Scientific Paper

Protein foliage (kenaf and cassava) in rations of sugarcane without urea, for dairy cows

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ABSTRACT: A study was conducted in order to evaluate the utilization of kenaf and cassava forage as alternatives of natural protein sources to substitute urea, in rations for dairy cows based on pastures and sugarcane forage, in the rainy season. For such purpose 30 dairy cows of the Siboney de Cuba breed were used, with productive potential of 12 L, live weight of 486 kg ± 12 and similar lactation times (120 days ± 25), which were randomly distributed in three treatments: A) sugarcane (15 kg/day) + 10 kg of fresh kenaf forage/day, B) sugarcane (15 kg/day) + 10 kg of fresh cassava forage/day and C) sugarcane (15 kg/day) + urea (150 g/animal/day). High values of protein were found in the forages (23,4 and 24,5 % for kenaf and cassava, respectively). The treatments with these forages produced 0,7 L of milk over the control, and little variation was observed in the health indicators. The pH in the urine and excreta of the animals was higher under the conditions of supplementation with urea, which indicates a possible alkalization. It is concluded that both forages could be a good choice to decrease imports of chemicals for cattle production and favor the higher use of natural protein sources, with a higher benefit in dairy production systems.

Keywords: weight gain, forage plants, milk production

INTRODUCTION

It is usual in the tropical zone to have volumes of feedstuffs with very low protein percentage, especially in the so-called shortage or dry seasons; and, consequently, the most usual variant to compensate that deficit, at least in Cuba, is the use of urea, imported product very difficult to obtained in the markets (Rodríguez *et al*., 2013), which is used in diets based on sugarcane forage –grass of high energy content that is still object of study throughout the world– (Chizzotti *et al*., 2015).

However, in the tropic huge quantities of high-protein foliage are produced, which mostly are not used or are little appreciated by cattle raisers or professionals of the field, whose utilization in small portions could contribute to decrease the chemical rates in the animals and reach productions more in accordance with the current times.

The studies with the use of kenaf (*Hibiscus cannabinus*) and cassava (*Manihot esculenta* Cranz) started in Cuba since the early 20th century, although cassava was already consumed and used since the pre-Columbian era. In the case of kenaf, its initial value was associated to its fiber for textile purposes; however, in the last decades there has been great interest in its use in cattle production (García López *et al*., 2004). Vinent (2011) reported yields of 20-60 t of green matter per hectare in commercial varieties (for fiber), at ages of 45 and 75 days. Likewise, Vinent (1993) reported in Cuba a new variety of kenaf which was called vinkat-3. When evaluating its bromatological composition and observing its fast growth, it was estimated that this variety can offer a fast response to the feed deficit undergone by cattle production in certain seasons in many zones of the world (Gonzálvez, 2005).

The solutions to solve the feed deficit from the substitution of urea by other protein-rich feedstuffs in the diet can be numerous (Cappellozza *et al*., 2013; Castillo-López *et al*., 2014).Nevertheless, there are still few alternatives used in Cuba to improve the feeding balances in the productive systems for cattle milk production.

The objective of this research was to evaluate the inclusion of kenaf and cassava foliage in dairy cows, as protein complements of the diets with sugarcane forage, which have nitrogen deficit.

MATERIALS AND METHODS

Experimental procedure. A herd of 30 dairy Siboney de Cuba cows was used, with productive potential of 12 L, live weight of 486 kg ± 12 and similar lactation times (120 ± 25 days), which consumed star grass (*Cynodon nlemfuensis*) and were randomly distributed in three treatments: A) sugarcane (15 kg/day) + 10 kg of fresh kenaf forage/day, B) sugarcane (15 kg/day) + 10 kg of fresh cassava forage/day, and C) sugarcane (15 kg/day) + urea at a rate of 150 g/animal day^{-1} (control).

The soil preparation (2 ha) for the establishment of kenaf was conventional (plowing, crossing, harrowing, furrowing) and the sowing was gradually performed, in August and September, in order to achieve homogeneous forage in age and have fresh foliage permanently throughout the dry season (between 50 and 70 days of cutting). These age ranges were selected because they are the ones that cause lower variations in the nutritional components of the crop. A sowing dose of 10 kg of seed/ha (with 85 % of germination) was used and it was sown by drilling, with a distance between rows of 0, 90 m. In the case of cassava, planting was performed with a density of 18 000 plants/ha and at once, but the cuttings were gradual to obtain regrowths every 90 days, once the cutting frequency was established.

The cutting height in both crops was 30 cm, in order to guarantee the fast recovery of the plantation. All the green material was harvested between 7:30 and 8:30 a.m., ground and offered to the animals; which also had free access to water and a mixture of salts, constituted by NaCl, Ca, P and trace minerals.

Determinations. In kenaf and cassava the biomass production (GM, DM and DM %) was determined, according to Herrera (2006); as well as the leaf-stem ration, plant height and production of protein ha^{-1} year^{1}. In addition, the bromatological composition of all the plant species (star grass, sugarcane, kenaf and cassava) was determined. Sugarcane was not planted in the work farm, but it was transported daily and distributed, just like the other feedstuffs, in the indicated quantities, so that no residues were left in the troughs.

On the other hand, in the animals the milk production cow^{-1} day^{-1}, the milk corrected at 4 % of fat and the weight gain animal^{-1} day^{-1} were measured. Health indicators, such as pH in the urine and excreta, were also evaluated. The chemical indicators of the milk and the feedstuffs were analyzed according to the AOAC (2005).

Statistical processing. The data were processed in the electronic tabulator Microsoft Excel and analyzed through the statistical package INFOSTAT (Balzarini *et al*., 2012). ANOVA was made and Duncan (1955) was used, as required.

RESULTS AND DISCUSSION

The importance of such crops as kenaf and cassava in cattle production is explained by their fast growth and high productivity per hectare. In this study an acceptable biomass production was obtained for both forages (table 1); six cuttings per year were performed on kenaf and four cuttings in 13 months were made on cassava.

According to these results, one hectare could provide feedstuffs to satisfy 10 cows of 500 kg of live weight, which makes these crops an attractive choice for feeding cattle.

Table 2 shows the performance of some bromatological indicators of the studied crops; the crude protein content of kenaf and cassava and their high value of calcium, which is three times that of

Table 1. Agronomic characteristics of kenaf vinkat-3 and cassava as forage.

Crop	Plants ha^{-1}	t GM ha^{-1} cutting^{-1}	t DM ha^{-1} cutting^{-1}	DM (%)	Leaf-stem ratio	t CP ha^{-1} year^{1}
kenaf	182 000	12,5	2,2	17	1,19:1	2,7
cassava	18 000	13,4	3,5	26	1,1:1	2,9

Table 2. Bromatological composition of the crops (%).

Crop	DM	CP	CF	Ash	Ca	P	K
Star grass	26	8,12	29,00	5,90	0,48	0,28	-
Kenaf	17	23,40	23,00	6,90	1,12	0,23	4,20
Cassava	26	24,50	14,00	7,70	1,72	0,28	0,80
Sugarcane	29	2,40	30,80	4,30	0,20	0,10	-

star grass. However, the DM percentage of kenaf is low (17 %) if it is compared with star grass or other tropical pastures and forages, but acceptable if the reference is the king grass pasture (Gutiérrez *et al*., 2014).

From the results of this research it can be assumed that one hectare of kenaf, with a content of 23,4 % of crude protein in the foliage yields in the dry season 1 544 kg of protein; while the cassava forage yields 1 878,3 kg. In the diets with sugarcane forage, the cows daily receive 0,150 kg of urea, the equivalent to 0,423 kg of crude protein day^{-1}. Hence one hectare of kenaf could contribute the equivalent leaf protein in urea for 17, 38 animals day^{-1} throughout that period; while one hectare of cassava could support 21,14 animals day^{-1}.

Thus, the use of these forages or other similar crops could minimize the expense that is incurred due to the use of urea in the dry season, which can be extended to 210 days. A simple calculation for the two variants shows the quantity of urea that is used during that period:

- Cassava variant: 0,150 kg of urea x 21,14 animals x 210 days = 0,66 t.
- Kenaf variant: 0,150 kg of urea x 17,38 animals x 210 days = 0,54 t.

It is known that the ton of urea in the international market exceeds $ 300,00 USD (World Bank, 2015), for which in any of the variants under study with the protein foliage, more than 160,00 USD would be saved for every 17-21 animals which do not use urea.

The productive performance of the dairy cows showed a better response in the production of fresh milk ($p < 0,05$) with the protein foliage compared with the use of urea (table 3).

This can be justified by the additional contributions of nitrogen made by these protein forages, as well as a valuable set of other nutrients, which could contribute to a better animal response with the ration complemented with them (Butler and Patton, 2011). It was proven that the additional nutrients were channeled with higher preference to the milk production process than to the weight gain, and no significant differences were found with regards to the control treatment. The fact that the animals used were of dairy breed, and as it is known they show a more efficient metabolism in the presence of certain nutrients, perhaps influenced this (Chapa *et al*., 2001).

Nevertheless, a higher production ($p < 0,05$), of fresh milk as well as corrected milk at 4 % of fat was shown, with the cassava forage, perhaps because of the aminoacid composition of this foliage, which has been qualified as similar to the soybean one (Giraldo *et al*., 2006); this indicates the productive advantages that can be reached with the use of natural sources of protein of relatively easy production in the country.

When analyzing the chemical indicators of the milk composition (table 4), differences were appreciated ($p < 0,05$) in favor of the treatments with kenaf and cassava forage for the protein-fat ratio, which indicates that in cows with potential of 12 L, the energy and protein contribution in the ration is improved.

The protein content of the milk of the animals fed kenaf and cassava was also better, which indicates a higher efficiency in the utilization of nitrogen in the ratio, although it was still low (Jonker *et al*., 1998) and this had repercussion on the other indicators.

The fat percentage in the treatment with kenaf forage did not differ from the one obtained with sugarcane with urea, which shows that the kenaf forage is valuable due to its protein contributions;

Table 3. Productive performance of dairy cows fed with urea or protein foliage.

Type of feedstuff	Fresh milk production day^{-1}	Corrected milk production	Weight gain g day^{-1}
A) Star grass + sugarcane + kenaf foliage	7,8^{b}	6,8^{ab}	130
B) Star grass + sugarcane + cassava foliage	8,4^{a}	7,0^{a}	152
C) Star grass + sugarcane + urea	6,9^{c}	6,6^{b}	133
SE ±	0,2*	0,2*	16

a, b, c: means with different letters within the same column differ at p <0,05 (Duncan, 1955).
* p <0,05

Table 4. Bromatological composition of the milk (%).

Treatment	Protein-fat ratio	Fat	CP	NFS	TS
A) Star grass + sugarcane + kenaf foliage	0,92[a]	3,76[ab]	3,45[a]	8,50[ab]	12,30[ab]
B) Star grass + sugarcane + cassava foliage	0,91[a]	3,82[a]	3,50[a]	8,70[a]	12,50[a]
C) Star grass + sugarcane + urea	0,81[b]	3,71[b]	3,00[b]	8,10[b]	11,80[b]
SE±	0,01*	0,02*	0,02*	0,10*	0,04*

a, b: Means with different letters within the same column differ at $p < 0,05$ (Duncan, 1955).
*$p < 0,05$

but its energy could be a limitation, or even protein itself, in higher-producing cows (Aguilar *et al.*, 2012).

The pH in the urine and the excreta (table 5) is interpreted differently. In this sense, the urine pH indicated that the diets with those urea volumes could be alkalizing the medium and, consequently, cause physiological disorders (Mordak and Nicpon, 2006); while the pH of the excreta (acknowledged as an indirect indicator of the pancreatic alpha-amylase) showed values close to the optimum one (6,9) reported by García López (2010), more adequate for a better utilization of the energy sources of the kenaf and cassava diets, compared with the diet that contains urea.

It is concluded that the alternative of supplementing sugarcane with kenaf or cassava foliage, which produce high protein phytomass, could constitute a fast solution to the protein deficit of cattle production in Cuba, and thus decrease the amount of foreign currency that is used to import urea or other nitrogen sources which are used in ruminant feeding during the dry season.

The results indicate the need to continue the studies with kenaf and cassava crops, due to their fast growth, high protein value, and their positive effect on milk production and composition, in order to search for integrated milk production systems.

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Table 5. Some health indicators in the animals that consumed different protein sources.

Indicator	Treatment A	Treatment B	Treatment C	SE ±
Urine pH	7,40[ab]	7,20[b]	7,60[a]	0,01*
Excreta pH	7,10[b]	7,10[b]	7,35[a]	0,02*

a, b Means with different letters within the same column differ at $p <0,05$ (Duncan, 1955).
*$p < 0,05$

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