Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1806-2636
ISSN on-line: 1807-8672
Doi: 10.4025/actascianimsci.v39i2.33452

Production and economic viability of feedlot beef cattle categories

Petrônio Batista dos Santos[1], Hermógenes Almeida de Santana Júnior[2*], Marcos Jacome de Araújo[1], Aracele Prates de Oliveira[2], Tiago Brandão Freitas[3] and Pablo Teixeira Viana[4]

*[1]Universidade Federal do Piauí, Bom Jesus, Piauí, Brazil. [2]Universidade Estadual do Piauí, Avenida Joaquina Nogueira, s/n., 64900-000, Corrente, Piauí, Brazil. [3]University of Illinois Urbana-Champaign, Urbana, Illinois, United States of America. [4]Faculdade de Guanambi, Guanambi, Bahia, Brazil. *Author for correspondence. E-mail: hsantanajunior@hotmail.com*

ABSTRACT. This study was realized to evaluate the production and economic viability of finished beef cattle in feedlot in the *Cerrado* biome of Piauí State, Brazil. One hundred and fifty cattle -50 bulls (B) with an body weight of 283.0 ± 20.82 kg, at 30 months of age; and 100 cull cows (CC) with an body weight of 296.1 ± 17.80 kg, at 100 months of age- were used in a completely randomized design. The animal performance indicators for the evaluation of economic viability were initial age (months), slaughter age (months), was initial body weight (kg), final body weight (kg), daily feed intake (kg animal^{-1}; kg kg^{-1} BW), diet cost (R$ kg^{-1} of diet), cost of kg produced (R$ kg^{-1} produced), and average price of the kg of meat for finishing (R$). The CC consumed more sorghum silage and concentrate than B ($p < 0.05$).There was a difference between the categories ($p < 0.05$) for gross revenue, balance, opportunity cost, and net revenue per animal, with higher values found for the steer category. The animal category did not affect the profitability of the system, although the bulls provided lower revenues than cull cows.

Keywords: performance, production systems, rate of return.

Produção e economicidade de categorias de bovinos de corte em confinamento

RESUMO. Objetivou-se avaliar a produção e a viabilidade econômica de bovinos de corte confinados no bioma Cerrado do estado do Piauí, Brasil. Cento e cinquenta bovinos - 50 novilhos não castrados (NNC) com peso corporal de 283,0 ± 20,82 kg, aos 30 meses de idade; e100 vacas de descarte (VD) com peso corporal de 296,1 ± 17,80 kg, aos 100 meses de idade - foram utilizados em delineamento inteiramente casualizado. Os indicadores de desempenho animal para a avaliação da viabilidade econômica foram idade inicial (meses), idade de abate (meses), peso corporal inicial (kg), peso corporal final (kg), ingestão diária de alimento (kg animal^{-1}; kg custo de alimentação^{-1} (R$ kg^{-1} de dieta), custo por kg produzido (R$ kg^{-1} produzido) e preço médio do kg de carne para acabamento. Essas variáveis foram obtidas a partir da coleta de dados realizada durante o experimento. As VD consumiram mais silagem e concentrado de sorgo do que os NNC ($p < 0,05$). Houve diferença entre as categorias ($p < 0,05$) para a receita bruta, o saldo, o custo de oportunidade e a receita líquida por animal, com maiores valores encontrados para NNC. A categoria de animais não afetou a rentabilidade do sistema, embora os novilhos tenham fornecido menores receitas do que as vacas de descarte.

Palavras-chave: desempenho, sistemas de produção, taxa de retorno.

Introduction

In view of the great competition between crop and livestock and the high demand for land, the feedlot stands out as a good option in beef cattle farming, because when the adequate management techniques are applied and investments are made at the right time, this rearing system becomes economically viable (Silva et al., 2010).

Like any activity of the livestock sector, in order to maintain competitiveness, this activity must be constantly evaluated, especially with respect to economic aspects. In this regard, the production costs of the activity, including the net revenue and the rate of return of the invested capital, are important factors for the success of any production system (Silva et al., 2010).

Compared with other countries, Brazil still has a low percentage of animals finished in feedlot; however, the feedlot practice is increasingly present in relation to previous years, which is explained by the increased amount of grains in the market, coupled with the increasing food alternatives to make up diets (Leão et al., 2012).

Among other factors, for cattle production to be economically viable and competitive, the animals must be provided with the conditions to exteriorize the maximum performance of their genetic potential through the supply of a balanced, low-cost diet

aimed at achieving the weight conditions for the earliest slaughter possible (Geron, Mexia, Garcia, Silva, & Zeoula, 2012).

In the *Cerrado* region, most producers do not have the habit to finish cull cows in feedlot, since they are old, unappreciated animals. Consequently, they are finished on pasture and sold for a low price. In light of this fact, this study proposes to show that it is viable to finish this category by making comparisons with bulls.

The Brazilian literature lacks information on the productive comparison between finishing bulls and cull cows in feedlot associated with their weight gains, acquisition price, among other particular factors of each category. Given these considerations, the present study was realized to evaluate the production and economic viability of bulls and cull cows finished in the feedlot in the Cerrado, Piauí State.

Material and methods

This study was conducted after being approved by the Ethics Committee in Animal Use (Ceua) of the State University of Piauí, under number. 10.920/15.

The experiment was conducted on Branquinha farm, located in of Correntecounty (10° 26' 30" S latitude and 45° 9' 52" W longitude). Minimum and maximum temperatures in the region are 23 and 39ºC, respectively, and the climate is hot and semi-humid. The average annual precipitation is 900 mm, and the rainy period is concentrated between November and February, but can extend to May.

One hundred and fifty Nellore crossbred cattle were used in the experiment, including 50 bulls with an average initial weight of 283.0 ± 20.82 kg, at 30 months of age, and 100 cull cows with an average initial weight of 296.1 ± 17.80 kg, at 100 months of age. Animals were separated according to the following treatments: bulls (B) and cull cows (CC), in a completely randomized design.

The experimental area consisted of two paddocks for finishing (compacted dirt floor, flat wire partitions, uncovered half-drum troughs, and floating valve drinkers), with an area of 20 m^2 $animal^{-1}$. Each paddock had 200 L half-drum troughs with 50 cm per animal, and masonry drinkers. All animals were vaccinated against (Inactivated culture of *Clostridium chauvoei* and *C. botulinum* type C and D toxins, *C. septicum*, *C. novyi*, *C. perfringens* type B, C and D and *C. sordelli.*) and pulmonary diseases (Virus cultures IBR, BVD, PI3, *Pasteurella multocida*, *Mannheimiahaemolytica* (*Pasteurella*), *Haemophilussomnus*, inactivated and absorbed in aluminum hydroxide with saponin), dewormed, and identified to be included in the experiment.

The experiment comprised the period from August to October 2013, starting with 15 days of adaptation of the animals until visual finishing of the animals in each category (86 days for bulls and 42 days for cull cows). During the 15 day adaptation period, 16 kg of sorghum silage and 1 kg concentrate were provided per animal daily, and the concentrate was increased by 0.5 kg every three days, following the method of steps.

The diet was formulated aiming to meet the requirements of maintenance and weight gain of 1.5 kg per day (National Research Council [NRC], 1996). The feed was supplied (Table 1) *ad libitum*, with orts adjusted to 10%, at four times daily: 6, 10, 14 and 18 hours. The roughage: concentrate ratio was 54:46, and was similar across the treatments.

Table 1. Proportion of ingredients and chemical composition of the diet.

Proportion of ingredients (g kg^{-1} dietary DM)	
Sorghum silage	540
Ground corn	361
Soybean meal	70
Urea	08
Mineral mix[1]	21
Chemical composition (g kg^{-1})	
Dry matter	574
Organic matter	541
Crude protein	149
Mineral matter	42
Neutral detergent fiber corrected for ash and protein	250
Acid detergent fiber	101
Non-fibrous carbohydrates	517
Ether extract	38
Total digestible nutrients*	744

Composition per kg: calcium 180 g, phosphorus 20 g, iodine 25 mg, magnesium 17 g, manganese 840 mg, monensin 833 mg, selenium 7 mg, sodium 86 g, virginiamycin 500 mg, cobalt 25 mg, copper 420 mg, iron 490 mg, vitamin A 83, 200 IU, vitamin D3 10,400 IU, vitamin E 242 IU, zinc 2,000 mg.*Estimated by National Research Council (NRC, 1996).

Feed and orts samples were collected weekly and pooled to form a composite sample. Stool samples were collected directly into the rectal ampulla. These were packed in labeled plastic bags and stored at −10ºC for subsequent analyses.

Samples of diet, orts, and feces were pre-dried in a forced-air oven at 55ºC for 72 hours. The dry matter (DM, method 967), crude protein (CP, method 981, 10), mineral matter (MM, method 942), and ether extract (EE, method 920) contents were analyzed according to Association of Official Analytical Chemists (AOAC, 1990). Neutral detergent fiber corrected for ash and protein (NDFap) and acid detergent fiber (ADF) were analyzed by the sequential method, following Van Soest, Robertson, and Lewis (1991). Non-fibrous

carbohydrates (NFC) were calculated by the following Equation 1, proposed by Hall (2009):

$$NFC = 100 - [(\%\ CP - \%\ CP\ from\ urea + \%\ urea) + \%\ NDF + \%\ EE + \%\ ash] \quad (1)$$

The performance indicators for the evaluation of economic viability were initial age (months), slaughter age (months), initial body weight (kg), final body weight (kg), daily feed intake (kg animal^{-1}; kg kg^{-1} BW), cost of diet (R$ kg^{-1} of diet), cost of kg produced (R$ kg^{-1} produced), and average price of the kg of meat for finishing (R$). These variables were obtained from data collected during the experiment.

The following economic indicators were evaluated in the study: Average daily gain (ADG; g day^{-1}) = slaughter weight minus weight at the beginning of the experiment divided by the experimental period; Relative intake (kg of diet kg^{-1}) = (daily intake (kg of diet consumed animal^{-1}) divided by ADG (kg); Cost with diet kg^{-1} (R$ kg^{-1}) = Consumed amount of each ingredient multiplied by its purchase price; Cost with labor plus charges (R$ kg^{-1}); costs with depreciation and maintenance of betterments (R$ kg^{-1}); costs with administration and fees (R$ kg^{-1}) = Average cost (R$ kg^{-1}) were obtained from the updated Anualpec (2012).

Subtotal (R$ kg^{-1}) = Sum of costs with diet, labor and charges, depreciation and maintenance of betterments, and administration and fees.

Other expenses = Subtotal (R$ kg^{-1}) multiplied by 5%. Total cost per kg= Sum of subtotal and other expenses (R$ kg^{-1}); Gross revenue (R$ kg^{-1}) = Average price of the kg of finished meat multiplied by the body weight in kg of meat; Balance (R$ kg^{-1}) = Gross revenue minus the total cost (R$ kg^{-1}) and the animal purchase cost; Animal purchase price multiplied by the average percentage of the General Market Price Index (IGP-M) of the months of August, September, and October (months of the experiment) in the different productive sectors of the country between the years 2006 and 2010, according to Fundação Getúlio Vargas.

Net revenue (R$ kg^{-1}) = Balance minus opportunity cost.

Rate of return (R$ every^{-1} R$ 1.00 invested) = Revenue divided by the total invested, expressed as return in R$ for every R$1.00 (one Real) invested.

Profitability (% month^{-1}) = Net revenue divided by the invested capital multiplied by 100.

Results were subjected to an analysis of variance using the 'F' test at the 0.05 probability level, on the System for Statistical and Genetic Analyses - Saeg (version 9.1).

Results and discussion

Cull cows (CC) consumed more sorghum silage and concentrate than bulls (B) ($p < 0.05$) (Table 2). The higher intake of cows can be explained by their higher maintenance and production requirements (NRC, 1996). In bulls, the energy reserve is larger than that of cull cows, because the latter have a compensatory gain (Moura et al., 2013).

Table 2. Intake of feedlot-finished beef cattle categories.

Variable	Category		CV (%)	P
	B	CC		
Silage intake (kg DM)	4.59 ± 1.02	5.50 ± 0.64	15.3	0.03261
Concentrate intake (kg DM)	3.96 ± 0.85	4.76 ± 0.93	12.8	0.04454
Total intake (kg DM)	8.55 ± 1.73	10.26 ± 1.11	13.4	0.03764

B = Bulls; CC = cull cows; CV = coefficient of variation.

No significant statistical difference was observed ($p > 0.05$) at the beginning of the experimental period. At the end of the period, the S were the heaviest ($p < 0.05$) (Table 3). Similar results were reported by Lage, Paulino, and Pires (2012), who evaluated bulls, females, and ovariectomized females of the Nellore breed and found heavier weights at the beginning of the experimental period for bulls, and Rotta et al. (2009) related of bulls finished in feedlots present higher final weight than steers, cull cows and heifers.

Table 3. Performance of feedlot-finished beef cattle categories.

Variable	Category		CV (%)	P
	B	CC		
IBW (kg)	283.0 ± 20.82	296.1 ± 17.80	12.37	0.06245
FBW (kg)	409.06 ± 32.799	347.20 ± 46.585	9.73	0.00001
WG (kg)	126.66 ± 28.898	64.11 ± 24.926	26.06	0.00001
ADG (kg)	1.48 ± 0.334	1.53 ± 0.593	29.02	0.12472
FC (kg MS kg GMD^{-1})	5.78 ± 1.145	6.71 ± 3.400	19.94	0.00001

B = Bulls; CC = cull cows; IBW = initial body weight; FBW = final body weight; WG = weight gain, ADG = average daily gain; FC = feed conversion; FE = feed efficiency. Means with $p < 0.05$ differed by the F test at the 5% significance level.

Given that the initial body weight was 282.4 kg for Band 296.1 kg for CC, it is inferred that both genders were in the finishing stage. Bulls had a lower adult weight than the Brazilian standards (480 kg).

The animal gender influenced ($p < 0.05$) the weight gain (WG), which was higher in bulls (S) (126.66 kg), while cull cows showed 64.11 kg. However, it did not influence ($p > 0.05$) their average daily gain (ADG) bulls (Table 3). Our findings corroborate the results found by Paulino et al. (2008), who evaluated the performance and intake at different concentrate-supply levels of bulls, steers, and females of the Nellore breed and detected higher body weight, weight gain, and feed intake for bulls.

The cattle categories differed ($p < 0.05$) with regard to feed conversion (FC), which were better in the B. The results for FC indicate greater biological efficiency for younger animals. The CC showed worse feed conversion (6.71 kg dry matter intake kg^{-1} WG) and lower feed efficiency (0.15 kg WG kg^{-1} dry matter intake). This finding was related to the physiological condition of lower proportion of fat in the carcass of the bulls at their age during the present study as compared with the cull cows.

The costs with labor, depreciation, betterments, administration, and fees did not differ between the categories ($p > 0.05$) (Table 4). This is explained by the fact that the same facilities were used at the same time by both categories, and labor was the same in both categories in the same period. Lopes et al. (2011) evaluated the finishing of Nellore bulls in the feedlot and found lower values for labor (R$ 1.59/kg) and depreciation (R$ 1.52/kg).

The low depreciation cost of betterments in the present study is a result of the low investment necessary for the facilities of this feed lot model (compacted dirt floor, flat wire partitions, uncovered half-drum trough, and float-valve drinkers).

The subtotal showed a difference between genders ($p < 0.05$).

There was a difference between the genders ($p < 0.05$) for the item 'other expenses'. This variable is used to encompass the additional expenses that may arise when the production cycle is extended. Thus, a similar percentage was considered for the categories (5%). Because the subtotal of the cost per kg of the B was lower than that of CC, the costs with other expenses followed the same trend.

The daily cost with feed was different (R$ 5.04 for Band R$ 6.05 CC), due to the difference in feed conversion, because the diet cost R$ 0.59 kg DM. This effect is a result of feed conversion, for which the animal genders showed a difference of 26.4%, increasing the feed cost, but providing the same weight gain for both categories.

Results obtained for the daily cost with feed indicate that the higher biological efficiency obtained by B resulted in a lower cost with feeding. Besides, the lower biological efficiency shown by CC resulted in a higher feed cost.

Significant differences were detected between the categories ($p < 0.05$) with regard to total cost kg^{-1}. The cost with bulls (R$ kg^{-1} 3.65) was lower than that of cull cows (R$ kg^{-1} 4.87); this was a high and interesting variation for the system that might even represent the sustainability or unsustainability of the feedlot.

There was a difference between the categories ($p < 0.05$) for gross revenue, balance, opportunity cost, and net revenue per animal, with higher values found for the steer category. However, this superiority in gross revenue is a consequence of the higher final weight obtained by this category. Mainly, it is emphasized that the value received per kg (R$ 3.20) is interesting for both categories as compared with the prices found in the region, thereby maximizing the gross revenue to the system.

The opportunity cost was calculated as the percentage of the fixed capital multiplied by the General Market Price Index (IGP-M), considering both data during the feedlot period (September to November). The opportunity cost of the bulls was higher due to the elevated fixed capital per animal, considering that in the finishing stage, the body weight of males is higher than that of cull cows.

The rate of return was higher for the cull cows gender(R$ R$ 1.30^{-1} invested), due to the lower fixed capital with them than with the bulls (R$ R$ 1.22^{-1} invested). The net revenue of B was higher than that of CC. The lower net revenue of the females was economically similar when the yield was visualized as a function of the invested capital.

Table 4. Economic viability of feedlot-finished beef cattle categories.

Variable	Category		CV (%)	P
	B	CC		
Cost with labor, R$ kg^{-1}	0.15 ± 0.024	0.16 ± 0.012	21.11	0.15643
Cost with depreciation and betterments, R$ kg^{-1}	0.06 ± 0,004	0.07 ± 0,002	21.11	0.08746
Cost with administration and fees, R$ kg^{-1}	0.12 ± 0.016	0.13 ± 0,008	21.11	0.08462
Subtotal, R$ kg^{-1}	3.48 ± 0.699	4.63 ± 2.288	21.11	0.00001
Other expenses, R$ kg^{-1}	0.17 ± 0.035	0.23 ± 0.114	21.11	0.00001
Total cost, R$ kg^{-1}	3.65 ± 0.735	4.87 ± 2.402	21.11	0.00001
Gross revenue, R$ $animal^{-1}$	1499.88 ± 120.264	1273.05 ± 170.811	84.12	0.00001
Balance, R$ $animal^{-1}$	207.30 ± 90.232	163.92 ± 82.583	7.59	0.00659
IGP-M opportunity cost, R$ $animal^{-1}$	9.33 ± 2.235	2.22 ± 0.393	452.61	0.00001
Net revenue, R$ $animal^{-1}$	197.97 ± 90.934	161.69 ± 82.528	5.25	0.02335
Rate of return, R$ R$ 1.00^{-1} invested	1.22 ± 0.084	1.30 ± 0.096	25.26	0.00001
Profitability, % Interest per month	16.28 ± 7.688	16.55 ± 8.567	0.037	0,10345

B = Bulls; CC = cull cows; CV = coefficient of variation. Means with $p < 0.05$ differed by the F test at the 5% significance level.

There was no difference between the categories ($p > 0.05$) in relation to profitability, and caused by the same reasons as those for the rate of return. However, the profitability variable is given in percentage, which facilitates their understanding and analysis when compared with the other productive sectors of the country. Although the production cost of the kg was higher than its acquisition price, the positive rate of return and profitability are a consequence of the premium (33.3%) on the value received per kg at slaughter. It is thus noteworthy that for sustainability to be achieved in this study, a representative premium is necessary during the feedlot period.

The profitability of the feedlot for finishing cattle is variable, considering that it is influenced by the variations imposed by the market on the prices of inputs and end product. This variability can also be clearly visualized between different regions of the country, in which inputs and meat products respond to regionalized market changes (Missio et al., 2009).

Conclusion

The feedlot-finished beef cattle category did not affect the profitability of the system, although bulls provided higher revenues in relation to cull cows. Thus, in a decision-making process, the producer may choose for both categories, as long as this system is used in the period during which feed is purchased at a lower price; animal feeds are purchased at the time of low prices paid per kg; and the sale occurs in the period of high prices per kg sold.

Acknowledgements

To Uespi, Fapepi and CNPq for the cost of the project and scholarships.

References

Anualpec. (2012). *Anuário da Pecuária Brasileira* (20a ed.). São Paulo: FNP Consultoria, 2012. 378p.

Association of Official Analytical Chemists. (1990). *Official methods of analysis* (15th ed.). Washington, DC: AOAC.

Geron, L. J. V., Mexia, A. A., Garcia, J., Silva, M. M., & Zeoula, L. M. (2012). Suplementação concentrada para cordeiros terminados a pasto sobre custo de produção no período da seca. *Semina: Ciências Agrárias, 33*(2), 797-808.

Hall, M. B. (2009). Determination of starch, including malto oligosaccharides, in animal feeds: comparison of methods and a method recommended for AOAC collaborative estudy. *Journal of AOAC International, 92*(1), 42-49.

Lage, I. N. K., Paulino, P. V. R., & Pires, C. V. (2012). Intake, digestibility performance, and carcass traits of beef cattle of different gender. *Tropical Animal Health Production, 44*(2), 361-367.

Leão, J. P., Neiva, J. N. M., Restle, J., Paulino, P. V. R., Santana, A. E. M., Miotto, F. R. C., & Missio, R. L. (2012). Consumo e desempenho de bovinos de aptidão leiteira em confinamento alimentados com glicerol. *Ciência Animal Brasileira, 13*(4), 421-428.

Lopes, L. S., Ladeira, M. M., Machado Neto, O. R., Silveira, A. R. M. C., Reis; R. P., & Campos, F. R. (2011). Viabilidade econômica da terminação de novilhos Nelore e Red Norte em confinamento na região de Lavras - MG. *Ciência e Agrotecnologia*, 35(4), 774-780.

Missio, R. L., Brondani, I. L., Freitas, L. S., Sachet, R. H., Silva, J. H. S., & Restle, J. (2009). Desempenho e avaliação econômica da terminação de tourinhos em confinamento alimentados com diferentes níveis de concentrado na dieta. *Revista Brasileira de Zootecnia, 38*(7), 1309-1316.

Moura, I. C. F., Kuss, F., Moletta, J. L., Perotto, D., Strack, M. G., & Menezes, L. F. G. (2013). Feedlot finishing cull cows fed diets with different levels of concentrate. *Semina: Ciências Agrárias, 34*(1), 399-408.

National Research Council [NRC]. (1996). *Nutrients requirements of beef cattle* (7th ed.). Washington, D. C.: NRC.

Paulino, P. V. R., Valadares Filho, S. C., Detmann, E., Valadares, R. F. D., Fonseca, M. A., Veras, M. L., & Oliveira, D. M. (2008). Desempenho produtivo de bovinos Nelore de diferentes classes sexuais alimentados com dietas contendo dois níveis de oferta de concentrado. *Revista Brasileira de Zootecnia, 37*(6), 1079-1087.

Rotta, P. P., Prado, R. M., Prado, I. N., Valero, M. V., Visentainer, J. V., & Silva, R. R. (2009). The effects of genetic groups, nutrition, finishing systems and gender of Brazilian cattle on carcass characteristics and beef composition and appearance: a review. *Asian-Australasian Journal of Animal Sciences, 22*(12), 1718-1734.

Silva, R. R., Prado, I. N., Carvalho, G. G. P., Silva, F. F., Almeida, V. V. S., Santana Júnior, H. A., ... Abreu Filho, G. (2010). Níveis de suplementação na terminação de novilhos Nelore em pastagens: aspectos econômicos. *Revista Brasileira de Zootecnia, 39*(9), 2091-2097.

Van Soest, P. J., Robertson, J. B., & Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber, and non starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science, 74*(10), 3583-3597.

Received on September 7, 2016.
Accepted on November 28, 2016.