DOI: 10.5433/1679-0359.2016v37n4Supl1p2701

Growth performance and carcass characteristics of Nelore Angus and Nelore Angus Guzera crossbreed cows fed with supplemented pasture during the yearling and feedlot stages

Desempenho e Características de carcaça de bovinos mestiços suplementados em pasto e terminados em confinamento

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Abstract

The objective of this study was to evaluate the growth performance of two crossbreed genetic groups, ½ Nelore ½ Angus and ¼ Nelore ¼ Angus ½ Guzera, which originate from the rotational crosses of Nellore cows with Angus bulls and ½ Nellore ½ Angus cows with Guzera bulls, respectively. The growth performance was evaluated at the end of the yearling and feedlot stages, and carcass characteristics were evaluated after the slaughter. A completely randomized trial design was used, with 12 cows in each group. The yearling stage lasted 270 days, and the cattle were fed with pasture of *Brachiaria brizantha* 'Marandu' with 2.0 UA ha^{-1} and a forage allowance of 2.5 kg of dry matter (DM) per 100 kg of live weight (LW), during this stage the animals, with an average age of 365 ± 10 days, received protein and energy supplementation *ad libitum*. After the yearling stage, the cows were confined until they reached the age of 22–24 months and received 6.0 kg DM of sugar cane + urea and 4.0 kg DM of concentrate, with 150 g kg^{-1} of crude protein (CP), daily during 90 days. The daily average weight gain (DAWG) during the yearling stage was higher for the ½ Nelore ½ Angus group. The ¼ Nelore ¼ Angus ½ Guzera group reached higher slaughter weight because they had higher DAWG during the feedlot stage (1.022 vs. 728 g dia^{-1}). No significant difference ($P>0.05$) was found between the groups when the hot carcass weights were compared. The ½ Nelore ½ Angus group reached a higher carcass weight percentage (53 vs. 50 %) and subcutaneous fat thickness (4.3 vs. 4.0 mm).

Key words: *Bos indicus*. Correlation coefficient. Fat thickness. Weight gain.

Resumo

Conduziu-se o experimento para avaliar o desempenho e as características da carcaça de dois grupos genéticos de bovinos mestiços, ½ Nelore ½ Angus e ¼ Nelore ¼ Angus ½ Guzerá, provindo, respectivamente, de dois cruzamentos rotativos: vacas nelore acasaladas com touro angus e vacas

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Recebido para publicação 26/11/15 Aprovado em 29/04/16

½ Nelore ½ Angus acasaladas com touro Guzerá. O desempenho foi avaliado em pasto na fase de sobreano e no confinamento e as características da carcaça avaliadas no abate. O delineamento experimental foi inteiramente ao acaso com 12 animais de cada grupo. Foi utilizado, no período de sobreano, 270 dias, pastagem de *Brachiaria brizantha* cv. Marandu com 2,0 unidades animal ha^{-1}, oferta de 2,5 kg de matéria seca (MS) por 100 kg de peso vivo (p.v.), nesse período os animais, de 365 ± 10 dias de idade média inicial, receberam suplementação proteica-energética *ad libitum*. Após o período de sobreano, os animais foram confinados em baias individuais com 21-22 meses de idade, nas quais foram fornecidos cana-de-açúcar + ureia, 6,0 kg de MS; e concentrado, 4,0 kg de MS, sendo 150 g kg^{-1} de proteína bruta (PB), diariamente, durante 90 dias. O ganho médio de peso diário (GMPD) na fase de sobreano foi maior no grupo bimestiço ½ Nelore ½ Angus. Os animais do grupo ¼ Nelore ¼ Angus ½ Guzerá obtiveram maior peso ao abate em razão do maior GMPD no confinamento (1.022 contra 728 g dia^{-1}). Não houve diferença (P>0,05) entre os grupos no peso de carcaça quente, porém no grupo ½ Nelore ½ Angus foram obtidos maiores rendimento de carcaça e espessura de gordura (4,3 contra 4,0 mm).
Palavras-chave: *Bos indicus.* Coeficiente de correlação. Espessura de gordura. Ganho de peso.

Introduction

National beef cattle herds have shown improvements in the quantity and quality of the carcasses produced. This was achieved through the selection of suitable animals, the use of a balanced diet, and the use of appropriate breeding, rebreeding, and finishing methods.

To select the appropriate genetic group, the one that produces heavier animals and better-quality carcasses should be considered. Almost 90% of the Brazilian herds belong to the *Bos indicus* genotype, which is habituated to the tropical conditions, but has some unwanted characteristics in this climate, such as low meat production (AZEVEDO et al., 2005; RIBEIRO et al., 2009). One of the strategies to increase meat production is to use genetically improved animals (CRUZ et al., 2009), because the genotype influences the performance of the animals (PIMENTEL et al., 2005), and crossbreeding allows the use of the genetic capacity of the animals, which allows the producer to take advantage of the complementarity of different breeds (PADUA et al., 2004).

Crossbred animals show greater weight gain owing to heterosis (PIMENTEL et al., 2005). However, animals crossbred using three different breeds show higher performance than pure and half-blood animals, owing to direct maternal heterosis (EUCLIDES FILHO, 2003), which accounts for the increase in multibreed populations in Brazil and worldwide (LOPES et al., 2010a).

The majority of the Brazilian cattle are fed on pastures (LIMA et al., 2004). Among the cultivated grasses, the genus *Brachiaria*, which occupies approximately 60 million hectares, constitutes the main option for feeding beef cattle in the country (SÁ et al., 2011), especially in the growing and fattening stages.

However, a lower performance with lower average daily weight gains (ADWG) and higher fattening period is observed when using pasture systems or systems with more fodder on the diet (CUVELIER et al., 2006), in particular when supplementation is not used. Conversely, in the feedlot, the animals are fed considering their nutritional requirements and different genetic potentials (YANG et al., 2009).

Some studies have been carried out (LEME et al., 2000; SILVA et al., 2004; RIBEIRO et al., 2008) to evaluate the performance of purebreds and crossbreds under several modes of growing and fattening; however, more studies are required to compare different breeds of cattle that are under the same production system (CUVELIER et al., 2006).

Based upon the discussion presented above, the aim of this study was to compare the performance and characteristics of the carcasses of two genetic groups during the growing stage with supplementation and the fattening stage in the feedlot. We evaluated the performance and characteristics of the genetic groups½ Nelore ½ Angus and ¼ Nelore ¼ Angus ½ Guzerá, which originate from the rotational crosses of Nelore cows mated with Angus bulls and ½ Nelore ½ Angus cows mated with Guzerá bulls, respectively.

Material and Methods

The study was performed from August to November, at the San Antonio farm facilities, located in the municipality of Realeza, PR, in the south-west of Paraná, 25° 46 ‘08” South Latitude and 53º 31’ 57” West Longitude and altitude of 520 m. Taking into account the Koppen climate classification, the humid subtropical climate, mesothermal, and the climatic data for the duration of the experiment are presented in Table 1.

Table 1. Average monthly temperatures of the minimum, maximum, and average daily temperatures, average evapotranspiration, and average monthly rainfall, during the yearling stage in the pasture, until the entrance in the feedlot, in the municipality of Realeza-PR.

Month/year	Minimum °C	Maximum °C	Average °C	Evapotransp. mm	Rainfall mm
August	15.1	27.5	21.2	25.0	224.0
September	15.3	27.3	21.3	27.3	436.0
October	18.2	30.1	24.1	39.8	359.9
November	17.9	26.9	22.4	37.0	210.0
December	19.0	28.9	24.0	45.6	171.6
January	19.5	29.1	24.3	45.5	169.0
February	19.2	30.1	24.7	31.4	122.0
March	18.6	27.8	23.1	32.2	99.0
April	18.2	28.4	23.3	26.5	127.7
May	15.4	24.5	19.5	20.1	238.9

The animals used in the study originated from two herds of distinct genetic groups, kept on pasture, in a creep feeding system, with an age of 60 to 210 days, and supplemented in the pasture until the beginning of the experiment, in the yearling, at 365 ± 10 days old. The animals were weaned between 180 ± 27 kg and 210 ± 15 days old, with 12 animals belonging to the genetic group 1 (½ Nelore ½ Angus) and 12 animals to the genetic group 2 (¼ Nelore ¼ Angus ½ Guzerá), which originated from the rotational crosses of Nelore cows mated with Angus bulls and ½ Nelore ½ Angus cows mated with Guzerá bulls, respectively.

The experiment was performed in two stages. During the first stage, from August to May, the animals were raised on pastures with *Brachiaria brizantha* cv. Marandu, fertilized with 120 kg ha^{-1} ano^{-1} of N. At this stage, the average environmental temperature was 23 °C and the average monthly precipitation was above 120 mm, except in March when the average precipitation was 99 mm. This climate is known to be adequate for the growth of the fodder used in the study. At the dates of weighing the animals (Figure 2), forage samples were collected to determine the content of dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF) in the forage and forage allowance. The forage allowance were administered at a rate of 2.5 kg of DM per 100 kg live weight; for this, control cattle was used with the technique 'put and take' and the pasture area was controlled with a mobile fence. The average levels of DM, CP, NDF, and ADF in the growing stage under grazing were 266, 75, 530, and 420 g kg^{-1}, respectively. During this stage the animals received protein and energy supplementation *ad libitum* (NDT-750, PB-240, P-5,2, Ca-2,4, and EE-33 g kg^{-1}). In the second stage, the animals were housed in individual corrals for 90 days. The animals were fed with 10.0 kg of DM per day (6.0 kg of roughage + 4.0 kg concentrate) as a full ration (Table 2), with 740 g kg^{-1} of NDT and 150 g kg^{-1} of CP, an amount estimated to be consumed by 21 g kg^{-1} of live weight with an average daily weight gain of 1.10 kg. The total daily ration was divided into three parts and fed throughout the day. Each time the animals were fed, the leftovers were weighed in order to estimate the DM intake. When moved to the feedlot, the animals were adjusted to the diet and were fed with 25% of the concentrate in the first three days, 50% up to day 6, 75% up to day 9 and 100% from day 10 onwards.

Table 2. Chemical composition and concentration of the ration.

Ingredients	DM kg	NDT inna DM g kg^{-1}	PB in DM
Soybean Bran	160.0	503.2	75.2
Corn Meal	592.0	144.0	59.2
Calcareous	40.0	-	-
Nucleus	8.0	5.2	3.2
Sugarcane and urea	200.0	92.0	15.2
Total	1000.0	744.4	152.8

Nucleus: calcium-8.0 g; phosphor -4.87 g; sulphur-6.0 g; chrome-1.55 g; cobalt-1.0 g; zinc-0.3 g; sodium-31.2 g; manganese-0.2 g; copper- 0.6 g; crude protein-400 g kg^{-1}; NDT-400 g/kg; humidity-10 g kg^{-1}.

During the growing stage in the yearling, the animals were weighed monthly and the initial weight and average daily weight gain were assessed. The slaughter was carried out at 24 months of age, after a fasting period of 16 hours, and the following characteristics were determined: slaughter weight, average daily weight gain in the feedlot, feed conversion, hot carcass weight, carcass yield and fat thickness on the 12th rib, using calipers.

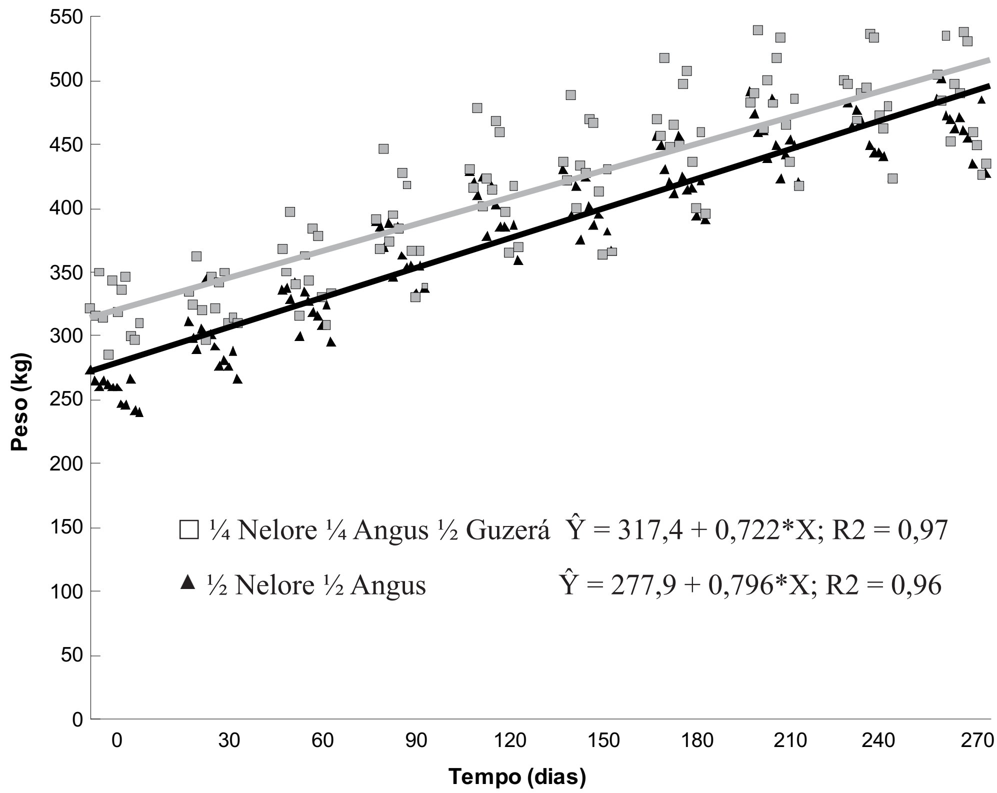
The results were submitted to analysis of variance, using the Sisvar program (FERREIRA, 2011), and the averages of the treatments were compared using the F test at 5% probability. For regression analysis, the significance of the regression coefficients of 1 and 5% was determined using a *t*-test. A correlation analysis between random variables was performed.

Results and Discussion

The weights of the animals of both genetic groups were studied as a function of time obtained monthly during the yearling stage and adjusted to the linear model (Figure 1), considering the significance of the regression coefficients. Lôbo and Martins Filho (2002) compared various models, which describe the growth of Nelore beef cattle, and reported that although the nonlinear models de Richards (R^2=0.99) and Brody (R^2=0.99) have a better fit, the quality of the fit of the linear model (R^2=0.97) is similar to that of nonlinear models.

The genetic group ¼ Nelore ¼ Angus ½ Guzerá showed greater weights throughout the yearling stage. The fact that this group had a greater initial average weight in the growing stage (319 kg) contributed to the greater weight observed in the following assessments throughout the growing stage of the animals at the yearling (Table 3). However, for the group ½ Nelore ½ Angus had the highest regression coefficient (b), which demonstrates a higher estimated daily gain.

Figure 1. Weights of beef cattle of the group ¼ Nelore ¼ Angus ½ Guzerá and ½ Nelore ½ Angus during the yearling stage.



* Significant at 1% probability by the *t*-test.

There was a higher average weight gain during the growing stage of the ½ Nelore ½ Angus group (Table 3), which represents an increase of 10.15% when compared with the group ¼ Nelore ¼ Angus ½ Guzerá. It might be due to several factors, such as higher heterosis for weight gain of the half-blood group (which theoretically would be 100% in both groups), better response to supplementation in the pasture, and greater initial weight in the growing stage. Perotto et al. (2000) observed the heterosis effect on the weight gain of crossbred cattle Charolais/Nelore.

The greater weight gain of the group ½ Nelore ½ Angus is contrary to the notion that animals originated from crosses of the three breeds have higher performances than pure or half-blood animals owing to direct maternal heterosis (EUCLIDES FILHO, 2003). However, the lower weight gain in the ¼ Nelore ¼ Angus ½ Guzerá group may be due to genetic proximity between Nelore and Guzerá breeds, thus reducing the effect of heterosis in the gain. Ribeiro et al. (2008) found no heterosis effect on the performance of ½ Nelore ½ Guzerá and, according to the authors, this is probably due to the genetic similarity between these two groups. Crosses maximize the effect of heterosis (LOPES et al., 2010b), and are used to increase the rate of growth and fattening of the animals (LOPES et al., 2008).

It is relevant to highlight the importance of supplementation in the growing phase, 8 g/kg per day, to obtain greater weight gains and final weights. Goes et al. (2009) observed greater weight gains and final weights on Nelore beef cattle and crossbreds in pastures with *B. brizantha* during the dry season, with protein and energy supplementation of 10 g/kg. However, supplementation only during the first dry season did not contribute to higher yields and quality of the carcasses in the growing stage of beef cattle F1 Angus-Nelore (FEIJÓ et al., 2001).

Table 3. Performance of beef cattle during the yearling stage (270 days) for the different genetic groups.

Genetic Group	Weight at the beginning of the growing stage kg	Weight gain during the growing stage kg day^{-1}	Weight at the end of the growing stage kg
½ Nelore ½ Angus	255b	0.727a	453b
¼ Nelore ¼ Angus ½ Guzerá	319a	0.660b	486a
Variation Coefficient (%)	7.55	13.77	7.48

* Significant at 5% probability by the F test.

The greater final weights obtained in the growing stage for the ¼ Nelore ¼ Angus ½ Guzerá group suggest that the time of supplementation in the pasture is flexible and allows a reduction in time and a decrease in cost of supplementation. On the other hand, Assad et al. (2015) observed that the additional daily weight gains of Nelore beef cattle using several supplement formulations, compensates for the daily costs of supplementation.

The greater initial weight in the growing stage led to a greater weight of the ¼ Nelore ¼ Angus ½ Guzerá group at the beginning of the feedlot stage (Table 4). On the other hand, the ½ Nelore ½ Angus group, despite of having a greater weight gain, did not reach the weight of the first group. Ferreira et al. (2009) emphasized the importance of the weight of the animals at the start of the feedlot stage.

The ¼ Nelore ¼ Angus ½ Guzerá group reached a higher weight at the time of slaughter (8.7% higher), probably due to a higher daily weight gain in the feedlot (Table 4). Kippert et al. (2008) observed large differences in performance between animals of the same group, ½ Nelore ½ Angus. The greater slaughter weight of the ¼ Nelore ¼ Angus ½ Guzerá group did not lead to a higher hot carcass weight, with an increase of only 2.75% in carcass weight.

There was a higher carcass yield for the ½ Nelore ½ Angus group, in agreement with Muchenje et al. (2008) who reported a carcass yield of 53% for animals of the Angus breed. It is observed (Table 4) that there was a compensatory effect between slaughter weight and hot carcass yield, i.e., a lower carcass weight is compensated by a higher carcass yield. This higher yield, the lower carcass weight and the higher fat thickness show a higher precocity on the½ Nelore ½ Angus group. This group, according to Silva Goulart et al. (2008), has a greater demand in net energy per kg gain, which negatively affects the feed conversion but generates better animals in the finishing process.

No difference was found (P <0.05) between genetic groups with respect to feed conversion in the feedlot stage (Table 4). Perotto et al. (2000) found no significant effect (P> 0.05) of heterosis on feed conversion and consumption of DM in Charolais, Caracu, and alternate cross cattle. Although not statistically significant, the difference in feed conversion between the groups may be economically relevant, since it represents a decrease of 55.8 kg/kg of fed food per animal on the ¼ Nelore ¼ Angus ½ Guzerá group, over a period of 90 days in the feedlot. Since food costs represent an average of 77.2% of the total beef cattle production costs (RESTLE et al., 2007), feed efficiency is an important factor for the identification of more efficient crosses, which may lead to more economically and environmentally sustainable herds (LANCASTER et al., 2008).

Table 4. Performance and carcass quality of beef cattle from different genetic groups in the feedlot.

Group	CIW	SW	HCW	WGF	FC	CY	FT
	-------------- kg		-------------	kg dia^{-1}	kg kg^{-1}	%	mm
½ Nelore ½ Guzerá	453b	549b	291a	0.728b	8.36a	53a	4.3a
¼ Nelore ¼ Angus ½ Guzerá	486a	597a	299a	1.022a	7.74a	50b	4.0b
Variation Coefficient (%)	7.48	5.80	5.37	28.33	22.30	3.95	5.70

IW., initial weight; SW., slaughter weight; HCW., hot carcass weight; WGF, weight gain in the feedlot; FC., feed conversion; CY., carcass yield and FT., fat thickness. * Significant at 5% probability by the F test.

A positive correlation was observed (r=0.49) between the initial weight in the growing stage and the initial weight in the feedlot stage (Table 5), supporting the results of Vieira et al. (2005), who observed a positive correlation (r=0.70) between the initial weight and the weight at the end of supplementation during the growing stage of Nelore cattle. This finding emphasizes the importance of supplementation during the growing stage in order to obtain heavier animals at the beginning of the feedlot stage, because animals with feed restrictions at this stage rarely reach the initial weights, although they may have a compensatory gain.

The higher positive correlation coefficients between the initial weight in the feedlot and slaughter weight (r=0.70) and between the slaughter weight and carcass weight (r=0.75) can be observed in Table 5 According to Reinhardt et al. (2009), in the United States, the initial weight in the feedlot in 19 feedlot systems for beef cattle (Angus and continental races) was positively correlated with the final weight.

Table 5. Pearson correlation coefficients between the variables studied.

	WGG	IWF	SW	WFG	HCW	CY	FT	FC
IWG	-0.05	0.49*	0.57*	-0.36*	0.38*	-0.38*	-0.60*	0.12
WGG	-	0.31	0.39*	0.12	0.33	-0.18	0.28	0.09
IWF	-	-	0.70*	-0.36*	0.55*	-0.36	-0.45*	-0.40*
SW	-	-	-	0.41*	0.75*	-0.59*	-0.26	-0.39*
WGF	-	-	-	-	0.28*	-0.29*	0.25	-0.58*
HCW	-	-	-	-	-	0.09	0.01	0.22
CY	-	-	-	-	-	-	0.38*	0.16
FT							-	0.21

IWG., initial weight in the growing stage; WGG., weight gain in the growing stage; IWF., initial weight in the feedlot; SW., slaughter weight; WGF., weight gain in the feedlot; HCW., hot carcass weight; CY., carcass yield and FT., fat thickness; FC., feed conversion; * Significant at 5% probability by the *t*-test.

A high average daily weight gain in the feedlot stage can lead to the reduction of production costs since the animals with a higher average daily gain reach the slaughter weight in a shorter period of time. The initial weight in the feedlot stage showed a negative correlation with the daily weight gain (Table 5), supporting the results of Reinhardt et al. (2009), who reported that an increase in the initial weight led to a lower daily weight gain. Animals with a genetic background for fast growth reached the highest weights at a particular time; however, fat deposition in these animals was delayed (LABORDE et al., 2001), which extended the feedlot stage.

Restle et al. (2002) observed a high positive correlation (r=0.94; P=0.0001) between slaughter weight and cold carcass weight in half-blood (½ Nelore ½ Charolais) cattle and low correlations between slaughter weight and cold carcass yield (r=0.06), and between cold carcass weight and fat thickness (0.11). Silva et al. (2004) observed a positive linear association between the fat layer at the 12th and 13th ribs, and the weight of living animals, but with high variability in fat thickness for the same weight of live Nelore and Brangus animals. In this study, the weights of living animals negatively correlated with the fat thickness (Table 5). This contrasting result may be due to the high variability of this feature (SILVA et al., 2004) for animals of the same weight.

No correlation was found between hot carcass weight and carcass yield (Table 5), but the slaughter weight was negatively correlated with the carcass yield, indicating that slaughter weight is more significant than the hot carcass weight for the yield.

Conclusions

The ½ Nelore ½ Angus genetic group had a better growth performance during the yearling stage, as well as, higher precocity than the ¼ Nelore ¼ Angus ½ Guzerá group. In the feedlot stage, the ¼ Nelore ¼ Angus ½ Guzerá group had a better performance and the ½ Nelore ½ Angus group had better performance in terms of yields and carcass finishing. The initial weights of the animals in the yearling and feedlot stages correlate positively.

Acknowledgments

To the fridge JBS S.A., Maringá-PR unit, for providing the facilities to evaluate the animal carcasses.

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