Genetic Association Between Temperament, Assessed By Reactivity In A Mobile Cage, Body Weight And Scrotal Circumference Of Nellore Cattle

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Introduction

Beef cattle industry in Brazil is based on zebu (*Bos taurus indicus*) genetics. Among zebu breeds, Nellore represents 83% of the population (ABCZ, 2008). Although Nellores are well adapted to the tropical environment and prevalent range production systems of the country, and have high fertility and weight gain, they are recognized as having more agitated and reactive temperament than European breeds.

Temperament of an animal may be defined as its behavioral response to handling (Burrow and Corbet (2000)). Compared to calm animals, agitated ones have lower weight gains, reproductive efficiency and milk production; produce meat of poorer quality; are more susceptible to diseases; cause more accidents and have higher maintenance costs (e.g. Burrow and Prayaga (2004); Nkrumah et al (2007); Cooke et al. (2009)).

Despite its importance, quantifying bovine temperament is not an easy task. Traditional traits that have been used either are measured in a categorical (scores) or continuous scale (running distance and flight speed). These methods have been mostly applied to European breeds or to European-zebu crosses, and have showed limitations when applied to zebu breeds in Brazil (Maffei et al. (2006)).

Animal reactivity measured in a mobile cage has been recently described as an indicator trait for bovine temperament. Measurements of reactivity are accessed by an electronic device that quantifies the intensity and the number of movements of the animal in a mobile cage, such as the ones used as weighting scale (Maffei et al. (2006)).

This study presents estimates of heritability for reactivity measured at weaning, yearling and post-yearling ages, and of genetic correlations between these measurements of reactivity, body weight and scrotal circumference of Nellore cattle.

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Material and methods

Reactivity measurements (React) and body weights (Wt) on 2335 (1189 females and 1146 males) Nellores were observed at weaning (WReact and WWt; from 163 to 275 days of age), yearling (YReact and YWt; from 276 to 375 days of age) and post-yearling (PReact and PWt; from 376 to 475 days of age). For the last two ages, scrotal circumferences (YSC and PSC) were also observed in the males. Animals, progeny of 101 sires and 2,057 cows, were born in two calving seasons (2003-04 and 2004-05) from three herds and raised in similar management conditions. Reactivity test was performed during the weighting of the animals, using an electronic device to record the number of points of reactivity in 20 seconds, starting after the animal enter the cage and the gate is closed. The only instruction given to the personnel during the management was that they could not touch the scale during the evaluation time (Maffei et al. (2006)). Due to dependency between mean and variance, points of reactivity in the original scale (X, ranging from zero to 9999) were transformed according to Log_{10} X+1 (Burrow and Prayaga (2004)).

Fixed effects of contemporary groups for React, Wt and SC analysis included herds, calving season, months of birth and sex (except for SC) of the animal; and, for React, the effect of scale was also included. In addition, the effects of age of the dam (linear and quadratic) and age of the animal (linear) were included in the models.

Estimates of genetic parameters were obtained using restricted maximum likelihood (REML) methodology applied to the following animal models: univariate (WReact, YReact and PReact, as independent traits); multivariate (WReact, YReact, PReact, as correlated traits), repeatability (WReact, YReact, PReact, as repeated measurements of the same trait) and bivariate (combinations of YReact and PReact with YWt and PWt; and with YSC and PSC).

Results and discussion

Descriptive statistics for Wt and SC are representative of average measurements observed for Nellore cattle in Brazil. Points of reactivity showed large phenotypic variation either in the original or transformed scales. According to the three ages, Log transformations of React were able to reduce mean-variance dependency (table 1).

From univariate models, heritability estimates for WReact, YReact and PReact were 0.08±0.04, 0.39±0.09 and 0.23±0.06, respectively. The last two values were similar to the ones observed by Burrow (2001) and Kadel et al. (2006), respectively, 0.40 (temperament score) and 0.19 (flight speed).

When the three measurements of React were considered as different traits, multivariate animal models estimates of genetic correlations converged to unity. Although estimates of heritability for React were different among the three ages, genetic correlations estimates indicated that they are the same trait, and that selection in one age could lead to genetic improvement in the others.

Table 1: Descriptive statistics (mean±standard deviation; CV, coefficient of variation; maximum and minimum values) for reactivity (original and transformed scales), body weight and scrotal circumference of Nellore cattle

Trait		Mean± SD	CV(%)	Minimum	Maximum
WReact, points	Original	775.2±869.9	112	0	7,092
	Transformed	5.59±1.96	35	0	8.67
YReact, points	Original	1,041.8±1,216.6	117	0	6,844
	Transformed	6.00±1.68	28	0	8.83
PReact, points	Original	1,330.6±1,157.1	87	0	5,660
	Transformed	6.52±1.61	25	0	8.64
WWt, kg		201.6±35.9	18	98	324
YWt, kg		235.9±42.4	18	135	390
PWt, kg		291.6±66.9	23	144	550
YSC, cm		20.3±2.4	12	14	30
PSC, cm		24.6±3,4	14	16	35

Considering WReact, YReact and PReact as repeated measurements of reactivity, repeatability and heritability estimates were, respectively, 0.24 and 0.14±0.06. Repeatability estimate was higher than the ones observed by Burrow (2001), 0.18 for temperament score and 0.14 for flight speed. Estimates of repeatability by Kadel et al. (2006) were higher, 0.46 for flight speed and 0.36 for temperament score. In general, results from the present study indicated that temporary environmental effects might be important in explaining reactivity variation for Nellores and that multiple observations would not lead to important gain in selection accuracy.

Heritability and genetic correlation estimates between YReact and PReact with Wt and SC are presented in table 2. All genetic correlation estimates are favorable. For Wt, estimates ranged from -0.20 (between PReact and WWt) to -0.49 (between PReact and YWt). These values are higher than the observed in the literature, mostly when scores were used to access temperament (Phocas et al (2006)). For SC, genetic correlations ranged from -0.12 (between YReact and YSC or PSC) to -0.58 (between PReact and PSC). These results are quite different from the ones observed by Burrow (2001), whose genetic correlations between yearling temperament scores and SC ranged from +0.11 to +0.22. However, the author commented that results were not expected and they might have been influenced by the small number of measured animals.

Genetic correlation indicated that more reactive animals will weight less and will have smaller SC than the less reactive ones. In addition, considering that for most Nellore herds of Brazil, independent culling level selection is applied at weaning, yearling and post-yearling, and that

there is an additional cost to measure reactivity, results suggested that an unique reactivity measurement is necessary for selection and that it might be better to observe the trait at yearling.

Table 2. Estimates of genetic correlation between reactivity, body weight and scrotal circumference of Nellore cattle

	YReact			PReact		
Traits	r_G	h^2	(h^2)*	r_G	h^2	(h^2)*
WWt	-0,23±0,04	0.41±0.08	0.18±0.05	-0.20±0,05	0.22±0.06	0.24±0.05
YWt	-0.33±0.09	0.35±0.09	0.38±0.09	-0.49±0.04	0.21±0.05	0.25±0.06
PWt	-0.38±0.08	0.37±0.07	0.20±0.05	-0.36±0.06	0.24±0.04	0.25±0.04
YSC	-0.12±0.06	0.38±0.07	0.35±0.06	-0.16±0.06	0.20±0.05	0.30±0.04
PSC	-0.12±0.04	0.41±0.08	0.33±0.05	-0.58±0.04	0.28±0.06	0.93±0.04

*Estimate of heritability for the trait listed in first column.

Conclusions

Although reactivity of Nellore cattle measured in three different ages (weaning, yearling and post-yearling) is essentially the same trait, there is no need of repeated observations to conduct selection. Selection for low reactive animals would lead to correlated favorable response on body weight and scrotal circumference. Among the three ages, yearling reactivity selection might be better than selection conducted at weaning or post-yearling.

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