Inclusion of *Pennisetum purpureum* Cuba cv. CT-115 in the diet of Holstein crossbred cattle. Its effect on body composition

D. Rodríguez, O. Tuero, J.L. Hernández and Lucía Sarduy
Instituto de Ciencia Animal, Apartado Postal 24, San José de Las Lajas, Mayabeque, Cuba
Email: durorodriguez@ica.co.cu

Eighteen crossbred Holstein bulls with live weights of 436, 432 and 431 kg under stabling feeding systems were used. Animals were fed a sugar cane forage basal diet to which *Pennisetum purpureum* cv. Cuba CT-115 forage was included to determine differences in viscera and internal organs weight. A simple classification analysis was carried out and Duncan's multiple range test in the necessary cases was applied. Animals were weighed before moving them to the slaughter house and left to fast for 24 h, with *ad libitum* water. Later they were slaughtered through the captive bolt method and internal organs were weighed separately, as well as other body components. There was an increase ($P < 0.05$) of the percentage representing the full digestive tract, regarding the live weight of the animals consuming sugar cane forage with the inclusion of CT-115 forage at 23 % of the diet. It is concluded that in this genotype the inclusion of CT-115 forage in complete diets of sugar cane only affected the percentage representing the full digestive system of the live weight of the animal.

Key words: *bovine cattle, internal organs, sugar cane, empty live weight*

The analysis of the organs' weight and the percentage representing it, regarding the weight at slaughter and to the empty body weight of animals, could vary according the feeding systems (Kuss *et al*. 2008 and Cattelam *et al*. 2011).

The decrease of the voluminous feed in the diet supplies lower percentage of the digestive system relating to the live weight of the animal, favoring carcass yield (Menezes *et al*. 2005 and Restle *et al*. 2005). However, in the feeding systems in which the voluminous-concentrate relationship is maintained equal and the forage source varies, it has been demonstrated that in animals fed sugar cane, the digestive system represents higher percentage respecting live weight (Macitelli *et al*. 2005 and Moreno *et al*. 2011).

The objective of this study was to evaluate the inclusion of *Pennisetum purpureum* cv. Cuba CT-115 forage in diets with sugar cane forage and its effect on the weight of the different body parts of crossbred Holstein animals.

Materials and Methods

Eighteen crossbred Holstein bulls of 33 months of age were used divided in three treatments with an average live weight of 436, 432 and 431 kg, respectively. Each treatment included six animals which were the replications. During the work in the slaughter house, data from one animal in treatments two and three were not processed due to incorrect manipulation.

According to Rodríguez *et al*. (2009), the feeding system was based on the use of sugar cane. Treatments consisted of the partial substitution of sugar cane forage by CT-115 forage: a) without addition of CT-115, b) 11.5 % of CT-115 forage and c) 23 % of CT-115.

Animals were housed in slotted floor corrals. In the morning feed residues were removed, corrals were cleaned and feed was distributed according to treatments. The bromatological analysis of feeds is set out in table 1.

Animals were weighed before moving them to the slaughter house and left to a 24 h fast, with water *ad libitum*. Later they were slaughtered by the captive bolt method. Once slaughtered, each one of the components was weighed as dissection was performed. In the case of the digestive tract, it was weighed and all the gastrointestinal contents was eliminated. Washing was made to weigh again and the digesta weight and empty body weight (EBW) were obtained.

Weight in kg was recorded from each one of the organs and later the percentage that it represented regarding the live weight before moving the animals to the slaughter house and the percentage relating the empty body weight was determined.

A simple classification analysis was carried out. Duncan's (1955) multiple range test was applied in the

Table 1. Bromatological composition of the feeds (% DB)

Feeds	DM	CF	Ca	P	NDF	ADF	Lig	Cel
Sugar cane	33.5	4.8	0.24	0.20	64.9	50.3	12.1	36.5
CT-115 forage	28.6	9.0	0.37	0.24	79.3	46.9	6.81	38.0
Concentrates	87.3	20.9	0.49	0.17	14.6	6.9	1.2	5.4
Molasses-urea[1] 2 %	76.6	11.0	1.31	0.91	---	---	---	---

[1]According to García Trujillo and Pedroso (1989)

necessary cases for $P < 0.05$. The statistical package used was SPSS for Windows version 11.5.1, 2002 (Visauta 2002).

Results and Discussion

Results indicate that there were no differences between treatments for slaughter weights, head, hide, digestive system and legs (table 2). Weights of head, forelegs and hind legs coincide with the results obtained by Zamora *et al*. (2007) who indicated that they could be between 18 and 20 kg and between 4 and 5 kg, respectively in Zebu and crossbred animals with 440 kg of live weight.

Regarding the hide of animals slaughtered in this experiment, their weight was lower by 10 kg with respect to that reported by Zamora *et al*. (2007). This could be due to the animals' age. Different authors state that live weight (Restle *et al*. 2005), slaughter age (Pacheco *et al*. 2005) and the genetic group (Menezes *et al*. 2007) could influence on the hide.

The weight of the full digestive system showed no differences. However, it must be borne in mind that it could vary among experiments, according to the fast time to which the animals are submitted before their slaughter. This period allows eliminating higher or lower amount of the gastrointestinal contents.

Liver, heart, lungs and trachea weights (table 3) did not show differences between treatments. Heart weight coincided with that reported by Zamora *et al* (2007), not being so with that of the liver which was higher in this study. This heavier weight could be due to the feeding system, since although bulls were slaughtered at the same weight, they were younger. This represents higher daily gain throughout the whole life period. Veras *et al*. (2001) found increase of the liver weight, as the nutritional level to which animals were submitted was increased. This is due to the fact that this organ is in charge of the metabolic processes of the organism and has a response before the nutritive variations of the diet.

Studies carried out with different voluminous feeding sources, among which saccharina produced from sugar cane forage was included (Menezes *et al*. 2013), evidenced lower liver weight regarding to that obtained with other diets. This did not agree with what was found in this study.

Results shown in table 4 indicate that from the different body components, only the full digestive system exhibited differences when compared with the percentage representing the live weight of the animals.

As the substitution level of sugar cane forage increased by CT-115 forage, the full digestive system represented a higher percentage regarding the live weight. These data do not agree with Macitelli *et al*. (2005) who demonstrated that in animals fed different forage sources those consuming sugar cane had a heavier digestive system, representing a higher percentage with respect to the live weight.

According the data of the nutritive value of the feeds used for the feeding (table 1), the CT-115 has higher NDF concentration, an aspect that must have influenced on the higher filling capacity of the organ, since as the NDF level in the diet increases, the retention time of the feed

Table 2. Slaughter weight (kg) and indicators of different body parts of bulls under three feeding systems based on voluminous feeds

Indicators	Sugar cane forage 73 % + molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 61.5 % + CT-115 forage (11.5 %) + molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 50 % + CT-115 forage (23 %) + molasses urea 2 % (10 %) + concentrates 17%
Slaughter weight	436.00 ± 2.22	432.00 ± 2.44	431.00 ± 2.44
Head	18.76 ± 0.40	18.27 ± 0.44	17.87 ± 0.44
Hide	28.17 ± 0.88	28.2 ± 0.97	28.40 ± 0.97
Full digestive system	78.17 ± 2.25	81.4 ± 2.46	86. 68 ± 2.46
Empty digestive system	30.83 ± 2.05	29.6 ± 2.25	30.10 ± 2.25
Forelegs	4.04 ± 0.13	4.29 ± 0.15	4.22 ± 0.15
Hind legs	4.60 ± 0.13	4.90 ± 0.14	4.72 ± 0.14

Table 3. Weight of internal organs (kg) of bulls under three feeding systems based on voluminous feeds

Indicators	Sugar cane forage 73 % + molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 61.5 % + CT-115 forage (11.5 %) + molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 50 % + CT-115 forage (23 %) + molasses urea 2 % (10 %) + concentrates 17%
Liver	4 43 ± 0.31	4.57 ± 0.34	4.59 ± 0.34
Heart	1.36 ± 0.07	1.35 ± 0.08	1.44 ± 0.08
Lungs + trachea	5.97 ± 0.29	6.03 ± 0.32	6.22 ± 0.32

Table 4. Percentage of different internal organs and body parts regarding live weight (LW) and empty body weight (EBW) of bulls under three feeding systems based on voluminous feeds

Indicators	Sugar cane forage 73 % + molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 61.5 % + CT-115 forage (11.5 %) + molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 50 % + CT-115 forage (23 %) + molasses urea 2 % (10 %) + concentrates 17%
Head, % LW[1]	4.30 ± 0.09	4.23 ± 0.10	4.14 ± 0.10
Head % EBW[2]	5.65 ± 0.17	5.51 ± 0.18	5.30 ± 0.18
Hide % LW[1]	6.46 ± 0.20	6.57 ± 0.22	6.54 ± 0.22
Hide % EBW[2]	8.48 ± 0.35	8.56 ± 0.38	8.37 ± 0.38
Full digestive system % LW[1]	17.94^{a} ± 0.52	18.83^{ab} ± 0.57	20.09^{b} ± 0.57*
Full digestive system % EBW[2]	23.50 ± 0.76	24.50 ± 0.83	25. 70 ± 0.83
Empty digestive system % LW[1]	7.07 ± 0.22	6.85 ± 0.52	6.99 ± 0.52
Empty digestive system % EBW[2]	9.22 ± 0.59	8.92 ± 0.64	8.94 ± 0.64

*P < 0.05

[1]Live weight

[2]Empty body weight

in the rumen augments (Pereira *et al*. 2007).

Buckley *et al*. (1990) expressed a negative correlation between animal yield and the weight of the gastrointestinal contents, when feeding presented high levels of forage. Menezes *et al*. (2011) and Iriñiz *et al*. (2012) found that animals fed tropical pastures or harvest waste showed higher gastrointestinal contents than those consuming pastures of temperate climate. This is due to the fact that when digestibility is higher, the emptying speed is higher in the digestive system.

Data published by Rodríguez *et al*. (2011) regarding carcass yields in the animals of this experiment, reflect that there were no differences between treatments. These performed between 54.22 %, for animals fed sugar cane and 53.87 % for the highest inclusion level of CT-115 forage. All seems to indicate that with the feeding based on tropical pastures with high fiber contents, the filling effects on animal yield can present variations.

The values of the head percentage regarding the empty body weight are higher than those reported by Díaz (2008). It must be indicated that in this can influence the animal's genotype, since on using more specialized animals in beef production this author found a decrease of the head percentage registering values of 5.57, 5.06 and 4.3 for crossbred Holstein, Zebu and Charolais, respectively.

The hide percentage respecting the empty body weight was lower than that obtained by Díaz (2008), who referred values of 9 and 10 % in Zebu animals slaughtered at 440 kg live weight.

The value of the empty digestive system after the planning (9 %) coincides with Díaz (2008) in diets with animals that had a supplementation level lower than that used in this experiment. This demonstrates that tropical pastures, as the main feeding source of the animals, provoke that the digestive system represents a high percentage regarding the live weight of the animals.

The genotype of the animal must be analyzed since it can contribute to the modifications in the percentage of the digestive system, regarding the empty body weight. Díaz (2008), for example, obtained for Charolais animals, slaughtered at similar live weights, values of 8 %. In crossbred Holstein animals, slaughtered at 412 kg, the empty digestive system represented 17 % of the empty body weight.

Jorge and Fontes (2001) and Zamora *et al*. (2007) stated that animals of European breeds or crossbreds of dairy breeds tend to present higher mass of internal organs regarding the live weight than those of Zebu breed.

Weights of head, hide, and legs represented, approximately, 17 % of the empty body weight. This value coincides with data of Carvalho *et al*. (2003) who indicated that all these parts as a whole could be between 15 and 17 %.

The percentage representing the heart, liver, lungs and trachea, as well as the live weight-empty body weight relationship did not show differences between treatments (table 5).

The empty body weight-live weight relationship was lower than that reported by Macitelli *et al*. (2005), Menezes *et al*. (2007) and Menezes *et al*. (2011). This demonstrates the increase of the percentages of the digestive system in the feeding systems used, due to the effect of pastures and forages as main feeding source. Willians *et al*. (1992) found this value, of approximately

Table 5. Percentage of different organs regarding live weight (LW) and empty body weight (EBW) of bulls under three feeding systems based on voluminous feeds

Indicadores	Sugar cane forage 73 % + molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 61.5 % + CT-115 forage (11.5 %) molasses urea 2 % (10 %) + concentrates 17 %	Sugar cane forage 50 % + CT-115 forage (23 %) + molasses urea 2 % (10 %) + concentrates 17%
Liver % LW[1]	1.02 ± 0.07	1.06 ± 0.08	1.07 ± 0.08
Liver % EBW[2]	1.34 ± 0.10	1.38 ± 0.11	1.36 ± 0.11
Heart % LW[1]	0.32 ± 0.02	0.31 ± 0.02	0.34 ± 0.02
Heart % EBW[2]	0.41 ± 0.02	0.41 ± 0.03	0.43 ± 0.03
Lungs + trachea % LW[1]	1.37 ± 0.07	1.39 ± 0.08	1.44 ± 0.08
Lungs + trachea % EBW[2]	1.80 ± 0.09	1.81 ± 0.10	1.85 ± 0.10
EBW/LW relationship	0.76 ± 0.01	0.77 ± 0.01	0.78 ± 0.01

[1]Live weight
[2]Empty body weight

0.92, from the analysis of diverse factors that can affect it as the fiber content in the diet, the concentrate level and the degree of maturity.

It is concluded that the inclusion of CT-115 forage in complete diets of sugar cane in the percentages studied, only affected the percentage representing the full digestive system, as percentage of the live weight of the animal.

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