Original Article

BIOLOGICAL AND ECONOMIC PERFORMANCE OF ANIMAL GENETIC GROUPS UNDER DIFFERENT DIETS

DESEMPENHO BIOLÓGICO E ECONÔMICO DE GRUPOS GENÉTICOS ANIMAIS SOB DIFERENTES DIETAS

Valéria Pacheco Batista EUCLIDES[1]; Fernando Paim COSTA[1]; Kepler EUCLIDES FILHO[2]; Denise Baptaglin MONTAGNER[3]; Geraldo Ramos FIGUEIREDO[1]

1. Engenheiro(a) Agrônomo(a), Pesquisador (a) da Embrapa Gado de Corte, Campo Grande, MS, Brasil. 2. Engenheiro Agrônomo, Pesquisador da Embrapa, Secretaria de Pesquisa & Desenvolvimento, Brasília, DF, Brasil. 3. Zootecnista, Pesquisadora da Embrapa Gado de Corte, Campo Grande, MS, Brasil. denise.montagner@embrapa.br

ABSTRACT: A grazing trial to evaluate biological and economic efficiencies for rearing young animals exclusively on pasture from weaning at 7 months of age, with average initial weight of 220 ± 12 kg, to slaughter was conducted from May 2006 to October 2007. Two levels of combined supplementation during the first dry period and four genetic groups (F1 Angus-Nellore; ½Braford-¼Angus-¼Nellore; ½Brahman-¼Angus-¼Nellore; and ⅝Charolais-⅜Nellore) were used following a 4 by 2 factorial arrangement and eight replications in a completely randomized design. During both dry periods, eight paddocks of deferred *Brachiaria brizantha* were utilized. During the first dry period, concentrated mix (CM) and protein-mineral mixture (PMM) were provided in quantities of 0.8% and 0.2% of body weight (BW), respectively, for 142 days. During the subsequent rainy period, the animals were transferred to eight guinea grass paddocks for 197 days. During the second dry period, the animals were allocated to the same eight palisade grass paddocks used during the previous dry season. Steers had received supplementary diet with the same CM used before at 0.8% of BW. Animals supplemented with CM gained more BW than those supplemented with PMM; however, during the rainy season, steers supplemented with PMM performed better than those receiving CM during the preceding dry period. Using concentrate since the first dry season is a risky option in economic terms, as only the Angus-Nellore group showed a positive but small gain.

KEYWORDS: *Brachiaria brizantha*. Deferred grazing. Feed supplementation. *Panicum maximum*. Rotational grazing.

INTRODUCTION

Sustainable technological alternatives to improve the quality of beef meat are required if Brazil aims to maintain its position as one of the most important players in the world beef market. There is consensus that meat tenderness is, directly or indirectly, the organoleptic characteristic consumers value most (MENDES et al. 2012). As far as this trait is concerned, slaughter age plays an important role since younger animals tend to produce tender meat (ALVES et al. 2005). However, seasonality of forage production, a common feature of tropical pastures, might be one of the major constraints for slaughtering young animals.

This seasonality is characterized by marked reductions in forage quantity and quality during the dry season, consequently decreasing animal performance and increasing age at slaughter. It is, therefore, essential to provide conditions to maintain high animal performance throughout the year. This crucial problem could be solved by more intensively using the alternatives available for pasture management (DIFANTE et al. 2010, GIMENES et al. 2011) and feed supplementation (GARCIA et al. 2014, CANESIN et al. 2007). In this context, the wise and strategic use of supplements may be among the most critical economic factors in the management of a forage-livestock enterprise. Furthermore, the responses obtained could be enhanced by using animals with superior genetic makeup to make better use of the resources provided (PEROTTO et al. 2009, MENEZES; RESTLE 2005).

Thus, this study aimed to evaluate the effects of feeding two supplements to four animal genetic groups on the biological and economic efficiencies of steers reared on tropical pastures.

MATERIAL AND METHODS

Study site and pastures

The experiment was conducted from May 2006 to September 2007, encompassing two dry periods, at the National Beef Cattle Research Center/Embrapa in Campo Grande, MS, Brazil (20°27'S, 54°37'W, 530 m elevation). According to the Köppen classification, the climate is rainy tropical savannah of the Aw subtype, which is characterized by a seasonal distribution of rainfall and well-defined occurrence of the dry period during the colder months (May to September). Monthly rainfall and the minimum, average and

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maximum temperatures during the study period were recorded at the Embrapa Beef Cattle weather station, 5 km from the experimental site. The average temperature and monthly precipitation were used to calculate the water balance (Figure 1). The value used for soil water storage capacity was 75 mm.

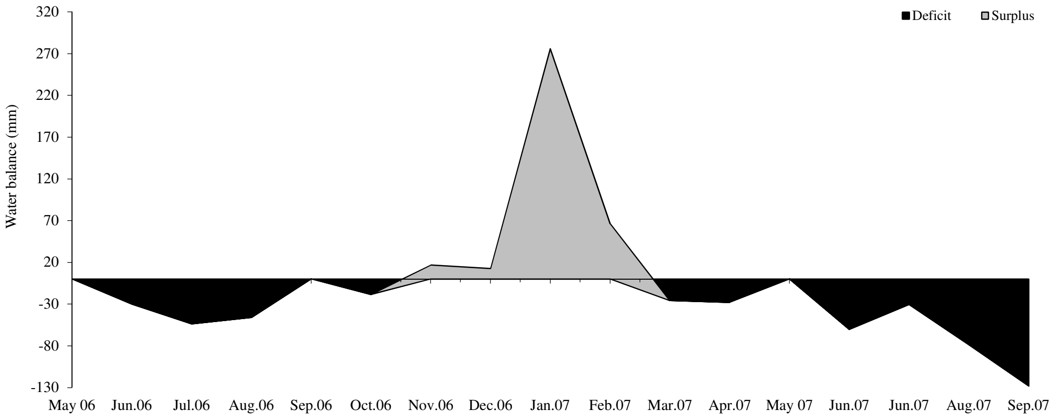

Figure 1. Water deficit and surplus in the soil during the experimental period.

The pastures utilized during both dry periods (May to September 2006 and 2007) were eight paddocks of *Brachiaria brizantha* cv. Marandu (palisade grass) with 3 ha each. During the first week of February 2006 and 2007, the pastures were grazed down to 10 cm of height, fertilized with 50 kg/ha of nitrogen and deferred. Throughout the dry periods, they were continuously stocked.

The pastures grazed during the rainy period (October 2006 to April 2007) were eight paddocks of *Panicum maximum* cv. Tanzania (guinea grass), each measuring 1.7 ha. Each one of them was subdivided into a set of nine paddocks for rotational stocking; the rest period was associated with a pre-grazing height of 70 cm, the height at which the canopy intercepts 95% of incident light (BARBOSA et al. 2007), and the post-grazing height was set at 35 cm (DIFANTE et al. 2010).

The Tanzania guinea grass pastures were established on Oxisol. Starting in October 2006, the pastures were fertilized with 80 kg ha^{-1} of P_2O_5, 80 kg ha^{-1} of K_2O and 200 kg ha^{-1} of N divided among four application times, namely, October, September, December and February.

Treatments, experimental design and animal management

The treatments consisted of four genetic groups and two types of supplements during the first dry period following a 4 by 2 factorial arrangement with eight replications in a randomized complete design.

The genetic groups were: ½Angus-½Nellore (AN); ½Braford-¼Angus-¼Nellore (BfAN); ½Brahman-¼Angus-¼Nellore (BhAN); and ⅝Charolais-⅜Nellore (Canchim). The supplements employed were a concentrate mix (CM) with 51% corn, 44% soybean, 1.8% mineral mixture and 3.2% calcium carbonate (25.8% crude protein (CP) and 78.9% total digestible nutrients (TDN)); and a protein-mineral mixture (PMM) with 28% corn, 38% soybean hulls, 14% urea, 12% NaCl and 8% other essential minerals (50.7% CP and 41.1% TDN).

In May 2006, 64 weaned calves at 7 months old, with an average initial weight of 220 ± 12 kg, were distributed in the eight palisade grass paddocks, keeping two from each genetic group in each paddock, allocated on body weight (BW) basis within each genetic group.

During the first dry period (May to September 2006), weaned calves were supplemented with CM or PMM. These supplements were provided in quantities representing 0.8% and 0.2% of BW, respectively, for 142 days. The supplement adaptation period consisted of 15 days. Daily feed intake was estimated as the difference between supplied feed and refusals in the trough. Concentrate amount was adjusted every 28 days when the animals were weighted.

During the subsequent rainy period (October 2006 to April 2007), all animals were transferred to eight guinea grass paddocks for 197 days. The animals were re-allocated as follows: Two animals of each genetic group were placed in each paddock, one supplemented with PMM and the other supplemented with CM in the previous dry season. Mineral salt and water were offered *ad libitum* throughout the rainy period.

During the second dry period (May to September 2007), the steers of the same guinea grass paddock were transferred to one of the eight palisade grass paddocks used in the previous dry season; pasture management was the same as described previously. All steers had their diet supplemented with the same CM used before at 0.8% of BW and supplementation management was the same as described above.

Measurements

Dry seasons

Palisade grass samples were taken at 28-day intervals. The samples were taken through systematic points along five transect lines (12 measurement points per transect) in each paddock. The forage was cut at ground level using a 1-m^2 frame. Each sample was weighed and divided in two. One of the subsamples was oven-dried at 65°C and weighed while the other was separated into leaf (leaf blades), stem (stems and leaf sheaths) and dead material, dried at 65°C and weighed.

Rainy seasons

Throughout the regrowth period, sward height was monitored twice a week using a 1-m ruler graduated in centimeters through systematic readings performed along five transect lines (12 measurement points per transect) in each paddock. The readings of sward height were taken from ground level to the 'leaf horizon' on the top of the sward as a reference. This procedure was followed throughout the rainy season, including the periods when the plants were in reproductive stage and produced taller flowering stems.

For sampling guinea grass, all plant measurements were carried out in one paddock per nine paddocks set. The pre- and post-grazing forage samples were randomly cut at ground level, from 15 1-m^2 quadrats per paddock. Each sample was weighed, divided in two and processed as described above.

Forage nutritive value (dry and rainy seasons)

A grazing simulation method was used to collect forage samples for chemical analysis and digestibility determination (Sollenberger and Cherney 1995). Two random samples were harvested by hand per paddock. They were oven-dried, ground to pass through a 1-mm screen and analyzed for crude protein, neutral detergent fiber, acid detergent lignin and *in vitro* organic matter digestibility via near-infrared reflectance spectroscopy (NIRS).

Body weight gain and fat thickness

All steers were weighed shrunk at 28-day intervals. A 16-hour pre-weighing fasting period was imposed to minimize gut-fill effects on body weight measurements (i.e., fast from both water and feed). The average daily gain (ADG) was calculated as the increase in body weight of the steers divided by the number of days between weightings.

Brazilian beef industries require carcasses with a minimum of 240 kg and 3 mm of fat thickness at the 12-13th ribs. Thus, these two conditions were observed in order to send animals to slaughter. Fat thickness was monitored throughout the second dry season using an ultrasound device. The animals considered finished were slaughtered, their carcasses were weighted and fat thickness, determined.

*S*tatistical analysis

Data were grouped and analyzed according to periods (first dry period, rainy period and second dry period), using the SAS GLM Procedure (Statistical Analysis System, version 9.4). The applied model included the fixed effects of the supplement offered in the first dry period, genetic group and the interactions between them. The means were compared with Tukey's test at 5% significance level.

Economic analysis

In the economic analysis, a partial budgeting approach (Hoffmann et al. 1987) was employed, calculating additional costs and benefits of CM + CM in relation to the usual PMM + CM treatment for each genetic group and for cattle as a single group, regardless of breed. For the partial budgeting, additional costs are expressed as increased costs and reduced revenues, while the additional benefits correspond to reduced costs and increased revenues.

Thus, the balance of the partial budgeting, which originates net gain or loss, was constituted as follows: a) additional benefits - cost reduction of non-use of PMM in the first dry season and decreased intake of CM in the second dry season; increased revenue from higher beef production and financial gain due to advancing slaughter; and b) additional costs - increased cost due to the use of CM in the first dry season.

The financial gain due to earlier slaughter is the interest earned (real rate of 0.5% per month) on the total value of the beef carcass for the period corresponding to such advance.

In the concentrated mix used, corn and soybeans correspond to 31% and 64% of total cost, thus encompassing 95% of it, at June 2013 prices. Due to these figures and to the variability of prices of such ingredients and the finished steer, the Monte Carlo method (see, among others, Ladaga and Berger 2006) was added to the partial budgeting, making the analysis stochastic and complementing the deterministic approach.

Monthly prices of soybeans, corn and finished steers from the last nine years (January 2004 to December 2012) were obtained from CEPEA (2017) and, using the general price index (IGP-DI) of Fundação Getúlio Vargas (2017), real prices for December 2012 were computed. Based on that, the parameters (mean and standard deviation) of the probability distributions of the three price series, assumed as normal, were calculated.

From these data, and using the random number generator from Excel, 200 iterations were obtained, then the random net gain or loss (per animal) resulting from the CM + CM strategy was calculated. To better figure out the resulting numbers, the gain or loss was also expressed for a 500-head herd, resembling a commercial scale.

RESULTS AND DISCUSSION

First dry season

There was no interaction (p=0.8826) between supplement and genetic group for the average daily gain (ADG) during the first dry period season. All animals gained weight during this period (Table 1), indicating that both supplements were effective to compensate deficiencies in forage protein or energy (Table 2) and promoted an additive effect on forage consumed. However, the ADG was greater for steers supplemented with CM than for those supplemented with PMM, as shown in Table 1. Forage mass, morphological components and nutritive value did not vary between the pastures in which the animals received one or the other supplement (Table 2), thereby ensuring that the difference in weight gain was a result of the supplement used (CM or PMM). Thus, this better performance could be explained not only by the higher energetic density, but also by the greater intake of the CM supplement in relation to the PMM supplement (Table 1), which resulted in greater nutrient intake. On the other hand, the PMM supplement was fed in a small amount and led to a positive but relatively small daily gain. Similar results were observed by Garcia et al. (2014) for animals grazing deferred palisade grass and supplemented with similar supplements at the same amounts during the dry season. Generally, these results are in agreement with the observation of Moore et al. (1999), who reported the lowest increases in ADG when the supplement had high level of non-protein nitrogen and low level of TDN; conversely, the greatest increases in ADG were found with supplements featuring over 60% TDN and supplemental CP intake above 0.05% of BW.

Table 1. Means, standard error of the mean (SEM) and probability levels (p) for initial body weight, supplement intake, average daily gain, body weight at slaughter, fat thickness, carcass weight, and slaughter age according to supplements used in the first dry season, protein-mineral mixture (PMM) or concentrated mix (CM).

	Supplement			
	PMM	CM	SEM	p
First dry period (May to September 2006), deferred palisade grass				
Initial body weight (kg)	220	220	-	-
Supplement intake (kg/steer)	70	295	-	-
Average daily gain (kg/steer)	0.425	0.808	0.022	0.0001
Rainy period (October 2006 to April 2007), guinea grass under rotational grazing				
Initial body weight (kg)	280	323	4	0.0001
Average daily gain (kg/steer)	0.760	0.710	0.018	0.0018
Second dry period (May to September 2007), deferred palisade grass				
Initial body weight (kg)	413	447	7	0.0001
Supplement intake (kg/steer)	480	415	-	-
Average daily gain (kg/steer)	0.570	0.550	0.032	0.5633
Body weight at slaughter (kg)	487	492	2.42	0.1302
Fat thickness (mm)	3.7	4.0	0.15	0.2516
Carcass weight (kg)	259	261	3.4	0.1753
Slaughter age (no. of months)	22.6	21.1	0.3	0.0001

There was no interaction (p=0.4146) between supplement and month for ADG; however, the steers performed worse during the last two months of the first dry period. Regardless of the supplement provided, the means and standard error for ADG were 690, 700, 660, 530 and 500 ± 0.02 g/steer, respectively, for May, June, July, August and September. As the amount of supplement was constant throughout the dry season (% of BW), this decrease in weight gain could be explained in part by the decrease in forage mass, leaf percentage and nutritive value throughout the dry period (Table 2). In the current study, forage mass, sward structure and nutritive value showed the same pattern of variation throughout the dry season described by Euclides et al. (2007) for deferred palisade grass pastures.

Table 2. Means, probability levels (p), correlation coefficient (r^2), and linear equation for forage mass (FM), leaf, stem and dead matter percentages, crude protein (CP), *in vitro* organic matter digestibility (IVOMD), neutral detergent fiber (NDF), acid detergent lignin (ADL), and stocking rate (SR) in *B. brizantha* cv. Marandu pastures deferred in February and continuously grazed during the dry season.

	Paddock effect		Month effect		
	p	Means	p	r^2	Equation[1]
First dry period (May to October 2006)					
FM (kg/ha)	0.1726	3,890 (62)	0.0001	0.89	y = 5462 – 450x
Leaf (%)	0.8076	23.6 (1.5)	0.0001	0.77	y = 44.8 – 6.0x
Stem (%)	0.4273	21.4 (1.9)	0.0626	-	-
Dead material (%)	0.5243	54.8 (2.2)	0.0001	0.82	y = 31.6 + 6.7x
CP (%)	0.5927	6.1 (0.2)	0.0001	0.89	y = 8.8 – 0.63x
IVOMD (%)	0.6618	49.1 (0.9)	0.0001	0.64	y = 50.3 – 0.34x
NDF (%)	0.3110	74.7 (1.0)	0.0001	0.56	y = 71.2 + 1.57x
ADL (%)	0.1722	3.4 (0.2)	0.0001	0.54	y = 2.6 + 0.29x
SR (AU/ha)	0.0891	1.5 (0.4)	0.0001	0.91	y = 1.2 + 0.1x
Second dry period (May to October 2007)					
FM (kg/ha)	0.0860	3,065 (93)	0.0001	0.88	y = 4,252 – 295x
Leaf (%)	0.8407	17.9 (1.2)	0.0001	0.91	y = 33.8 – 4.0x
Stem (%)	0.8093	20.5 (1.3)	0.1754	-	-
Dead material (%)	0.8761	61.6 (1.9)	0.0001	0.79	y = 44.1 + 4.3x
CP (%)	0.2739	6.1 (0.3)	0.0001	0.89	y = 8.5 – 0.7x
IVOMD (%)	0.8414	46.1 (0.9)	0.0002	0.64	y = 50.6 – 1.1x
NDF (%)	0.6738	73.5 (1.4)	0.8376	-	-
ADL (%)	0.1251	3.7 (0.2)	0.0001	0.54	y = 3.4 + 0.23x
SR (AU/ha)[2]	0.1974	1.9 (0.2)	0.0001	0.68	y = 2.8 – 0.23x

[1] x = months during the dry seasons (May = 1...... September = 5); [2] AU = 450 kg body weight.

Rainy season

During the rainy season, steers supplemented with PMM performed better than those which received CM during the preceding dry season (Table 1). However, such gain was not enough to allow them to reach the same body weight at the end of the rainy period (Table 1). The difference in body weight between the CM and PMM groups decreased from 43 kg at the beginning of the rainy season to 34 kg at the end of the same period (Table 1). A similar ADG was observed by Difante et al. (2010) and Euclides et al. (2014) for steers grazing Tanzania guinea grass managed under the same criterion during the rainy season.

The pre-grazing forage mass, morphological components and nutritive value did not vary among guinea grass paddocks (Table 3). The use of a plant-growth-based criterion such as pre-grazing canopy height around 70 cm to define intervals between successive grazing resulted in low variability in sward structure and nutritive value during spring and summer. However, the highest stem percentage and lowest leaf percentage values were observed in autumn (Table 3). It is probable that these circumstances contributed to an increase in the difficulty of selecting and apprehending the forage, in addition to a decrease in the nutritive value of the available forage (Table 3), resulting in lower ADG during that season (Table 3). These changes could be explained by the flowering of the grass, which occurs in mid-April in Campo Grande (lat. 20°25'S). It is known that, after the inflorescence emerges, stem elongation increases and forage nutritive value decreases. A similar pattern of canopy structure, forage nutritive value and animal performance variations over the rainy season was found in Tanzania guinea grass managed likewise (EUCLIDES et al. 2014).

Table 3. Pre-grazing means and probability levels (p) for rest period, forage accumulation rate, forage mass, leaf and stem percentages, crude protein, *in vitro* organic matter digestibility (IVOMD), neutral detergent fiber, average daily gain and stocking rate in *P. maximum* cv. Tanzania pastures subjected to rotational grazing from October 2007 to May 2008.

	Paddock effect	Season effect			
	p	Spring	Summer	Autumn	p
Rest period (days)	0.3935	32.4b (1.6)	28.3b (1.1)	41a (1.8)	0.0001
Forage accumulation rate (kg/ha day)	0.6194	69.9ab (7.1)	87.9a (4.9)	45.2b (7.9)	0.0011
Forage mass (kg/ha)	0.1349	4795a (38)	4920a (36)	4200b (57)	0.0001
Leaf (%)	0.0715	69.7 (0,7)	70.0 (0.7)	62.3 (1.1)	0.0001
Stem (%)	0.9857	16.2b (0.8)	16.5b (0.7)	24.8a (1.2)	0.0001
Crude protein (%)	0.3995	15.1a (0.3)	15.5a (0.3)	12.9b (0.5)	0.0003
IVOMD (%)	0.1440	67.6a (0.6)	67.8a (0.6)	62.9b (0.9)	0.0002
Neutral detergent fiber (%)	0.3553	71.3 (0.6)	71.7 (0.6)	74.1 (0.5)	0.0444
Average daily gain (kg/steer)	0.6396	0.805a (0.1)	0.820a (0.1)	0.570b (0.2)	0.0001
Stocking rate (AU/ha)[1]	0.2570	3.3c (0.05)	3.9b (0.05)	4.3a (0.04)	0.0001

[1] AU = 450 kg body weight; Values in parentheses are standard errors of the difference.

Second dry season

During the second dry season, as a consequence of the similarities between the pastures (Table 2) and the use of the same supplement, the animals showed the same ADG (Table 1). However, steers supplemented with PMM in the first dry season extended the time needed to reach the slaughter criteria by 45 days compared to those supplemented with CM (Table 1). The animal performance observed was in agreement with the ADG observed by Canesin et al. (2007), Sales et al. (2008) and Morais et al. (2014) for steers grazing palisade grass and supplemented with similar supplements during the dry season.

There was no interaction between genetic group and month (p=0.0671) for ADG; however, ADG differed (p=0.0001) throughout the second dry period. The means and standard error were 560, 775, 605, 570 and 400 ± 0.03 g/steer, respectively, for May, June, July, August and September. The lower animal performance in May in relation to June could be explained by adaptation of the steers to the supplement and to pastures of lower nutritive value since they were moved from guinea grass (Table 3) to palisade grass pastures (Table 2). On the other hand, the decrease in ADG from June to the end of the dry season was probably the result of decreases in forage mass, leaf percentage and nutritive value over the dry period (Table 2).

Additionally, fat thickness and carcass weight were similar between CM and PMM groups (Table 1). On the other hand, reducing slaughter age required the use of over 150 kg of supplement, during the second dry season for animals of the CM group (Table 1).

Genetic group

There were differences among genetic groups for all traits analyzed except fat thickness (Table 4), which was expected since it was defined as the end point for slaughter. As far as ADG is concerned, the trend favored ½Angus-½Nellore animals, which gained 0.710 kg per day during the whole period as opposed to 0.610 kg for the other three groups. This might be the result of better performance of F1 animals compared to the ones with higher percentage of European genetics in their composition, which has been observed in different experiments. Similar results were obtained by Cruz et al. (2009) when evaluating Nellore, ½Canchim-½Nellore, ½Angus-½Nellore and ½Simmental-½Nellore.

Table 4. Means, standard errors of the mean (SEM) and probability levels (p) for average daily gain (ADG) in the first dry period (FDP), rainy period (RP) and second dry period (SDP), body weight at slaughter (BWS), fat thickness, carcass weight, and slaughter age (SA), according to genetic groups.

	Genetic groups[1]					
	AN	Canchim	BfAN	BhAN	SEM	p
ADG FDP (kg/steer/day)	0.70a	0.66a	0.55b	0.56b	0.03	0.0001
ADG RP (kg/steer/day)	0.81a	0.67c	0.74b	0.72ab	0.03	0.0470
ADG SDP (kg/steer/day)	0.62a	0.49b	0.57a	0.55ab	0.02	0.0277
BWS (kg)	475b	495a	493a	490a	1.4	0.001
Fat thickness (mm)	4.1	3.6	3.9	3.8	0.3	0.3895
Carcass weight (kg)	256b	265a	263a	255b	1.5	0.0001
SA age (no. of months)	19.2c	23.3 a	22.2b	22.7ab	0.3	0.0001

Means followed by the same letter within rows do not differ (p>.05) by Tukey's test.
[1]½Angus-½Nellore (AN); ½Braford-¼Angus-¼Nellore (BfAN); ½Brahman-¼Angus-¼Nellore (BhAN); and ⅝Charolais-⅜Nellore (Canchim).

The F1 Angus-Nellore also outperformed all the others in relation to precocity since they had the lowest age at slaughter, which was evaluated considering fat thickness as end point. Aligned with the early-maturing characteristic of this genetic group, it also had the lowest slaughter weight. On the other hand, the crossbred animals with European continental breed (Charolais) and/or Zebu breeds (Brahman and Nellore) in their composition tend to reach higher weights for a given end point measured as fat thickness at the 12-13th ribs. These results were because these breeds are late maturing, which means that fat deposition starts later in life compared to breeds which are, in contrast, early maturing, such as the British breeds (Angus and Hereford). The reduction in ADG of Canchim animals during the second dry period might be a result of their higher maintenance requirements. Additionally, it might be observed that these late-maturing animals stayed longer under grazing in order to reach the desired fat thickness as a result of a combination of slow fat deposition with lower daily weight gain. These conditions might be useful in a production system where feedlot is used to finish the animals as observed in the results obtained by Leme et al. (2000) and Cattelam et al. (2014).

Economic analysis

The partial budgeting balance, with finished steers, soybeans and corn prices taken as averages, is presented in Table 5. The AN group is the only one with net gain at BRL 2.73/animal. BfAN had the largest net loss (BRL 66.09/animal), followed by Canchim (loss of BRL 34.71/animal) and BhAN (loss of BRL 0.56/ animal). The AN group had the lowest value for increase in meat production and the highest additional cost from the intake of CM in the first dry season. These financial disadvantages, however, are offset, albeit with a small margin, by the decreasing intake of CM in the second dry season, by the larger financial impact of early slaughter and by the greater financial repercussions of not using PMM during the first dry season. It is noteworthy that, without the financial gain from slaughter advancement, AN would have a net loss rather than net gain.

In the results from the Monte Carlo method (Table 6), which considers the more likely net gain/loss, the genetic groups kept the previously described ranking, as expected, with AN as the best and BfAN as the worst alternative. However, all groups are subject to negative results, even AN, though with a probability of 39.5%. For BfAN and Canchim, this probability is 100%. Winning or losing are equally probable events to BhAN as the chance of a negative result is around 50%. This genetic group shows the highest maximum value (gain of BRL 12.7 thousand for 500 cattle, against BRL 11.7 thousand from AN), but its minimum value is -BRL 13.4 thousand, against -BRL 9.5 thousand of AN. These figures show there is no absolute financial dominance by a genetic group, so a choice between AN and BhAN depends on the risk profile of the decision-maker (choosing BhAN may bring higher gain but also greater loss in comparison with AN).

Considering all genetic groups together (Table 6), and, therefore, getting close to the animal variability normally found in cattle herds, replacing protein-mineral mixture by concentrated mix in the first dry season has a 97.5% chance of financial losses, while the more likely figure for 500 cattle is -BRL 12.5 thousand. In short, it is a highly risky strategy, in economic terms, as only one genetic group showed positive results.

Table 5. Supplementation of steers (four genetic groups) with concentrated mix (CM) in the first dry season: partial budgeting with real prices for finished steers, soybeans and corn - average for the period 2004-2012.

Partial budgeting components (BRL/head)	Genetic groups[A]			
	AN	BfAN	BhAN	Canchim
Additional benefits	215.99	136.79	196.77	168.86
Cost reduction - non-use of PMM in the 1st dry season	45.76	43.32	42.10	42.10
Cost reduction - decreased consumption of CM in the 2nd dry season	148.95	78.50	119.79	84.56
Increased revenue - increased beef production	2.18	11.31	20.45	30.89
Financial gain - early slaughter	19.10	3.66	14.44	11.31
Additional costs				
Increased cost - using CM in the 1st dry season	213.26	202.88	197.34	203.57
Net gain/lost	2.73	(-66.09)	(-0.56)	(-34.71)

[A]½Angus-½Nellore (AN); ½Braford-¼Angus-¼Nellore (BfAN); ½Brahman-¼Angus-¼Nellore (BhAN); and ⅝Charolais-⅜Nellore (Canchim).

Table 6. Supplementation of steers (by genetic groups and cattle as a single set) with concentrated mix in the first dry season: partial budgeting with stochastic real prices for finished steers, soybeans and corn.

		Genetic groups[1]				All breeds together
		AN	BfAN	BhAN	Canchim	
Probability of values < 0	%	39.5	100.0	52.5	99.5	97.5
		Net gain/loss for 1 head of cattle (BRL)				
More likely value (average)	BRL	2.44	-67.14	-0.88	-35.43	-25.18
Maximum value	BRL	23.40	-28.10	25.42	4.33	6.34
Minimum value	BRL	-18.91	-107.19	-26.81	-74.67	-55.68
		Net gain/loss for 500 cattle (BRL)				
More likely value (average)	BRL	1,220.18	-33,570.12	-440.23	-17,714.83	-12,592.28
Maximum value	BRL	11,698.14	-14,052.36	12,709.95	2,167.10	3,167.60
Minimum value	BRL	-9,453.38	-53,595.65	-13,403.02	-37,332.71	-27,838.05

[1]F1 Angus-Nellore (AN); ½Braford-¼Angus-¼Nellore (BfAN); ½Brahman-¼Angus-¼Nellore (BhAN); and ⅝Charolais-⅜Nellore (Canchim).

CONCLUSIONS

Steers receiving small amounts of supplement during the first dry season performed better in the subsequent rainy season; however, it is not enough to allow them to reach the slaughter point at the same age.

The use of an early-maturing genetic group fed a reasonable diet might result in better economical and biological performances.

Irrespective of the genetic group, using concentrated mix since the first dry season is a risky option in economic terms.

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REUMO: O experimento foi conduzido de maio de 2016 a outubro de 2017 com o objetivo de avaliar as eficiências biológica e econômica de animais exclusivamente em pastos, da desmama ao abate. Foram avaliados dois níveis de suplementação alimentar combinados com quatro grupos genéticos durante o período seco: F1 Angus-Nelore; ½Braford-¼Angus-¼Nelore; ½Brahman-¼Angus-¼Nelore; e ⅝Charolais-⅜Nelore, seguindo-se um arranjo fatorial 4 x 2 com oito repetições em delineamento completamente ao acaso. Durante os dois períodos secos avaliados, oito piquetes de *Brachiaria brizantha* diferida foram utilizados. No primeiro período seco, mistura concentrada (MC) e mistura mineral múltipla (MMM) foram fornecidas nas quantidades de 0,8 e 0,2% do peso vivo (PV), respectivamente, durante 142 dias. Durante a estação das águas subsequente, todos os animais foram transferidos para oito piquetes de *Panicum maximum*, por 197 dias. No segundo período seco, os animais foram alocados nos mesmos oito piquetes de braquiária utilizados no período seco anterior e receberam suplementação alimentar MC, no mesmo nível, 0,8% PV utilizado anteriormente. Animais suplementados com MC apresentaram maior ganho de peso que animais recebendo MMM; entretanto, durante o período chuvoso, estes animais apresentaram melhor desempenho que àqueles que receberam MC durante o período seco. Animais Angus-Nelore apresentaram desempenho superior aos demais cruzamentos, destacando-se a precocidade da raça em alcançar o ponto de abate. A utilização de suplemento concentrado desde a primeira seca após desmama é uma opção de risco econômico, uma vez que apenas o grupo genético Angus-Nelore apresentou pequeno incremento positivo de ganho.

PALAVRAS-CHAVE: *Brachiaria brizantha*. Diferimento. Suplementação. *Panicum maximum*. Pastejo intermitente.

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