Genetic Effects On Milk Production And Weight In A Cattle Population In Tropics

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Introduction

Carora is a short-horned *Bos taurus* cattle breed raised in Venezuela and other Southern American countries, mainly for milk production (ASOCRICA (2007)). It is a synthetic breed developed in west-central Venezuela by using Brown Swiss semen on the local Criollo population (Ganado Criollo de Quebrada Arriba). Its origins can be traced back to the 1930's and it was declared to be a breed by the Venezuelan Government in 1975 (Morales et al. (1989)). Carora cattle are bred in a tropical environment with a large range of average temperatures, with relative humidity up to 90%.and under different production systems, from extensive systems, characterized by grazing and manual milking in the presence of the calf, to intensive systems with high yields, machine milking, and feed supplementation. The primary selection objective is improving milk production in terms of quantity and quality. Since 1995, Carora bulls have been used in Holstein herds to obtain a crossbred and more productive animal adapted to the tropical climate. In addition, Carora bulls are mated today to *Bos. indicus* cows with the aim of obtaining dual-purpose animals (Cerutti et al. (2006); Caroli et al. (2008)).
The object of this study is to evaluate both the additive and non-additive genetic effects on the milk production and on weight at 18 months and the genetic parameters for the two traits in Carora and dual purpose cows in tropical environment.

Material and methods

1781 weights at 18 months (W18), for 1245 Carora and 356 crossbred cows were collected from 1992 to 2006 on 21 herds of the central-west part of Venezuela. For these cows, 4844 milk yields (MY) at 305 days were collected in the same period, but the number of herds increased to 27.
For each animal, information relative to the herd, the year and the month of calving/weighting, and the proportion of breed genes were available.
Months were pooled in three seasons: the dry season from December to March, the wet season from May to August and the transition season that included the remaining months.
Breeds involved in the sample composition were Carora (CAR), Criollo (CRI), Holstein Fresian (HOL), Brown Swiss (BRO) and Zebu (ZEB) breed.

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For each animal the epistatic loss was calculated as 1-Σp^2,where *p* is the breed proportion, according Kinghorn (1980, 1983) who defined 'epistatic loss' as 'proportional to the probability that two non-allelic genes in the diploid individual are of different breeds'.
The crossbreds averaged between 0% to 54.69% of CRI breed genes, from 0 to 75% for HOL and BRO and from 0 to 100% for CAR and ZEB.(Co)variance components for W18, and MY, were estimated by a Multiple Trait Animal Model, that included the random genetic additive effect, the fixed effects of the herd, the year, the season of weighting/calving, the direct breed effects, considered as the deviation from Carora breed, the epistatic effects (Kinghorn (1980)) and only for the MY model the permanent environmental as random effect and the age of calving as fixed effect. Pedigree information for these analyses included 203 sires and 1479 dams for a total of 4432 animals. All analyses were performed with VCE.6 software (Neumaier et al. (2008)).

Results and discussion

Descriptive statistics for weight at 18 months and milk yield are in table 1

TRAIT	N	Mean	Standard Deviation	Coefficient of Variation
W18 (kg)	1781	293.45	48.09	16%
MY (kg)	4844	3011.93	1157.00	38%

Table 1 Means, standard deviations and coefficients of variation for weight at 18 months (W18) and milk yield (MY)

Their heritabilities, genetic and phenotypic correlation with the relative standard errors are reported in table 2.

	W18	**MY**
W18	**0.32 (**0.03)	0.50 (0.08)
MY	0.14	**0.23** (0.03)

Table 2 Heritability (diagonal), genetic (upper) and phenotypic (lower) correlations of weight at 18 months (W18) and milk yield (MY) with relative standard errors in parenthesis .

Results from the analysis relative to weight at 18 months and milk are similar to those found in literature for dairy cattle in tropical environments: heritability of body weight (0.32 ±0.06) is in agreement with values reported by Araguren-Mendez et al.(2006), who found values of 0.38 ± 0.10, while the heritability of the milk (0.23 ± 0.03) is close to value of 0.25 found by Syrstad et al. (1993).
Genetic and phenotypic correlations differed from that ones reported elsewhere in the literature. Genetic correlation, 0.50 ± 0.08, was higher than value of 0.34 reported for dual purpose cows (Salgado et al. (2008)). Vercesi Filho et al. (2006) found a negative correlation (-0.22 ± 0.22) between milk and weight in crossbred dairy cattle in Brazil.
The phenotypic correlation (0.14) is positive and higher than that reported by Vercesi Filho et al. (2006), who found a negative phenotypic correlation (-0.13).
Repeatability for milk, 0.37, can be included in the range of repeatability of tropical breeds reported by Syrstad (1993).

Heterozigosity and breed effects for weight and milk yield are reported in table 3.

	W18	MY
Epistatic loss	-3.28	490.05
Breed effect:		
CRI	-0.034	-10.623
HOL	-0.013	3.711
BRO	-0.003	3.331
ZEB	-0.016	-2.849

Table 3 Heterozigosity and breed effects for weight and milk yield

Results of the analysis show an important difference between the W18 and the MY. The value of -3.28 for weight indicates that for an increase of 1% of epistatic loss, there is an expected decrease in W18 of 0.03 kg., while, in the opposite way, for milk the increase in epistatic loss corresponds to an increase of 4,9 kg of milk. In other words, if an animal is not purebred milk yield is expected to increase up to 490 kg.
Breed effect plays a more important role on the milk yield than on the weight at 18 months. In general, the breed of the animal have a small effect on weight and these results could be due to the small differences in the size of the animals involved in this analysis. However, when the direct effects of the breed are not considered, the epistatic loss value falls to -9.04 kg and this suggests that the direct effects, even if small, affect the variability of the trait.
In contrast, for milk yield, there is an important breed effect. In fact, the substitution of 1% of Carora with Criollo genes lead to a decrease of 10.6 kg of milk. Direct Zebu breed effects were similar in sign but the decrease is smaller, 2 kg instead of 10, for an increase of 1% of Zebu genes.
The two European breeds (HOL and BRO) show similar results (3.711 and 3.331), that is, the substitution of 1% of CAR with HOL or BRO genes leads to an increase of milk production of about 3 kg. That is not surprising, because Holstein and Brown Swiss breeds are specialized in milk production and have been selected towards this objective for many years. Results are in agreement with that ones found by Kahi et al. (1998) and Montaldo et al. (2006), that reported the positive effects of the HOL breed in selection programs to improve milk yields in local populations.

Conclusion

Heritability both for weight and for milk yield were in the ranges previously reported for these two traits. Furthermore, a positive and average to high correlation between these two traits was found, indicating that selection for cows reared in tropical environments with high weight at 18 months, which corresponds to age at first insemination, may improve milk yield. Positive additive direct effects for milk yield were found for European breeds, but direct effects on weight were very small. Results relative to non additive genetics effects suggested that crossbreeding effects would be important to milk yield improvement.

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