

Genetic Trends For Growth And Carcass Traits In Nelore Beef Cattle

D.P. Munari^{1*}, R.G. Zuin^{2‡}, M.E. Buzanskas², G.C. Venturini^{2‡}, S.L. Caetano^{2‡}, C.C.P. Paz³, R.B. Lôbo⁴ and L.A.F. Bezerra⁵

Introduction

The productive performance of the herds needs to be evaluated according to traits connected with the quantity and quality of the meat produced. Beef cattle production represents an important source for development of Brazilian agribusiness. Improvements in raising, nutrition, pre and post slaughter management, cooling process, carcass processing and beef cattle breeding are ways of attaining the international market needs.

Body weight measured at different ages is often used to the most productive animals. The carcass meat yield, in quantitative terms, depends on content of striated muscle, skeleton forme and fat. This relation can be expressed by a prediction of longissimus muscle area (LMA), back fat thickness (BF) and rump fat thickness (RF), using real-time ultrasound scanning. LMA is related to muscle deposition, carcass yield and mainly to the most tender cuts of beef. BF and RF are measures related to growth, sexual and fatness precocity and both traits are associated to meat quality.

The present investigation aims to provide tools for the selection of Nelore breed animals participating in a cattle breeding program and obtain genetic trends for growth and carcass traits.

Material and methods

Animals and data file. The present study was conducted using data from Nelore animals breed that participated in the Nelore Brazil Program, coordinated by the National Association of Breeders and Researchers (Associação Nacional de Criadores e Pesquisadores – ANCP). Body weight data from animals measured at 210 (BW210) and 365 (BW365) days of age, belonging to 17 farms, were used. The carcass traits studied were: LMA, BF and RF from animals belonging to 15 farms. All animals were born between 1998 and 2008. An index was employed to select genetically superior males and females (Lôbo et al. (2000)). This index

1 Departamento de Ciências Exatas, FCAV/UNESP, Jaboticabal, SP, Brazil

2 Pós-Graduação em Genética e Melhoramento Animal, FCAV/UNESP, Jaboticabal, SP, Brazil

3 Instituto de Zootecnia/APTA – SAA, Ribeirão Preto, SP, Brazil

4 ANCP, Ribeirão Preto, SP, Brazil

5 Departamento de Genética, FMRP/USP, Ribeirão Preto, São Paulo, Brazil

* E-mail address: danisio@fcav.unesp.br

‡ CAPES fellowship

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).

Measurements. An ALOKA 500V apparatus equipped with a 3.5 MHz, 17.2 cm linear transducer (Aloka Co. Ltd., Tokyo, Japan) and an acoustic coupler in conjunction with an image capturing system (Blackbox, BIOTRONICS, Inc., Ames, IA, USA) were used to make the ultrasound measurements of prediction of carcass traits. These images were then analyzed in a centralized laboratory responsible for the quality of the data. The LMA and BF traits were measured across the Longissimus dorsi muscle between the 12th and 13th ribs. The RF trait was measured between the hook and pin bones over the junction between gluteus medius and biceps femoris muscles (Aval Serviços Tecnológicos S/C, (2010)).

Data editing and contemporary groups. Preliminary analyses of all traits were performed to eliminate inconsistent data. Least square analysis, using the GLM procedure of the SAS computer software (SAS 9.1, SAS Institute, Cary, NC, USA), 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 LMA, BF and RF, the contemporary groups (CG) consisted of animals belonging to the same year and season of birth, sex and management group at 450 days of age. For BW210 and BW365, the CG considered the year and season of birth, sex and management group (at 210 days of age for BW210 and at 365 days of age for BW365).

Assumptions for the fixed-effect model. Residual normality was verified for each trait using Guided Data Analysis - SAS (SAS 9.1, SAS Institute, Cary, NC, USA). Observations exhibiting a standardized residual 3.5-fold above or below the standard deviation were excluded. Data transformation was recommended for every carcass trait. The transformations were: $LMA_t = (LMA)^{0.4}$, $BF_t = \log_{10}(BF)$ and $RF_t = \log_{10}(RF)$.

Statistical analysis. Heritability estimates and breeding values were obtained using the restricted maximum likelihood method, in single-trait animal model, using the MTDFREML software (Multiple-Trait Derivative-Free Restricted Maximum Likelihood) described by Boldman et al. (1995). The relationship matrix included 182,161 animals. The mixed model used for single-trait analysis for BW210 and for BW365 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 groups); 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 BW210 and BW365, a linear and quadratic effect of the covariate dam age was considered. For carcass traits, the maternal genetic effect was not included in the mixed model. A linear effect of the covariate age at the ultrasound measurement was considered for LMA_t, BF_t and RF_t analyses. The convergence criteria for all analyses were 1×10^{-9} . Genetic trends were calculated from a linear regression of predicted breeding values (PBV) based on

birth year. A t-statistic was used to test the null hypothesis that the regression coefficient for each equation is equal to zero.

Results and discussion

Means, standard-deviations, coefficient of variation, minimum and maximum values for LMA, BF, RF, BW210 and BW365 are presented in Table 1. The mean for BW210 was similar to that reported by Yokoo et al. (2010) in Nelore beef cattle. The same authors noted smaller means for LMA and BF, but higher means for BW365 and RF compared to ours.

The additive direct heritability estimates for LMA_t, BF_t, RF_t, BW210 and BW365, were equal to 0.28 (0.03), 0.21 (0.02), 0.25 (0.03), 0.32 (0.02) and 0.34 (0.02), respectively. The estimates for additive maternal heritability for BW210 and BW365 were equal to 0.26 (0.02) and 0.12 (0.01), respectively. Initial studies using smaller data files were conducted by Yokoo et al. (2010) for this Nelore population. Higher estimates for carcass traits (0.35 to 0.52) and smaller estimates for growth traits were found by these authors compared to our results. Difference on heritability estimates from literature can be attributed to the different number of animals in data files. Direct selection for any studied trait could result in genetic progress.

Genetic trends for PBV per birth year indicate a significant reduction ($p < 0.0001$) in carcass traits and a significant increase ($p < 0.0001$) for growth traits, revealing that the traits respond indirectly to selection used in the herds. The linear increase ($p < 0.0001$) of direct and maternal PBV per birth year was 0.386 kg/year and 0.082 kg/year for BW210 and 0.513 kg/year and 0.092 kg/year for BW365, respectively. In this Nelore cattle breeding program, the expected progeny difference (EPD) for total maternal effect is obtained by adding the half direct EPD for body weight at 120 days with maternal EPD of the same trait. Because this EPD for maternal effect is considerable in selection index, significant linear changes based on birth year in maternal PBV for BW210 and BW365 were expected. Although the genetic trends for carcass traits indicated a selection response to the same index, it can be observed in figure 1 that the mean predicted breeding values (MPBV) of LMA by birth year has increased since 2003.

Table 1: Number of animals (N), mean, standard-deviation (SD), coefficient of variation (CV%), minimum and maximum values for LM area (LMA), backfat thickness (BF), rump fat thickness (RF), body weights at 210 (BW210) and 365 (BW365) days of age.

Trait	N	Mean	SD	CV%	Min	Max
LMA (cm ²)	11,578	52.87	10.43	19.80 (7.84)*	21.86	103.55
BF (mm)	11,578	3.28	1.67	44.57 (45.83)	0.40	18.80
RF (mm)	11,578	2.58	1.14	50.95 (41.38)	0.40	14.48
BW210 (kg)	31,862	186.72	28.10	15.05	73.00	323.00
BW365 (kg)	47,255	241.96	41.40	17.11	107.00	510.00

*In parentheses are shown the coefficients of variation for transformed data

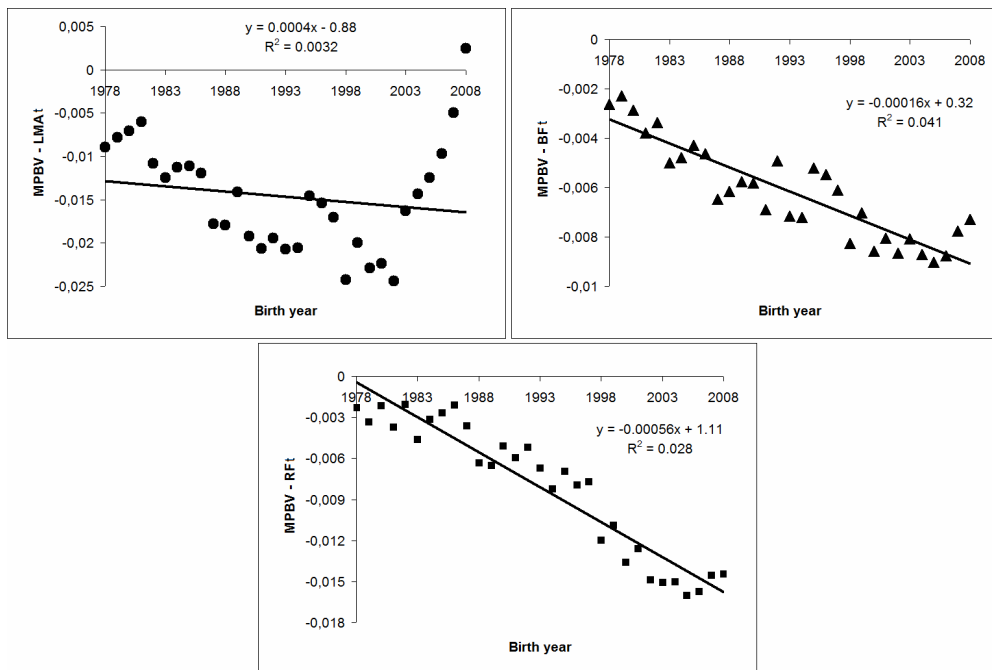


Figure 1. Genetic trends for mean predicted breeding values (MPBV) in Longissimus muscle area (LMA_t), backfat thickness (BF_t) and rump fat thickness (RF_t) by birth year.

Conclusion

The concern about beef quality in cattle breeding programs is recent in Brazil. The continuous amount of ultrasound measurements for prediction of carcass traits will contribute to genetic evaluation of these traits in beef cattle. Favorable selection response to increase LMA would respond to the growing demands for meat quality.

References

- Aval Serviços Tecnológicos S/C. (2010). *O uso da ultra-sonografia para avaliação de carcaça bovina*. [http://www.aval-online.com.br]
- Boldman, K.G., Kriese, L.A., Van Vleck, L.D. and Kachman, S.D (1993) “A manual for use of *MTDFREML*”. USDA. Clay Center, NE, pp.120.
- Lôbo, R.B., Bezerra, L.A.F., Oliveira, H.N., Garnerio, A.V., Schwengber, B. and Marcondes, C.R. (2000). *Avaliação genética de animais jovens, touros e matrizes: Sumário 2000*. SP, Ribeirão Preto, Brazil, pp.90.
- Yokoo, M.J., Lobo, R.B., Araujo F.R.C., Bezerra, L.A.F., Sainz, R.D. and Albuquerque, L.G. (2010) *J. Anim. Sci*, 88:52-58.