Supplementation of yearlings Cuban Charolais grazing multiple associations of herbaceous legumes and tropical grasses

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The productive performance of 12 yearlings Cuban Charolais, with 192.50 kg of initial live weight (LW), in associated grazing of multiple mixtures of herbaceous legumes and natural pasture was studied. Six hectares, divided into eight paddocks were used. The stocking rate was of two animals per hectare, with seven occupation days and 49 d of resting. Self-grazing, without fertilization and in dry conditions, during the rainy season was used. The animals were divided into two groups, one with energy-protein-mineral supplementation (19.80 % CP and 13.79 MJ kg^{-1} DM of ME) and other, with energy-mineral supplementation (11 % CP and 13.58 ME, MJ kg^{-1} DM), at a rate of 2.50 kg animal d. The animals consuming the energy-mineral supplement had LW gains superior ($P < 0.01$) in respect to those receiving the energy-protein-mineral source, of 1011 and 954 g animal d^{-1}, respectively. Besides, the pastures availability, in function of the grazing pressure (14.60 kg of DM per each 100 kg of LW), satisfied the daily ingestion capacity of DM of the animals. The protein-energy composition (12.70 % of CP and 10.68 MJ of ME kg^{-1} of DM) of the energy-mineral supplement and its nutritive value covered the nutritional requirements. In the animals consuming this supplementation source, the ratio total nitrogen-ME was better. The inclusion of the energy-mineral supplement favores the pasture of grasses and multiple tree legumes, predominating legumes during the rainy season, for the yearlings Cuban Charolais.

Key words: *bovines, meat, Charolais, legumes, maize, soybean*

Meat production is of great importance as it represents at about 23 % of the total meat consumed worldwide (Cabello and Torres 2010). However, developing tropical countries, with at about 50 % of the world bovine population, produce only 25 % of the meat, showing deficiencies in the rearing systems based, mainly, on pastures (Arteaga *et al*. 2007).

The productive potential of a grazing system depends, in great extent, on the correct management of the grassland, the supplementation and the genetics of the animal under exploitation. The meat genotype Cuban Charolais, obtained from an absorbent crossing of importations conducted since 1900, has high weight gain rate and good adaptation to the tropical weather (Rico *et al*. 1987). These conditions could contribute to the better use of grasslands with associations of grasses and herbaceous legumes of good quality.

In the tropical area of Latin-America, there is a wide biodiversity of legumes with high nutritive value, availability and annual productive stability, highlighting the genera Neonotonia, Macroptilium, Stylosanthes, Centrosema, among other which, associated with grass and tree legumes of this climatic area, have a great potential for improving the ruminants production systems (Pizarro 2005). In studies conducted in Cuba, Castillo *et al*. (2003), Díaz (2008), Cino *et al*. (2010), Cino and Díaz (2010) and Díaz *et al*. (2011) report high live weight (LW) gains, with association systems of multiple herbaceous legumes and grasses. These authors demonstrated the economical viability of these association systems for meat production. Likewise, they referred the necessity of adjusting the supplementation of the animals to improve the pasture use and, utilize specialized genotypes with higher production potential such as Cuban Charolais, mainly in the rainy season with higher plant availability and guarantee the maximum use of the grassland.

The objective of this study was to assess the effect of the energy-protein supplementation on the productive performance of males Cuban Charolais under grazing, with association of herbaceous legumes and tropical grasses, destined to meat production.

Materials and Methods

A completely randomized design was used for assessing the productive performance of twelve yearlings Cuban Charolais in the pre-fattening stage (June-October 2006), from 192.50 kg LW, in associated grazing of herbaceous legumes (22 % *Neonotonia wightii*, 11 % *Pueraria phaseoloides*, 10 % *Macroptilium atropurpureum* and 10 % *Centrosema pubensis*), grasses (20 % *Cinodon nlemfluensis* and 17 % natural pastures) and 10 % of weeds, for a total relation of 53 % legumes-37 % grasses.

The experimental area was of six hectares and divided into eight paddocks of 0.75 ha each. The stocking rate was of two animals per hectare, with 7 d of occupation and 49 d of resting. The auto-grazing (free asccess to water and supplement) was used and no irrigation and fertilization were used. The average monthly rainfall was of 187 mm.

The animals grazed together and were divided into two equal groups for the supplementation. One group consumed an energy-mineral supplement and the other an energy-protein-mineral one (table 1). The animals were weighed monthly for calculating the average daily gain (ADG) of LW, the accumulated weight and the stage duration.

Table 1. Formulation of the supplements and mineral salts

Ingredients	Percentage in dry basis	
	Energy-mineral	Energy-protein-mineral
Supplement		
Soybean meal, %	-	14.00
Maize meal, %	97.00	83.00
Mineral salt, %	3.00	3.00
Total, %	100.00	100.00
CP, %	11.00	20.00
ME, MJ kg^{-1} DM	13.58	13.79
Mineral salt included in the supplements		
Sodium chloride, %	46.50	
Dicalcic phosphate, %	50.00	
Trace minerals, %	3.50	
Total, %	100.00	

The pastures availability was calculated by rotation according to Haydock and Shaw (1975), with a systematic design in zigzag and 70 observations per paddock to determine the grazing pressure. The bromatological composition of the pasture and supplements were analyzed according to AOAC (1995). The herb selection by the animal was simulated to take samples of the pasture, agreeing with Senra (1977). The CP and ME were determined by the formulas of García-Trujillo and Pedroso (1989). The DM intake was estimated with the tables of Martín (1981), according to pastures quality and availability. The nutritional energy-protein balances of the diets were assessed and they were compared with the requirements according to Martín and Palma (1999).

The results were processed through the statistical software INFOSTAT (2001) to determine the differences between treatments by analysis of variance of simple classification (ANOVA simple), applying the T-Student test.

Results and Discussion

The results (table 2) showed that the animals consuming the energy-mineral supplement had superior gains ($P < 0.01$) in relation to those consuming the energy-protein-mineral one. The productive improvement was confirmed, in respect to the weight gain of animals grazing good quality pastures, predominating the herbaceous legumes associated with grasses, when using supplements of high energy-mineral value.

Galindo *et al*. (2009) demostrated that the voluble herbaceous legumes free great amonts of NH_3 in the rumen, hence the inclusion of the energy supplement, composed of maize meal as starch source, could improve the efficiency of protein in the ration. This leads to a better use of the nitrogen released in the rumen fermentation and favors the weight gain of the animals.

In studies conducted in Cuba with growing bovines, grazing association of grasses and herbaceous legumes, inferior results were reported. Chao *et al*. (1982), Monzote *et al*. (1985) and Díaz *et al*. (2011) obtained, with Holstein x Zebu crossbred animals, 326, 415 and 491 g animal d^{-1} per season. Respectively, with these same animals, in the rainy season, Castillo *et al*. (1991) reported 882 g of ADG, with two animals per hectare and molasses supplementation.

During five months, and between both seasons, Iglesias (2003) referred 623 g of ADG in a similar system with Zebu males, with 2.50 animals ha^{-1}. Díaz *et al*. (2005), with pre-fattening Zebu males and a stocking rate of two animals per hectare, in both seasons, obtained 841 g animal^{-1} of ADG with the application of 1.50 kg animal d^{-1} of a rumen activator supplement and 794 g animal d^{-1} with 50 g animal d^{-1} of mineral salt.

As previously referred, these researches are conducted with Zebu and Holstein x Zebu crossbred animhals, of lower potential for meat production. Díaz *et al*. (2008) worked for the first time with the genotype Cuban Charolais, and obtained 885 g animal^{-1} of ADG, only with a mineral supplementation in both seasons, in a grazing with association of grasses and multiple legumes. Rico *et al*. (1987) informed ADG of 632 g animal^{-1} with Cuban Charolais supplemented but in grazing of fertilized grasses. Osorio and Segura (2011), in studies with Charolais in the humid tropic of Mexico, recorded 520 g animal^{-1} of ADG in extensive grazing of grasses, without fertilization and under dry conditions, plus a supplementation with an energy-protein mixture. These researches confirmed the importance of establishing a proper relation between the productive potential of the grassland, the animal and the supplementation to obtain the best results.

The protein-energy composition of the pasture (12.70 % CP and 10.68 MJ MEkg DM^{-1}), together with the nutritive value of the supplementation (table 1) and the satisfaction of the daily ingestion capacity

Table 2. Performance of productive indicators of Cuban Charolais yearlings in grazing associated of multiple herbaceous legumes and tropical grasses, with energy or energy-protein supplement

Indicators	Energy	Energy-protein	SE ±
Initial LW, kg	192.00	193.00	12.20
Final LW, kg	313.33	307.50	16.14
Accumulated LW, kg	121.33	114.50	-
kg of LWha^{-1}	626.66	615.11	-
ADG, g	1011.00	954.00	0.03**
Supplement intake, kg	2.50	-	
Duration, d	120.00	-	
Accumulated age, months	18.00	-	

** T-Student ($P < 0.01$)

(7 kg DM, approximately) for the sufficient availability (14.60 kg DM 100 kg of LW-1in function of the grazing pressure), allowed selecting the pasture and the adjustment of the protein requirements (table 3) to the animals' needs.

The use of the energy-mineral supplement favored the best use of the pasture nitrogen, the adjustment of the N total-ME ratio and the conversion of CP and ME in ADG of LW. Meanwhile, the energy-protein-mineral supplement caused an exceeding of nitrogen that produced lower ADG (table 3).

The energy was lightly below the needs for the ADG obtained. It is important to highlight that these animals mature late, hence they take advantage of the energy better in the accumulation of not-fatty issues and they have lower maintenance expenses (Preston and Willis 1970 and López *et al*. 2002). Besides, the formation of new issues over the accumulation of the body fat predominates in the growing stage. On this respect, Prado (2011) proved the favorable use of the nutrients for fattening Charolais males. Studies with other sources of higher energy concentration of the supplements would be necessary in order to cover the deficit of balance and reach superior results in the ADG of LW.

Selecting an energy-mineral supplement in these grazing systems with herbaceous legumes can be justified not only for the higher ADG of LW obtained, but also for the economic saving of using 14 % of soybean in the ration. At present, the price of maize ranges between \$ 209 and 276 USD t^{-1}, while that of soybean between 426 and 545 USD t^{-1} (INFOASERCA 2012).

In genotypes like Charolais, destined to meat production, applying high energy value supplements, particularly, starch sources like maize meal and others, are suggested during the grazing with multiple associations of herbaceous legumes and tropical grasses, where legumes predominate.

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Table 3. Energy-protein feeding balance, total N -ME ratio and conversion of ME and CP in diets with energy or energy-protein supplement

Supplement		Energy	Protein-energy
Intake capacity, kg of DM		6.74	6.52
Contributions	ME, MJ	78.13	76.46
	CB, g	819.00	981.00
Requirements	ME, MJ	81.47	76.87
	CB, g	804.00	772.00
Difference	ME, MJ	(3.34)	(0.41)
	CB, g	15.00	209.00
N-ME ratio of the contribution, g MJ^{-1}		1.68	2.05
ME of the contribution DMG^{-1}, MJ g^{-1}		0.07	0.08
ME of the contribution CP^{-1}, g g^{-1}		0.81	1.03

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