeffer et al. (2000) presented the Canadian experience with the implementation of test-day models for their national genetic evaluation. They exploited details about the process of changing from a system where 305-days lactations yields were considered as repeated measurements of the same trait and a standard lactation curve was assumed for each cow to a system where each lactation was considered to be a separate trait, where a cow could have different shapes for each lactation curve, and the analyses were on test-day yields. One important discussion within that study was about the extensive efforts that would be required for the producer's acceptance on the changes of methodology and ranking of sires. El Faro and Albuquerque (2003) pointed out some potential advantages for the test-day models, like a better consideration for the systematic effects influencing specific periods of the lactation, which would be intangible under lactation models, or the possibility of inclusion of information from lactating animals. Nevertheless, they concluded that better genetic improvement would be expected from the selection using genetic values obtained under a lactation model, specifically for the Caracu population from their study.

Referring to the Zebu breeds, some studies have been conducted referring to estimates of genetic parameters and comparisons among lactation, repeatability, or random regression models with the Gyr breed (Costa et al., 2005; Herrera et al., 2008; Ledic et al., 2002). Freitas et al. (2010) estimated genetic parameters for TDMY and persistency of lactation measurements for a Guzerat population in Brazil, using random regression models. Nevertheless, studies are still scarce for the Guzerat breed.

The objectives of the present investigation were to estimate variance components and genetic parameters for test-day milk yields (TDMY), their associations with cumulative milk yield (MY305) and lactation length (LL), and expected genetic gains and correlated responses to selection. Those parameters are intended be valuable as a basis for future studies on selection using test-day models within a population of first lactating Guzerat cows.

2. Material and methods

The original data file included 25, 365 test-day records from 3538 first lactating Guzerat cows, with age ranging from 23 to 65 months. Lactations with any interval bigger than 75 days between measurements, from calving to drying off, or with records outside the range between ± 3 standard deviations from their contemporary group averages have been removed. The final data file contained 20,524 test-day records from 2816 Guzerat cows, daughters of 371 sires, and belonging to 28 herds. Calving occurred from 1987 to 2009, with this period depending on each herd. Among these cows, there were 2631 with both parents known, 21 with only the sire known, 37 with only the dam known, and 127 with no pedigree information. Considering data used in test-day analysis (TDMY1–TDMY10), sires had an average progeny size of 7.15 and the average number of contemporary groups was 339.5. Number of animals in the average relationship matrix contained 4,148 animals. All information was obtained from the archives of the PNMGuL, a program coordinated by Embrapa Dairy Cattle in partnership with the Brazilian Center for the Genetic Improvement of the Guzerat breed (CBMG) and the Brazilian Zebu Breeders Association (ABCZ).

Test-day records obtained between day 6 and day 305 of lactation were considered in the analyses. Cows whose LL exceeded 305 days had their production records truncated at the last test-day before 305 days. The TDMY were then divided into monthly classes according to days after calving, for a total of 10 classes (TDMY1–TDMY10). Only data from cows with at least four test-day records were maintained. Numbers of observations, means and standard deviations of milk yield and days of lactation, calculated for TDMY1–TDMY10 and MY305 are shown in Table 1.Average lactation length among cows considered in the test-day analyses, was 273.14 days, with a standard deviation of 59.62 days. The frequency distribution of lactation lengths is shown in Fig. 1. Because lactation lengths are short, drying-off is usually done when cows reach low yield levels.

The contemporary groups for MY305 and LL were defined by the concatenation of herd, year and season of calving, and those for TDMY by the concatenation of herd, year and season of test. Seasons were classified into wet (October until March) or dry (April until September).For all traits, contemporary groups that contained fewer than three observations were eliminated.

Variance components were estimated simultaneously for the 12 traits by the restricted maximum likelihood method, under multi-trait animal models, using the Wombat program (Meyer, 2006). For the test-day traits, the model included additive genetic random effects, the fixed effect of contemporary groups, the linear and quadratic regressions of the covariate age at calving and the linear regression of the covariate days of lactation.