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Performance of beef heifers of various genetic groups, supplemented or not, in coastcross pastures

A.A. RODRIGUES, G.M. DA CRUZ, R.T. BARBOSA, M.M. DE ALENCAR, L.A. CORRÊA and G.P. OLIVEIRA

EMBRAPA-CPPSE, C. P. 339, São Carlos, SP, Brasil, 13560-970 armando@cppse.embrapa.br

ABSTRACT

The objective of this study was to determine whether the performance of beef heifers of different genetic groups was affected by breed x nutritional environment interactions. Sixty four weaned heifers, 16 per genetic group: ½ Angus + ½ Nellore (AN), ½ Canchim + ½ Nellore (CN), ½ Simmental + ½ Nellore (SN) and pure Nellore (NE), were used with or without 3.0 kg of concentrate.animal^{-1}.day^{-1} in a fertilized coastcross pasture under rotational grazing system. There were effects of genetic group and supplementation (P<0.05) on the weight and age at first estrus, but there was no interaction between them. In a rotational grazing system with 4000 kg of available dry matter per hectare with 13% of crude protein, the crossbred AN, supplemented or not, was more precocious (111 days) than Nellore heifers, showing the first estrus at 356 days of age and 324 kg of live weight.

KEYWORDS: *Cynodon dactylon*, rotational grazing, supplementation, age at puberty

INTRODUCTION

The main factors related to animal production under grazing are availability of dry matter, sward canopy characteristics, nutritive value of grass species, pasture management, feed supplementation, genetic potential of the animal, reproductive aspects and interactions among them (Holloway et al., 1985 and 1993; Jenkins, and Ferrel, 1994; Hohenboken, 1996).

Concentrate supplementation, fertilization of tropical pastures and rotational grazing are important factors which affect availability of dry matter, forage nutritive value and as a consequence weight gain necessary for the animal to reach puberty as well reduce calving intervals, mainly in first calving cows (Holloway et al, 1993; Selk et al., 1988).

Little is known about the effects of dry matter availability of tropical pastures and its interaction with concentrate supplementation and animal genetic potencial, for grazing beef heifers, upon biological and economic efficiency, as mentioned for cows by Morris and Wilton (1976 and 1977).

The objective of this study was to determine, under tropical conditions, the effect of breed x nutritional environment (dry matter availability of coastcross and concentrate supplementation) interactions on weight and age of puberty of beef heifers on a fertilized coastcross rotational grazing system.

MATERIAL AND METHODS

Sixty four weaned female Nellore (NE) and crossbred calves (½ Angus + ½ Nellore (AN), ½ Canchim + ½ Nellore (CN), ½ Simental + ½ Nellore (SN) were used in a fertilized coastcross pasture under rotational grazing system at Embrapa-Southeast Cattle Research Center, in the State of São Paulo (Brazil).

Table 1 - Means of available dry matter per hectare, coastcross quality in the paddocks of the different genetic groups with and without concentrate supplementation and mean stocking rate (SR).

Genetic group	AN*		SN*		CN*		NE*	
Concentrate (kg .anim^{-1} . day^{-1})	0	3	0	3	0	3	0	3
DM (kg .ha^{-1})	3953	3904	4138	4646	4401	4010	3798	3937
CP (%)	13,1	14,4	13,6	13,4	13,9	13,3	12,5	13,3
FDN (%)	80,3	78,8	78,8	80,5	79,4	79,0	79,5	80,8
SR (AU.ha^{-1})	6,8	7,3	7,0	7,8	6,1	6,7	5,2	5,8

*AN-Angus x Nellore, SN–Simmental x Nellore, CN–Canchim x Nellore, NE-Nellore.

Experimental design was completely randomized, in a 4x2 factorial arrangement with four genetic groups (16 animals of each genetic group) and two levels of concentrate (zero and 3.0 kg . animal^{-1} . day^{-1}), two replications of area and a total of 80 paddocks (740m^2 each). Experiment began in 01/19/99 after a pre-experimental period of 35 days. Five paddocks were grazed by four animals in a 5-day grazing period and 20 days rest. Paddocks were fertilized wiht 20 kg of the formula 20:05:20 immediately after each grazing during the rainy season (300 kg of N . ha^{-1} . year^{-1}). Heifers had free access to water and mineral supplementation. The concentrate had 19% crude protein (CP) and 81% total digestible nutrients (TDN).

Available dry matter per hectare and forage quality were determined by sampling some paddocks of each treatment (5 samples of 0.5 m^2 per paddock per month). Paddocks were selected randomly and sampled during the months of february, march and april of the rainy season.

RESULTS AND DISCUSSION

Variation in live weight of the different genetic groups is shown in Figure 1. Mean weight gain for all treatments in the experimental period was 0.75 kg per animal per day. The crossbred heifers gained more weight (P<0.05) than the Nellore heifers. Gains were 0.78, 0.76, 0.81 and 0.64 for the crossbred AN, CN, SN and pure Nellore, respectively. There was no interaction between genetic group and level of supplementation. Heifers supplemented with 3 kg of concentrate per animal per day gained more weight (P<0.05) than the unsupplemented ones (0.86 x 0.63 kg animal^{-1} . day^{-1}). This aspect contrast with the interaction observed by Holloway et al., (1993) between herbage allowance and yearling heifer growth of Brahman-Hereford F_1 grazing humid pasture and semiarid rangeland.

The means of available dry matter per hectare, crude protein and neutral detergent fiber are shown in Table 1. There was high availabilty of dry matter per hectare as well a high quality coastcross forage in all sampled paddocks, with stocking rates varying from 5.2 to 7.8 A.U. These conditions allowed high gains in all treatments.

The mean age at first estrus for all treatments was 404 days. There was effect of genetic group (P<0.05), but there was no effect of level of supplementation neither interaction between genetic group and level of supplementation.

First estrus of the Nellore heifers were observed later (P<0.05) than the crossbred heifers. The mean age at first estrus was 467 days (NE), 405 days (SN), 386 days (CN) and 356 days (AN).The difference in age at first estrus between the crossbred AN and pure Nellore was 111 days. Better results with crossbred AN as compared to Zebu (Brahman) heifers were also obtained by Reynolds et al. (1979) in the subtropical climate of Louisiana Agricultural Experiment Station.

Mean live weight at first estrus for all treatments was 312 kg. There was effect (P<0.05) of genetic group and level of supplementation, but there was no interaction between genetic group and level of supplementation. Mean weight at first estrus was 346.6 kg (SN), 324.4 (AN), 300.6 kg (CN), and 276.6 (NE). There was difference (P<0.05) between AN and NE heifers, between SN and NE heifers, but there was no difference (P>0.05) between AN and CN, AN and SN and neither between CN and NE.

Mean weight at first estrus of the supplemented heifers (332.7 kg) was greater (P<0.05) than the mean weight at first estrus of the unsupplemented heifers (291.4 kg).

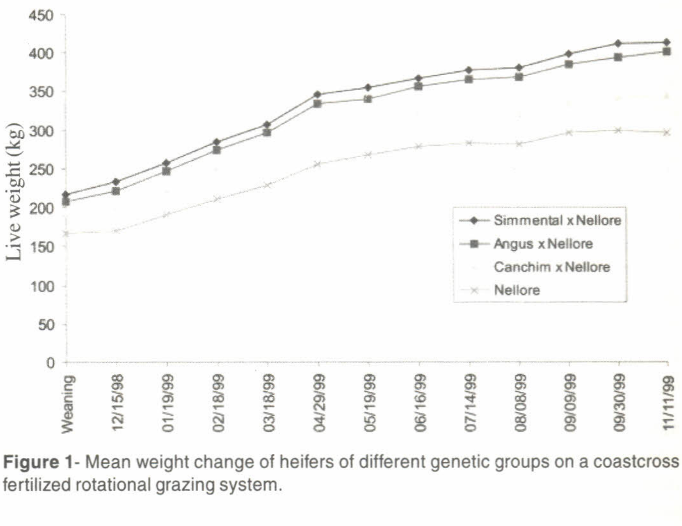

Figure 1- Mean weight change of heifers of different genetic groups on a coastcross fertilized rotational grazing system.

Based on these partial results, we conclude that with 4000 kg of available dry matter of coastcross per hectare with 13% of crude protein, under tropical climate, the crossbred AN heifers, supplemented or not, were more precocious (111 days) than Nellore heifers, showing first estrus at 356 days of age with 324 kg of live weight.

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ID # 19-10

A simulation model to evaluate supplementation of tropical forage diets for dairy cows

A.G. ASSIS[1], O.F. CAMPOS[1], J. DIJKSTRA[2] and J. FRANCE[3]

[1]*EMBRAPA/CNPGL, Juiz de Fora, MG, Brasil, 36038-330*

[2] *Wageningen Institute of Animal Sciences, 6709 PG Wageningen, The Netherlands*

[3]*Department of Agriculture, The University of Reading, Reading, Berks, RG6 6AT, U.K.*

ABSTRACT

A dynamic model of digestion kinetics has been built to evaluate dairy cattle diets based on tropical feeds and to estimate the potential of tropical forages for milk production associated with available supplements. Results of simulation were very consistent showing that grazed elephant grass alone can supply nutrients for cow maintenance and yield of 7.10 kg milk/day. Nevertheless, to produce 25 kg/day on grazed elephant grass, a dairy cow would need to be supplemented with 5.85 kg/day of a mixture of cottonseed meal (50%) plus ground maize (50%), while on maize silage it would be necessary 4.15 kg of the same supplementation. On the other hand, for the same amount of milk, a cow fed a sugarcane/urea-based diet would need 5.87 kg of the above mixture. As far as feeding cost is concerned, to reach the potential production of 25 kg of milk/day, a cow would expend US$ 1.19 on grazed elephant grass-based diet, as compared to US$ 1.40 on sugarcane- and maize silage-based diets. The present model showed to be an useful tool for assessing, pre-experimentally, the potential response to supplementation of dairy cows fed tropical forages.

KEYWORDS: Milk production, elephant grass, sugarcane, maize silage, supplements, feeding cost, simulation model, digestion kinetics

INTRODUCTION

Mathematical simulation models have been used to integrate and apply current knowledge of digestion kinetics in ruminant nutrition (France et al., 1998). Such models are useful tools for assisting dairy cattle feeding programmes in the tropics by pre-selecting potential sources of forage to be tested in the field.

A simulation model has been built to study supplementation of sugarcane for dairy cows in Brazil (Dijkstra et al. 1996). The model was able to predict nutrient flows through the gastrointestinal tract of Holstein-Zebu crossbred steers fed sugarcane-based diets. Furthermore, for dairy cows fed tropical forages, predictions of milk production by the model were very consistent (Kebreab et al., 2000; Rodrigues et al., 2000). The objective of this study is to use the model to assess the potential response of dairy cows fed tropical forage-based diets in association with increasing levels of locally available supplements.

MATERIAL AND METHODS

The gastrointestinal tract of a ruminant is represented in the model by three main compartments, namely: stomach - comprising rumen, reticulum, omasum and abomasum; small intestine - duodenum, jejunum and ileum; and large intestine - caecum, colon and rectum. Basically, the stomach contains twelve ruminal pools or state variables, namely: undegradable protein, insoluble degradable protein, soluble protein, ammonia, undegradable fibre, potentially degradable fibre, water soluble carbohydrates, volatile fatty acids, insoluble starch, lipids, microbes and endogenous protein. Amino acids, ammonia, glucose and lipids reaching the small intestine are represented as zero-pools, plus a full pool formed by endogenous protein from the stomach and small intestine. In the large intestine, six full pools - microbes, dietary protein, endogenous protein, fibre and starch - and two zero pools - ammonia and volatile fatty acids - are represented. Minerals and vitamins are not considered and assumed to be non-limiting. A complete description of the model structure and dynamics have already been reported elsewhere (Dijkstra et al.,1996).

The predictive ability of the model has been validated against experimental and literature data (Dijkstra et al., 1996; Oliveira 1990; Matos 1991; Kebreab et al., 2000; Rodrigues et al., 2000). In the present work, a version of the model, written in Continuous Simulation Modelling Program-CPSM for microcomputer, is used to simulate the potential response to increased levels of supplements of a dairy cow fed different sources of tropical forages. A simulation set of three types of forages - grazed elephant grass, fresh chopped sugarcane and maize silage - with four levels – 0: 2; 4 and 6 kg (dry matter basis) - of a mixture of cottonseed meal (50%) and ground maize (50%) was carried out. Individual feed characteristics are shown in Table 1, including production cost of forages and market price of supplements. Forage intake was fixed at 12.5 kg of dry matter (DM) for a 500-kg Holstein-Zebu crossbred cow with a potential milk production of 25 kg/day at the peak of lactation.

Table 1 - Chemical composition[(1)], degradation rates[(1)] and production cost[(2)] or market prices[(3)] of feeds used in the simulation trial.

Item[(4)]	Grazed elephant grass	Fresh chopped sugarcane	Maize silage	Ground maize	Cottonseed meal
DM (%)	19.60	29.12	30.45	80.51	85.00
OM (% DM)	90.00	95.64	94.30	97.74	98.20
CP (% DM)	12.90	2.44	8.00	9.93	42.40
DP (% CP)	83.21	52.83	12.86	60.71	84.67
N Sol (% N Total)	5.65	48.56	45.00	24.80	13.44
WSC (% DM)	14.28	42.02	22.86	0.00	2.02
ST (% DM)	1.59	2.10	15.24	69.60	18.18
EE (% DM)	1.23	1.03	3.20	6.94	6.60
NDF (% DM)	60.00	50.15	45.00	11.27	29.00
PD NDF (%)	73.74	46.78	75.36	66.99	66.08
Kd CP (% / h)	4.40	2.94	9.00	3.95	7.60
Kd NDF (% / h)	4.20	2.47	4.00	8.45	6.50
Kd ST (% / h)	-	-	12.50	40.00	12.50
Cost (US$ / kg DM)	0.0228	0.0394	0.0608	-	-
Price (US$ / kg DM)	-	-	-	0.14	0.17

[(1)] Source: Assis et al. (1999).
[(2)] Source: Tupy et al. (1999).
[(3)] Source: FNP (2000).
[(4)] **DM:** Dry matter; **OM:** Organic matter; **CP:** Crude protein; **DP:** Rumen degradable protein; **N Sol**: Nitrogen solubility; **WSC:** Water soluble carbohydrates; **ST:** Starch; **EE:** Ether extract; **NDF:** Fibre in neutral detergent; **PD:** Potential degradability; **Kd:** Degradation rate.

RESULTS AND DISCUSSION

Predictions of milk production from a 500-kg dairy cow fed forage-based diets with different levels of concentrate mixture are shown in Table 2. Despite being the cow potential set at 25 kg of milk per day, maize silage plus 6 kg of supplement diet was able to supply nutrients for up to 33 kg of milk. In this case, the cow genetic potential was limiting milk production.

All forage sources have shown linear response to increased level of concentrate, as follow: