Genetics Associations Between Reproductive Traits In Nelore Beef Cattle

C.C.P. Paz [1,2†]*, M.E. Buzanskas[3] H.L. Moreira[1], R.G. Zuin[3‡], R. P. Savegnago[3], R.B. Lôbo[2,4†], L.A.F. Bezerra[2,4] and D.P. Munari[3]

Introduction

Beef cattle production represents an important source for development of Brazilian agribusiness. The reproductive performance of the herds needs to be evaluated according to traits associated directly with the productive efficiency of the herds and as a result economic gain by decreasing beef production cycles. The age at first calving (AFC) is used in genetic evaluation of the Nelore cattle as indicator of the sexual precocity in females. The gestation length (GL) in the Nelore cattle genetic improvement program is assessed by days less than length of gestation, reflecting in favorable effect on reproductive and economic performance, because the weight of the calf at birth can be optimal, reducing the number of difficult calving by reducing birth weight, and increase of the reproductive efficiency of the cow. The present investigation aims to provide tools for the selection of Nelore breed animals participating in a cattle breeding program and obtain genetic associations for reprodutive traits.

Material and methods

Animals and data file. The present study was conducted using data on females of Nelore breed that participated in the Nelore Brazil Program, coordinated by the National Association of Breeders and Researchers (Associação Nacional de Criadores e Pesquisadores – ANCP). The reproductive traits studied in females were: birth weight (BW), age at first calving (AFC) and gestation length (GL). All femeales had been born between 1998 and 2008. An index was employed to select genetically superior males and females (Lôbo et al. (2000). This index includes breeding value estimates for the following weighted traits: maternal ability (0.20), pre-weaning gain (0.20), post-weaning gain (0.20), yearling gain (0.20), and scrotal circumference at 365 (0.10) and 450 days of age (0.10).

Data editing and contemporary groups. Preliminary analyses of all traits were performed to eliminate inconsistent data. A least square analysis, using the GLM procedure of the SAS

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1 Instituto de Zootecnia/APTA – SAA, Ribeirão Preto, SP, Brazil
2 Departamento de Genética, FMRP/USP, Ribeirão Preto, São Paulo, Brazil
3 Departamento de Ciências Exatas, FCAV/UNESP, Jaboticabal, SP, Brazil
4 ANCP, Ribeirão Preto, SP, Brazil
* E-mail address: claudiapaz@iz.sp.gov.br
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‡ CAPES fellowship

computer software (SAS 9.1, SAS Institute, Cary, NC, USA, 2003), aided in defining the fixed effects considered in the models. The birth season affect significantly ($P<0.05$) all traits and was defined as: rainy season, for animals born between October and March; and dry season, for animals born between April and September. For BW and GL, the contemporary groups (CG) consisted of animals belonging to the same farm and year and season of calf birth and sex of calf. For AFC, the CG considered the farm, year and season of birth and management group at 120, 365 and 450 days of age.

Assumptions for the fixed-effects model. Residual normality was verified for each trait using Guided Data Analysis - SAS (SAS 9.1, SAS Institute, Cary, NC, USA, 2003). Observations exhibiting a standardized residual 3.5-fold above or below the standard deviation were excluded.

Statistical analysis. Estimation of genetic parameters was performed using the Restricted Maximum Likelihood Method (REML) for bi-trait animal models, using the WOMBAT software, described by Meyer (2007). The relationship matrix included 182,161 animals. The mixed model used for BW was $y = Xb + Z_1a + Z_2m + e$, in which: y is the vector of the dependent variable; X is the incidence matrix for fixed effects, thereby associating the elements of b and y; b is the fixed-effects vector (contemporary group); Z_1 and Z_2 is the incidence matrix for direct and maternal random effects, thereby associating the elements of a and y; a is the random-effects vector for direct additive genetic effects; m is the random-effects vector for maternal genetic effect and e is the residual-effects vector. For AFC and GL, the maternal genetic effect was not included in the mixed model. For GL, the permanent environment effect was considered in the model. For BW and GL, a linear and quadratic effect of the covariate dam age was considered. The convergence criteria for all analyses were 1×10^{-9}.

Results and discussion

Means, standard-deviations, coefficient of variation, minimum and maximum values for BW, AFC and GL are presented in table 1. The mean for BW, AFC and GL were similar to that reported by Gunski et al. (2001). The variance components estimates and direct and maternal heritability coefficients and genetic correlations and respective standard errors obtained in bi-trait analyses for BW, AFC and GL are presented in table 2. Additive direct heritability coefficients for AFC found by Gunski et al. (2001), Pereira et al. (2000) and Gressler et al. (2000) were 0.15, 0.12 and 0.10, respectively. For GL, the median additive heritability estimated by Gunski et al. (2001) was 0.33, but in studies of Pereira et al. (2000), a low coefficient was estimated for this trait (0.13). For BW, the additive direct and maternal heritability estimates verified by Gunski et al. (2001) were 0.22 and 0.03 respectively. The estimates of heritability from literature were close of the estimated in this study, suggesting that all studied traits could be included in beef cattle improvement programs, because the direct selection for any trait could result in genetic progress. The genetic correlations between AFC, BW and GL, estimated in this study suggest that could be possible to obtain genetic gain by indirect selection, and that to use selection indices for these traits in addition to the productive traits, could be appropriate.

Table 1. Number of observations (N), mean, standard-deviation (SD), minimum (Min) and maximum (Max) values for birth weight (BW), age at first calving (AFC) and gestation length (GL) in Nelore cattle.

Trait	N	Mean	SD	Min	Max
BW (kg)	70,008	32.09	3.68	20.00	46.00
AFC (months)	13,294	35.16	4.98	21.00	49.00
GL (days)	24,947	296.49	5.87	276.00	314.00

Table 2. Estimates of genetics parameters in Nelore cattle[α]

Trait	σ_a^2	σ_e^2	σ_{pe}^2	σ_m^2	σ_P^2	h_d^2	h_m^2	r_a
AFC	2.79	12.14	-	-	14.93	0.19±0.01	-	
								0.08±0.01
GL	5.75	22.43	1.12	-	29.30	0.20±0.02	-	
BW	2.02	5.48	-	0.38	7.89	0.26±0.01	0.05±0.01	
								0.24±0.06
AFC	2.76	12.17	-	-	14.93	0.18±0.02	-	
BW	2.16	5.41	-	0.35	7.92	0.27±0.01	0.04±0.01	
								0.53±0.04
GL	6.51	22.42	0.60	-	29.53	0.22±0.01	-	

[α] direct additive genetic (σ_a^2), residual (σ_e^2), permanent environment (σ_{pe}^2), maternal (σ_m^2), and phenotypical (σ_P^2) variance, direct (h_d^2) and maternal (h_m^2) heritability coefficients (_s.e.) and genetic (r_a) correlation obtained in bi-trait analyses for birth weight (BW), age at first calving (AFC) and gestation length (GL)

Conclusion

The selection for AFC and GL could improve female reproductive efficiency and solve difficulty calving. Inclusion of both traits in the selection criteria for the Nelore Brazil Program is recommended, given the economical importance of the traits. Better phenotypic performances in these traits may also be achieved through changes in Nelore cattle management.

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