

Raw materials sources in the concentrate for assessing the productive performance of Holstein crossbred bulls fed sugarcane forage

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Eighteen Holstein x Zebu crossbred bulls of 296, 301 and 307 kg average liveweight per treatment were selected to study the productive performance of animals fed sugarcane forage and concentrate, with variation of the raw material used. They were located according to random block design with three treatments and six repetitions each. The treatments consisted of sugarcane forage + 50 g urea + concentrate 1 (A), sugarcane forage + 50 g urea + concentrate 2 (B), sugarcane forage + 50 g urea + concentrate 3 (C). An analysis of variance was conducted according to random block design. Duncan's test ($P < 0.05$) was applied when necessary. The daily weight gain of treatment A was higher ($P < 0.05$) than that of treatment B. The feed conversion of treatment A was higher ($P < 0.001$) than the rest. There were no differences in the intake of total and sugarcane DM in the treatments used, with values of 7.74, 8.0, 8.05 and 5.08, 5.25 and 5.33 kg for each treatment, respectively. It is concluded that the use of soybean and maize meal increased the productive performance in respect to the use of wheat bran and dry distillery grains with solubles (DDGS) in diets with sugarcane as voluminous feeds.

Key words: fattening, distillery grains, soybean and maize meal, wheat bran.

Sugarcane is a plant of high DM yield per surface unit. It is mainly harvested during the dry season, as forages and pastures for animal feeding could be in deficit during this period. González (1995) reported a group of nutritional deficiencies and physiological limitations that could affect the consumption and weight gain of the animals consuming this forage.

Rumen activators (Rodríguez 2005) and concentrates (Fundora *et al.* 2007 and Rodríguez 2009) with maize and soybean as main raw materials sources have been used as supplement of the sugarcane forage.

At present, cereals and oleaginous seeds are very demanded for human and monogastric animals feeding. The latter, in the majority, are unable to use great amount of pastures and forages in the diet. Besides, the use of these feeds for bio-fuel production has relegated its application in ruminants feeding. That is why the by-products obtained as substitutes of grains from different processes are so important.

The dry distillery grains with solubles (DDGS), obtained through the maize fermentation for obtaining alcohol are a balanced feed of great nutritive value (USGC 2007) and have been used in meat cattle feeding

(Felix and Loerch 2010, Félix *et al.* 2010 and Li *et al.* 2010). The wheat bran is also a by-product from meal extraction that can be considered as an energetic-protein feed (Gallardo 2011).

These by-products can be used in animal feeding, although determining if after the industrial processes they are submitted to they are able to supply the nutritional deficiencies of sugarcane is important. Besides, if its use allows expressing the same growth potential achieved with the use of cereals in formulating the concentrates for animal feeding should be proved.

The objective of this research was to study the productive performance of cattle fed sugarcane forage and concentrate, where maize and soybean meal was substituted by wheat bran and DDGS.

Materials and Methods

Eighteen bulls, 5/8 Holstein 3/8 Zebu, of 296, 301 and 307 kg of average liveweight per treatment were used. They were allocated according to random block design and their live weights, in three treatments with six repetitions each.

The treatments consisted of offering daily sugarcane

Table 1. Composition of the supplements

Indicators	Percentage of inclusion of the different raw materials		
Maize meal	50.5	0.0	0.0
Soybean meal	41.0	30.5	0.0
Wheat bran	0.0	61.5	0.0
DDGS	0.0	0.0	91.5
Minerals	5.0	5.0	5.0
Common salt	3.5	3.5	3.5
CP, g/kg of DM	229.0	190.0	226.0
ME, MJ/kg of DM	11.75	11.9	12.2

forage *ad libitum* and 3 kg of supplement, twice a day and six hours of difference. The sugarcane forage was manually harvested, without eliminating the top, and chopped in a forage machine.

The inclusion of different raw materials in the supplements is described in table 1. The nutritive value of feeds was obtained through the requirement tables.

The animals were allocated in pens with slatted cement floor. In the morning, the residual feeds were collected and weighed to determine the animals' intake. Besides, the pens were cleaned and the feed was distributed according to the treatments. The animals were weighed every 21 d to determine the weight increase during the period.

Analysis of variance was conducted according to the design described and that of covariance was applied to prove the effect of the initial weight on the rest of the variables.

Results and Discussion

There were no significant differences in the covariance analysis for the liveweight, therefore there were no differences in the initial and final weight of the animals used in this experiment, but the gain varied (table 2) according to the raw materials used for the concentrate. The daily intake of fresh and dry matter and the consumption in respect to the liveweight percentage did not show differences between treatments. However, the feed conversion was more efficient when using

soybean and maize meal in the concentrate (table 3).

The diet with soybean and maize meal in the concentrate allowed gains of 1.03 kg animal⁻¹d⁻¹. This is beneficial in production systems where sugarcane represents 66 % of the DM consumed by the animals. Rodríguez (2009) obtained liveweight gains of 1.09 kg animal⁻¹d⁻¹ in diets with sugarcane representing 49 % of the DM consumed.

This weight gain is superior to that obtained when using the wheat bran in the concentrate. Gallardo (2011) stated that wheat bran is a by-product of the starch extraction of this grain. So, its energy value derives, mainly, from the fiber of the grains cover. Therefore, it is an energy source of lower digestibility and metabolicity than that of the starch.

Besides, its content in nutrients has, normally, great variability, in function of the characteristics of the industry of origin. That is why its nutrients contribution is inferior to that of the cereals meal, affecting the productive performance of the animals.

The DM consumption, as liveweight percentage, is superior to the reports of Rodríguez (2009), although it does not surpass 1.7⁻¹.8 % reported as physiological limit of cattle for this feed (González 1995).

The protein quality has been reported as an important factor on consuming voluminous feeds in ruminants. Some authors, (Palma and Rodríguez 2001, Rodríguez and Palma 2002, Palma *et al.* 2003 and Macitelli *et al.* 2007) have achieved good productive performance when

Table 2. Effect of the concentrate composition on the weight and gain of crossbred bulls Holstein x Zebu fed sugarcane forage and concentrate

Indicators	Sugarcane forage + concentrate (soybean and maize)	Sugarcane forage + concentrate (soybean and wheat bran)	Sugarcane forage + concentrate (DDGS)	SE ±
Initial weight, kg	296.67	301.83	307.33	4.20
Final weight, kg	366.67	353.17	367.83	7.10
Live weight gain, kg/animal ⁻¹ d ⁻¹	1.03 ^b	0.76 ^a	0.89 ^{ab}	0.07*

*P < 0.05

Table 3. Effect of the concentrate composition on the intake and conversion of crossbred bulls Holstein x Zebu fed sugarcane forage and concentrate

Indicators	Sugarcane forage + concentrate (soybean and maize)	Sugarcane forage + concentrate (soybean and wheat bran)	Sugarcane forage + concentrate (DDGS)	SE ±
Intake of total DM, kg/d	7.74	8.0	8.05	0.11
DM intake	5.08	5.25	5.33	0.11
Intake of total DM (% LW)	2.33	2.44	2.38	0.03
Intake of sugarcane DM (% LW)	1.53	1.6	1.58	0.03
Conversion, kg DM/ kg gain	7.52 ^a	10.6 ^c	9.05 ^b	0.13***

*** P < 0.001

using different protein sources as ruminal fermentation activators in sugarcane diets. They have also included another forage source in the diet based on sugarcane. However, they did not obtain increase over 1.75 % of liveweight in the sugarcane intake.

When maize and soybean meal were used in the concentrate, higher feed conversion was obtained in respect to the use of wheat bran and the DDGS in the supplements.

The procedures of processing and drying in the DDGS varied considerably the by-pass characteristics. Hippen and García (2011) stated that this by-product has lower amount of degradable protein and lower digestibility than the soybean protein. This is result from the amount of protein joined to the fiber fraction during the drying process, not available, in great extent, for the digestion in the rumen.

This could affect the ammonium availability in the rumen for the development of cellulolytic microorganisms and fiber degradability. This aspect is very important in feeding systems with sugarcane, due to the low protein level of this forage.

It is also informed (USGC 2007) that the distillery grains have low levels of lysine, amino acid limiting in the diet. It is necessary for elaborating all the proteins of the organism in the calcium absorption and constructing the muscle proteins.

It should also be considered that substituting maize and soybean grains by distillery grains changes the maize starch for digestible fiber and lipids. These latter present in the DDGS and other co-products can be associated with the grain particles or be relatively free. As well as other vegetable oils and oleaginous seeds, the fat associated with the grain particles will have lower ruminal availability (Hippen and García 2011).

It is concluded that in diets with sugarcane as rough feed, the use of soybean and maize meal improved the productive performance if comparing with the use of wheat bran and DDGS in this type of diet.

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Received: October 3, 2012