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EVALUATION OF THE GENETIC COMPONENT ON THE PHENOTYPIC EXPRESSION OF PRODUCTION TRAITS IN NELLORE CATTLE SUBMITTED TO PERFORMANCE TEST

AVALIAÇÃO DO COMPONENTE GENÉTICO NA EXPRESSÃO FENOTÍPICA DE CARACTERÍSTICAS PRODUTIVAS DE BOVINOS NELORE SUBMETIDOS À PROVA DE DESEMPENHO

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Abstract

The objective of this study was to evaluate the effect of the genetic component on the phenotypic expression of productive traits of Nellore cattle submitted to the individual performance test. The data used came from 51 young bulls participating in the individual performance test of Nellore bulls held at the Capim Branco experimental farm of the Federal University of Uberlândia. The evaluated traits were weight and scrotal circumference standardized at 365 and 450 days of age, the longissimus muscle area, and the backfat thickness. The expected progeny differences of the animals and the sires were considered to evaluate the contribution of the genetic component. Variance analysis was performed through the General Linear Model procedure of the Statistical Analysis System to verify the effects of the genetic groups on the productive performance. The progenies of bulls with greater genetic potential tend to present better productive performance. In conclusion, the use of genetically superior animals allows better zootechnical indexes to be obtained, reflecting higher gains in herd productivity.

Keywords: beef cattle; breeding value; productivity, selection.

Resumo

Objetivou-se avaliar o efeito do componente genético na expressão fenotípica de características

produtivas de bovinos da raça Nelore submetidos à prova de desempenho individual. Os dados utilizados foram provenientes de 51 touros jovens participantes da Prova de Desempenho Individual de Touros Nelore realizada na fazenda experimental Capim Branco da Universidade Federal de Uberlândia. As características avaliadas foram peso e perímetro escrotal padronizado aos 365 e aos 450 dias de idade, área de olho de lombo e acabamento de carcaça. Com o intuito de avaliar a contribuição do componente genético no desempenho produtivo dos animais foram consideradas as predições das diferenças esperadas na progênie dos animais e dos touros (pais dos animais). Para verificar os efeitos dos grupos genéticos sobre o desempenho produtivo foram realizadas análises de variância por meio do procedimento *General Linear Model* do aplicativo *Statistical Analysis System*. Verificou-se que os filhos de touros com maior potencial genético tendem a apresentar melhor desempenho produtivo. Concluiu-se que o uso de animais geneticamente superiores permite a obtenção de melhores índices zootécnicos refletindo em maiores ganhos em produtividade do rebanho.

Palavras-chave: Bovinos de corte; produtividade; seleção; valor genético.

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Introduction

Beef livestock in Brazil undergoes a transformation process due to the increase in the use of new technologies that results in a lower production cost per area because of the greater productivity achieved. This technological advancement allows value aggregation to the product, besides increasing production efficiency and hence the net profit of the rural entrepreneur[1,2].

One of the technologies applied to beef livestock is the prediction of the genetic values of the animals, obtained by the use of statistical methodologies that allow to quantify the genetic and environmental effects that affect the traits of economic interest. Both the advancement of the techniques applied to genetic improvement and the selection programs that supply technical support to the producers have increased the productive efficiency of the herds.

In this context, monitoring the genetic evolution of a population is important to promote adjustments when they are necessary and to evaluate the results of genetic improvement programs[3]. Therefore, it is possible to follow and establish guidelines for these programs aiming at the genetic progress of these herds throughout time.

The multiplication of the best genotypes allied to the environmental conditions might increase productivity[4]; however, to identify superior genotypes it is important to consider the information that really expresses the individuals genetic quality. Such information is called expected progeny differences (EPDs), and they represent essential tools to understand the herd genetically and help the livestock producer make decisions aiming at an increase in profitability.

The EPDs are obtained from the genetic evaluations usually conducted at two levels: between and within herds. The weight gain proofs, developed to test remarkable young bulls, regarding

especially the growth potential, are also part of EPDs evaluations. Weight gain proofs are necessary to identify the superior genotypes taking into consideration the need to select animals based on productive criteria, such as weight gain, precociousness, carcass finishing, and yield, based on the genetic values of the animals, enabling a faster identification process through individual information[5].

The carry pout of a performance evaluation represents an important tool for the selection, involving animals from different herds. It is expected that performance differences among the animals would reliably represent the genetic differences aiming at standardizing the breeding environment conditions. Among the benefits, the possibility of estimating the genetic merit of young animals, enabling their early use, besides classifying the animals with higher precision stand out. It would reduce the interval between generations and, consequently, increase the genetic progress of the herds.

In this study, we aimed at evaluating the effect of the genetic component on the phenotypical expression of the productive characteristics of Nellore bovines submitted to the individual performance test.

Material and Methods

The data used in this study were obtained from 51 Nellore bovine cattle participating of the individual performance test of Nellore bulls carried out at the experimental farm Capim Branco of Universidade Federal de Uberlândia. The male animals at ages between 7 and 9 months came from 17 farms located in Minas Gerais, São Paulo, Goiás, and Mato Grosso States, registered by the Brazilian Associations of Zebu Breeders (Associação Brasileira de Criadores Zebu - ABCZ), at the full-blood (FB) category.

The test was carried out on pasture and lasted 294 days. The first 70 days were used for animals acclimatization to the environment[6]. The acclimatization period is necessary to minimize performance differences among the animals due to the differences in the environments where they experienced the growing phase. We used an area of 16 hectares of *Brachiaria brizantha*, subdivided into four paddocks, besides a 20-hectare pasture area reserve (also subdivided) for the dry season.

The measurements were taken at 56-days intervals, and the animals were submitted to a 12-hour fasting before each weighing. The animals characterized a contemporary group, at the age interval of 90 days; that is to say they underwent the same environmental conditions.

The productive characteristics evaluated comprise the following information: standardized weight at 365 (W365, kg) and 450 (W450, kg) days of age; standardized scrotal perimeter at 365 (SC365, cm) and 450 (SC450, cm) days of age; ribeye area (REA, cm^2), and finishing (FIN, mm). To verify the contribution of the genetic component to the productive performance of the animals, we evaluated the EPDs predictions of the animals (offspring) and the EPDs of the bulls (father), supplied by the National Association of Breeders and Researchers in comparison to the individual performance of the animals participating in the Performance Test.

The genetic groups or EPD classes for weight at 365 (W365) and 450 (W450) days of age were defined as described: (a) EPD of the father lower than 7 kg (Class A); (b) EPD of the father from 7 to 13 kg (Class B); EPD of the father above 13 kg (Class C). By the evaluation of the effect of the genetic component of the animals with phenotypical measures, the same genetic groups or EPD classes were also defined.

The genetic groups for the characteristics of scrotal perimeter at 365 (SP365) and 450 (SP450) days of age, ribeye area (REA), and carcass finishing (FIN) were defined as follows: (a) EPD of the father lower than zero for the evaluated trait (Class A); (b) EPD of the father higher or equal to zero for the evaluated trait (Class b). By the evaluation of the effect of the genetic component of the animals with phenotypical measures the same genetic groups or EPD classes were defined.

The descriptive analysis, files formatting, data preparation, evaluation of the observation distribution and statistical analysis were carried out by the software Statistical Analysis System[7]. Therefore, to verify the effects of the genetic groups of the fathers (EPD classes) on the productive performance of the offspring, analysis of variance (ANOVA) was carried out using the least-squares method employing the GLM procedure (General Linear Model) and the following statistical model:

$$y_{ijk} = \mu + S_i + M_j + ID^2 + e_{ijk}$$

Where: yijk= observed value (phenotypic characteristics W365, SP365, W450, SP450, REA, and FIN); μ=general mean of the phenotypic characteristic; Si= effect of the genetic group (EPD classes of the fathers) for the phenotypic traits (W365, SP365, W450, SP450, REA, and FIN); Mj= effect of the animal's month of birth (included only for W450 and SP365); ID^2= quadratic coefficient of regression for the animal's age (included only for REA); and eijk = vector of the residual effects. The comparison of the means was carried out by Tukey test, and there was a statistical difference when $P \leq 0.05$.

Results and Discussion

Table 1 presents the descriptive statistics of the EPDs for weight and scrotal perimeter at 365 (DW365, DSP365) and 450 (DW450, DSP450) days of age, ribeye area (DREA), and carcass finishing (DFIN) for both parents and the 51 animals evaluated at the Individual Performance Test of Nellore bulls.

We observed that the EPD means for all the traits, except for DREA and DFIN, were higher for the fathers of the animals evaluated at the Test, which was not expected (Table 1). Considering that in the additive genetic action, the offspring represents the means of the genetic values of the parents, these results may demonstrate low selection pressure of the female breeders, which is not desirable since both the female and the male contribute genetically in the same proportion to constitute and individual.

We also verified that the mean values of the EPDs of yield (DREA) and finishing (DFIN) were negative for both the fathers and the animals participating in the Test (Table 1). This result reflects

in little or no selection for such characteristics in the herds participating in the Test.

Table 1. Descriptive statistics of EPDs for weight and scrotal perimeter at 365 (DW365 and DSP365) and 450 (DW450 and DSP450) days of age, ribeye area (DREA), and carcass finishing (DFIN) of the bulls (fathers) and animals (offspring) participating in the Individual Performance Test of Nellore Bulls, Uberlândia, MG

Variable	Mean		Standard		Minimal value		Maximal value	
	Offspring	Fathers	Offspring	Fathers	Offspring	Fathers	Offspring	Fathers
DW365 (kg)	7.97	9.95	3.69	5.46	-1.45	-0.38	15.41	18.54
DW450 (kg)	9.02	11.37	4.43	6.33	-0.20	-2.74	17.76	19.69
DSP365 (cm)	0.03	0.06	0.28	0.41	-0.65	-0.65	0.64	0.89
DSP450 (cm)	0.02	0.06	0.42	0.57	-0.80	-0.95	0.92	1.01
DREA (cm^2)	-0.23	-0.24	0.97	1.65	-2.58	-0.49	2.03	2.29
DFIN (mm)	-0.05	-0.08	0.17	0.19	-0.35	-3.44	0.33	0.38

For the weight at 450 days of age (Table 2), the offspring of bulls with EPD below 7 kg (Class A) had a mean weight of 282 kg, while the offspring of bulls with EPD between 7 and 13 kg (Class B) had a mean weight of 298 kg. This difference is even more evident when compared with the performance of the offspring of bulls with EPD over 13 kg (Class C), where the mean weight was 310 kg. Therefore, Class C offspring was 28 kg LW heavier than Class A offspring. These results confirm the ones found by other authors[8].

At the scrotal perimeter evaluation at 365 days of age, the offspring of bulls with positive EPD for scrotal perimeter (Class B) presented scrotal circumference 1.13 cm higher than the mean value of scrotal perimeter of the offspring of bulls with EPD below zero for this trait. Considering the phenotypical information of the scrotal perimeter standardized for 450 days of age (SP450), this difference was 1.32 cm higher.

Significant values were also observed for ribeye area (REA) or carcass yield (Table 2). The animals evaluated at the Test, offspring of bulls with EPD over zero (Class B), presented phenotypical mean value of 65.35 cm^2 of ribeye area (REA), while the offspring of bulls with EPD under zero (Class A) presented values of 61.99 cm^2.

Table 2. Means of the weights (W365 and W450) and scrotal perimeter (SP365 and SP450) standardized for age, yield (REA), and carcass finishing (FIN) related to the EPD classes of fathers (bulls) of the animals participating in the 1st individual performance Test of Nellore Bulls of UFU, Uberlândia, MG

Category	Mean[1]	Mean[2]
W365[1] and W450[2]		
Class A - Father/Bull with EPD < 7 kg	216[b]	282[b]
Class B - Father/Bull with EPD of 7 kg ≤ X ≤ 13 kg	240[a]	298[ab]
Class C - Father/Bull with EPD > 13 kg	232[ab]	310[a]
SP365[1] and SP450[2]		
Class A - Father/Bull with EPD < 0 cm	19.43[b]	22.75[b]
Class B - Father/Bull with EPD ≥ 0 cm	20.56[a]	24.07[a]
REA[1] and FIN[2]		
Class A - Father/Bull with EPD < 0 cm^2 or mm	61.99[b]	2.25
Class B - Father/Bull with EPD ≥ 0 cm^2 or mm	65.35[a]	2.62

*Means with different letters in the same row differ statistically between each other at 5% error probability by Tukey test.

From these results, we proved that the offspring from bulls with higher genetic potential tend to present better productive performance and that EPD is a safe resource to choose animals aiming at obtaining greater productivity in the herds[4,9,10]. This gain is maximized from the adequate selection of breeders with higher EPD estimates for the traits of economic interest.

The comparison of the animals performance regarding EPD classes is displayed in Table 3. There was a significant effect for all the characteristics evaluated. We verified that considering the genetic value of the animal, the performance differences regarding the genetic differences are better evidenced and proved.

The difference is more significant when we compare the performance means of animals with EPD over 13 kg (Class C) with animals with EPD < 7 kg (Class A), presenting gain of 47 kg at 450 days of age (W450). Performance difference regarding the genetic values of the animals considering the weight at 365 days of age (W365) was 40 g between Class C and Class A. Similar behavior was also observed at the evaluation of scrotal perimeter at 365 and 450 days of age. The animals with positive EPD for SP365 (Class B) presented 1.7 cm more in the scrotal circumference compared with animals with EPD below zero for SP365. As for SP450, this difference was of 1.99 cm (Table 3).

Table 3. Means of the weights (W365 and W450) and scrotal perimeter (SP365 and SP450) standardized for age, yield (REA), and carcass finishing (FIN) related to the EPD classes of the animals participating in the 1st individual performance Test of Nellore Bulls of UFU, Uberlândia, MG

Category	Mean[1]	Mean[2]
W365[1] and W450[2]		
Class A - Animal with EPD < 7 kg	220[b]	284[c]
Class B - Animal with EPD of 7 kg ≤ X ≤ 13 kg	243[a]	300[b]
Class A - Animal with EPD > 13 kg	260[a]	331[a]
SP365[1] and SP450[2]		
Class A - Animal with EPD < 0 cm	19.10[b]	22.40[b]
Class B - Animal with EPD ≥ 0 cm	20.80[a]	24.39[a]
REA[1] and FIN[2]		
Class A - Animal with EPD < 0 cm^2 or mm	59.86[b]	2.05[b]
Class A - Animal with EPD ≥ 0 cm^2 or mm	67.89[a]	2.87[a]

*Means with different letters in the same row differ statistically between each other at 5% error probability by Tukey test.

As for the carcass traits, the animals that presented EPD for ribeye area (DREA) equal or above zero (Class B) had a mean phenotypical value of 67.89 cm^2, being 8.03 cm^2 superior to the mean value of the animals with EPD below zero (Class A). For carcass finishing, there was a difference of almost 1 cm of fat thickness compared with animals of Class A (EPD lower than zero for FIN). Therefore, we may infer that the use of genetically higher animals allows to obtain greater productive gains reflecting in the zootechnical indices of the herd.

Choosing genetically superior animals does not imply an increase in the costs for the producer because the semen of young bulls with high genetic values is usually less costly than semen from bulls of commercial interest, but lower genetic quality. This situation has not been widely clarified to beef cattle producers, and technology transfer actions are necessary.

Conclusions

The genetic component influenced the productive performance of Nellore bovines. Therefore, we concluded that animals selected from predicted genetic values presented superior productive performance, proving the EPDs (expected progeny differences) are efficient tools for the identification of genetically superior animals and hence for the obtainment of better zootechnical indices for the herds.

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References

1. Agricultura.gov.br [Internet]. Brasil: Ministério da Agricultura, Pecuária e Abastecimento [atualizada em 2011 Nov 27; citado 2014 Jul 7]. Disponível em: http://www.agricultura.gov.br/

2. Santana MB, Silva MSV. Marketing e agribusiness: análise mercadológica e divulgação do gado Nelore melhorado geneticamente da fazenda Alô Brasil. Revista Administra-Ação [Internet]. 2013 Jan [citado 2014 Jul 7]; 8:48-71. Disponível em: http://revistas.unievangelica.com.br/index.php/administracao/article/view/376/377

3. Santos GCJ, Lopes FB, Marques EG, Silva MC, Cavalcante TV, Ferreira JL. Tendência genética para pesos padronizados aos 205, 365 e 550 dias de idade de bovinos Nelore da região norte do Brasil. Acta Scientiarum Animal Science [Internet]. 2012 Jan [citado 2014 Jul 7]; 34(1):97-101. Disponível em: http://dx.doi.org/10.4025/actascianimsci.v34i1.12172

4. Faria CU, Magnabosco CU, Reyes AL, Lôbo RB, Bezerra LAF, Sainz RD. Bayesian inference in a quantitative genetic study of growth traits in Nelore cattle (Bos indicus). Genetic Molecular Biology [Internet]. 2007 Jul [citado 2014 Jul 7]; 30(3):343-348. Disponível em: http://dx.doi.org/10.1590/S1415-47572007000400007

5. Mamede MMS. Contribuição do componente genético de touros da raça Nelore avaliados para o desempenho de suas progênies em teste de desempenho de touros jovens [dissertação]. Programa de Pós Graduação em Ciência Animal (PPGCA): Universidade Federal de Goiás; 2012. Disponível em: http://bdtd.ufg.br/tedesimplificado/tde_arquivos/5/TDE-2012-10-05T115802Z-2139/Publico/Dissertacao%20Mariana_2012.pdf

6. ABCZ. Associação brasileira de criadores de zebu: manual do serviço de registro genealógico das raças zebuínas. 1st ed. Uberaba: ABCZ; 2009. 190p.

7. SAS Institute. Statistical Analysis System: user guide [CD-ROM]. Version 9.2. Cary (NC): SAS Institute Inc., 2008.

8. Magnabosco CU, Faria CU. Melhoramento Genético é Investimento: Comprovação Prática. In: Sumário de Touros Jovens do Programa de Melhoramento Genético da Raça Nelore. 1st ed. Ribeirão Preto: ANCP, 2004. p. 112-115.

9. Silva JAV, Dias LT, Albuquerque LG. Estudo genético da precocidade sexual de novilhas em um rebanho Nelore. Revista Brasileira de Zootecnia [Internet]. 2005 Set [citado 2014 Jul 7]; 34(5):1568-1572. Disponível em: http://dx.doi.org/10.1590/S1516-35982005000500017

10. Yokoo MJ, Magnabosco CU, Rosa GJM, Lôbo RB, Albuquerque LG. Características reprodutivas e suas associações com outras características de importância econômica na raça Nelore. Arquivo Brasileiro de

Medicina Veterinária e Zootecnia [Internet]. 2012 Jan [citado 2014 Jul 7]; 64(1):91-100. Disponível em: http://dx.doi.org/10.1590/S0102-09352012000100014