Chopped Sugar Cane and Urea Supplementation in Ovines during the Dry Season

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ABSTRACT

The aim of this paper was to prevent weight loss in ovines grazing on native grass, by providing chopped sugar cane alone, and chopped sugar cane + urea. Secondly, to evaluate the effect of sugar cane + urea supplementation compared to chopped sugar cane alone, on performance, consumption, and food conversion, along with ingesting behavior and production costs, of ovines fed native grass in the dry season. The study included nine 10-14 month-old ovines with an initial mean weight of 21.2 ± 2 kg. The experimental period lasted 90 days. The animals were distributed in three treatments: natural grass (G3), sugar cane + urea (G1), and sugar cane + pasture (G2). Compared to pasture alone, supplementation affected consumption ($P < 0.05$). A significant difference was observed ($P < 0.05$) for mean daily gains in the treatments with supplementation, compared to the pasture-alone treatment. Food conversion was higher ($p<0.05$) in the sugar cane + urea treatment. The economic result was positive for all the treatments with sugar cane + urea, and sugar cane alone. The pasture-only treatment showed a negative result. Supplementation with sugar cane + urea, and sugar cane alone increased performance and total food consumption. Accordingly, the returns were higher for the animals supplemented with sugar cane + urea.

KEY WORDS:/ sheep, weight gain, pasture, supplementation, economic viability.

INTRODUCCION

In the last decades, ovines have been labeled as a source of protein foods in developing economies. The total production cost of these animals is determined by nutrition. Therefore, the search for more efficient cost-effective animal food sources is a permanent task. Protein sources, in particular, are highly priced, since they compete with the sources of human nutrition (Piva Lobato & Pilau, 2004).

The digestive system of ruminants is made of pregastric pouch cavities where symbiotic microorganisms digest the nutrient contents in fibrous and gross foods.

The microorganisms in the rumen need 7% CP, minimum, for growth. According to Reis Rodrigues & Pereira (1997), supplementation with true protein or nonprotein nitrogen (NPN) stimulates the growth of microorganisms in the rumen, thus correcting energy deficiencies.

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Consequently, it increases digestibility of low quality forage, and consumption of dry matter and digestible energy, which improves animal performance.

Souza & Santos (2003) demonstrated that urea is a nonprotein nitrogen (NPN) compound that can be used for that purpose. Compared to other sources of nitrogen, it is more economical, and if properly used, it can maintain adequate production levels. Supplementation with nitrogen compounds is the priority goal to enhance low quality tropical forages.

Hence, the aim of this study was to evaluate the effects of sugar cane + urea supplementation on live weight increase, food consumption, food conversion, and production costs of ovines fed native grass in the dry season.

MATERIALS AND METHODS

This research was done between June 1 and September 30, 2015, at the Faculty of Veterinary Medicine, Huambo, San Antonio area, Huambo province. (Castanheira Diniz 1973).

The local climate is dry, 65% relative humidity, with maximum values (75-80%) in January, and minimum (35-40%) in August. The annual mean precipitation value is 1 400 mm, with maximum temperatures between 25 ºC and 27 ºC; the predominant soil is ferralitic (Castanheira Diniz 1973).

The study included nine 10-14 month-old ovines with an initial mean weight of 21.2 ± 2 kg. The animals were distributed in three treatments: deferred native grass (G3), sugar cane supplementation + urea (G1), and sugar cane (G2). The age of all animals was determined.

Group 1: -3, animals without a defined breed, females that consumed chopped sugar cane with urea, mineral salts, water, and grass.

Group 2: -3, animals without a defined breed, females that only consumed chopped sugar cane, mineral salts, water, and grass.

Group 3: -3, animals without a defined breed, females that only consumed mineral salts, water, and grass.

The animals were kept in enclosures, consuming native grass, predominantly, Hiparhernia *ruf*a, Aristada *purpúrea*, Eragrotis sp, and Melinis *minutiflora*, along with other unidentified native graminaceae and legume species under continuous rotation, in a 43-ha total area.

The techniques used included live weight measurements with a tape measure, according to Mahecha, Angulo & Manrique (2002). Performance was evaluated depending on weight gain. Weight measurements were made at the beginning and end of the experiment, in addition to the 15-day intervals, which totaled 90 days after a 14-day period of diet adjustment. Measurements to evaluate the consumption of supplied foods were made in a balance. Grass consumption was determined according to the NRC standards (2007) for food consumption and requirements. A study was conducted to evaluate economic feasibility, taking into account the expenses and income generated during the experiment.

The animals grazed between 08h00 and 15h00, and were stabled between 15h00 and 8h00, with daily supplementation; sugar cane was cut and chopped with an ensilage cutter machine (JF40).

During the experimental period (14 days), the animals were weighed, treated with antiparasitic medication, labeled, and distributed in barns for adaptation to diets and facilities. The foods were weighed and supplied daily (2kg/a/day sugar cane and 10g/a/day urea) to the sugar cane + urea group. The urea was dissolved in water and mixed with the sugar cane. The leftovers were withdrawn and weighed, in order to determine the daily consumption of each group of animals.

The data collected every 15 days from consumption and live weight gain were compiled in a database, by Excel, for Windows, and used for statistical analysis. The data were processed through Software Infosat, version 2, 2013. The variation coefficient and normalized error were determined for food consumption, weight gain, and food conversion, as source of variation.

The following materials were utilized to conduct this research: balance, tape measure, computer, printer, digital photo camera, notebook, buckets, sugar cane, urea, sprinkler, machete, tractor, and ensilage cutter machine (JF40).

The data from the bromatological composition of sugar cane varieties administered to the animals were collected by Dal Seco de Oliveira *et al*. (2007).

Table 1 -Bromatological composition of the sugar cane varieties used

(CO421 - CO617)

Variety	DM (%)	Components (% na DM)			
		CP	ME	CF	MM
CO421	29.5	3.2	4.2	23.7	2.0
CO617	31.7	2.7	4.6	14.8	3.2
Mean	30.7	2.4	4.4	19.2	2.0

Source: Dal Seco Oliveira *et al*. (2007).

RESULTS AND DISCUSSION

Whole sugar cane is an energy-rich graminaceae whose main nutritional limitation is the low contents of crude protein in dry matter (DM), with mean values of 2-3% in all the varieties. Other limitations are low sulfur, phosphorus, zinc, and manganese contents, and low ethereal extracts tenors (EE) (Silva, 1993).

Table 2 shows the values of supply and consumption for sugar cane as exclusive supplement. During the experimental period, 2kg/animal/day were supplied, and consumption was between 1.2 and 1.45 kg/animal/day, with a mean of 1.33 kg/animal/day. These low values did not meet the animal requirements for adequate live weight gain. These were influenced by the high levels of fiber and poor nutritional value of sugar cane. Nevertheless, such potential is limited due to its low digestibility and degradation rates, which led to low voluntary consumption. This fact is mainly linked to the structure of the cell wall that protects nutrients from microbial digestion in the rumen. Pedroso *et al*. (2007) said that food consumption was a critical aspect of animal nutrition when nutrient intake has begun, determining the animal response. A ruminant fed *ad libitum* only ingests a limited amount of sugar cane, since consumption is directly related to fiber content (NDF). The greater the fiber tenor is in sugar cane, the lower the digestibility of that fraction and consumption are. The rate of digestibility in the rumen is very low, and non-degraded fiber limits consumption.

Table 2-Average consumption of chopped sugar cane

	1 - 15	15 - 30	31 - 45	46 - 60	61 - 75	76 - 90
Supply	6	6	6	6	6	6
Consumption	3.6	3.75	3.9	4.1	4.25	4.35
Difference	2.4	2.25	2.1	1.9	1.75	1.65

Sugar cane has two major limitations for animal nutrition: very low mineral tenors and low nitrogen contents (CP). The nutritional requirement tables indicate that the CP tenors needed in the diet can vary depending on age, sex, physiological state, and production or weight gain (Silva, 1993).

Table 3 shows the values of supply and consumption for sugar cane + urea supplement. During the experimental period, 2kg/animal/day sugar cane were supplied with 10 g of urea/animal/day. Consumption was between 1.4 and 1.73 kg/animal/day, with a mean of 1.6 kg/animal/day. These acceptable values met the animal requirements for adequate live weight gain in the dry season. These values are in line with the NRC (National Research Council, 2007) for ovines, with 1 kg consumption of DM per day for sheep with a mean weight of 20 kg, and 150g/day gains.

Table 3- Consumption of chopped sugar cane + urea

	1 - 15	15 - 30	31 - 45	46 - 60	61 - 75	76 - 90
Supply	6	6	6	6	6	6
Consumption	4.2	4.65	4.85	4.85	5.05	5.2
Difference	1.8	1.35	1.15	1.15	0.95	0.8

These results corroborate the reports of Reis *et al*. (1997), who said that supplementation with true protein or nonprotein nitrogen (NPN) stimulated the growth of microorganisms in the rumen, thus correcting energy deficiencies. Consequently, it increased digestibility of low quality forage, and consumption of dry matter and digestible energy, which improved animal performance.

Summary of total consumption of foods per group (kg)

Table 4 shows the difference in food consumption among the different treatments (groups). This factor indicates the existence of limitations in food ingestion by the animals that ate native grass without supplementation (0.8 kg/animal/day), compared to the animals that consumed sugar cane + grass without urea. The ovines consumed 1.45 kg of sugar cane, plus 0.4 kg of grass per animal per day, and higher consumption by animals that ate sugar cane and urea (1.73 kg), plus 0.3 kg of grass, totaling 2.03 kg/animal/day.

According to Hodgson (1990), grass supplementation is an efficient choice to increase animal production and consumption. In every scenario, the available forage does not contain all the essential nutrients in the proper proportion.

Table 4- Average consumption of chopped sugar cane

	Sugar cane + urea	Sugar cane	Grass	Total
G1	1.73a	0	0.3a	2.3a
G2	0	1.45b	0.4b	1.85b
G3	0	0	0.8c	0.8c
VC			52.9	42.5

Note: Grass consumption was determined according to the requirement standards for ovines, of NRC (2007), a, b, and c. Values with uncommon superscripts in the column differ from $p<0.05$.

The basic condition for supplementation with urea is proper forage availability in the ration. This is in line with Cardoso *et al*. (2006), who said that a proper supplementation strategy would tackle maximization of consumption and forage digestibility. Grass consumption was very low due to poor quality. NRC (2007) claimed that at lower temperatures, the animals consume more foods. On the contrary, consumption is reduced in higher temperature conditions, especially due to stress.

According to Owens *et al.* (1980), the animals supplemented with urea were more selective and consumed more food than the animals fed only grass, since they moved longer distances and were able to choose quality grass areas. Alves de Souza & Barreto Espíndula (1999) in an ovine supplementation study with buffel grass (*Cenchrus ciliaris* L.) in the dry season, when crude protein limited animal performance, corroborated that supplementation with leucaena hay improved the quality of the diet, and animals increased consumption and therefore, weight: 31.7 g/day (250g hay/day) and 59.6 g/day (500g hay/day).

Table 5 shows that animals fed grass without supplementation, underwent a mean weight gain (MWG) of 3.45 kg, and daily mean gain (DMG) above 40 g/day. These animals fed low quality grass during the experimental period (July a September). Digestibility dropped from 60% in the rainy season, to 40% in the dry season. Another important change in the grass was related to age: the older the grass, the larger quantity of fiber, causing a rise in the structural compound tenors (fiber and lignin), and a reduction in cell contents (protein and non-fibrous carbohydrate), with an ensued decrease in the plant's nutritional value (Paula Lana, 2002).

Table 5.-Weight of animals fed only grass (kg)

Indicator	ILW	LW 15 days	LW 30 days	LW 45 days	LW 60 days	LW 75 days	LW 90 days
LW mean	20.8	21.5	21.5	22.05	22.75	23.53	24.33
Mean weight gain		0.67	0.67	1.22	1.92	2.65	3.45
Mean LWG/day/animal		0.04	0.02	0.03	0.03	0.04	0.04

According to Valadares Filho & Valadares (2001), the crude protein tenor is one of the most influential factors of grass consumption, since the ruminal microflora demands amino acid contributions to growth, thus affecting nutrient digestibility, negatively.

Therefore, it is important to develop technologies that can help overcome or minimize the effects of the absence or drop of forage quality during the dry season. The purpose is to keep more appropriate animal growth rates, as a way to reduce the raising time until sacrifice, and improve livestock raising performance.

Table 6 shows the behavior of live weight during the 90 days of the experiment of chopped sugar cane plus grass consumption; weight increased 7.78 kg, and the mean live weight gain was 0.086 kg/animal/day. Similar results were accomplished by Carvalho *et al.* (2006), who observed a positive linear increase, linking the rise of supplementation levels with daily mean weight gain.

Evangelista *et al*. (2006) said that sugar cane was a good feeding alternative for ruminants during the dry season. Its potential as forage is enormous; it can be easily included and requires not much tilling to achieve high forage yields (more than 120 t/ha) in a single harvest. The harvest season coincides with the low availability of grass, which is accompanied by high sucrose contents. However, grass is poorly balanced and low quality, with elevated fiber contents, which are badly digested. This factor limits thorough utilization in ruminant nutrition.

Table 6 Weight of animals that consumed chopped sugar cane plus grass (kg)

Indicator	ILW	LW 15 days	LW 30 days	LW 45 days	LW 60 days	LW 75 days	LW 90 days
Mean LW/animal	21	22.3	23.6	24.9	26.2	27.6	28.8
Mean weight gain		1.32	2.6	3.87	5.17	6.55	7.78
Mean LW/a/d		0.088	0.087	0.086	0.086	0.087	0.086

Note: Weight of animals that consumed chopped sugar cane + urea.

Table 7 shows the behavior of live weight during the 90 days of the experiment of chopped sugar cane plus grass; weight increased 11.3 kg, and the mean live weight gain was 0.127 kg/animal/day. Similar results were accomplished by Carvalho *et al.* (2005), who achieved daily weight gains (DWG) between 195.0 and 229.9 g/animal/day. This graminaceae cannot be supplied to ruminants alone due to its nutritional limitations. In that sense, when it is integrated with other forages and food ingredients, it becomes a low-cost, more efficient nutritional alternative to feed animals (Buzo, Avila & Bravo, 1972). The utilization of fermented sugar cane, or its combination with cereals and protein concentrates (Otto *et al*., 1997), has been suggested as a way to improve its nutritional value to feed polygastric animals.

Table 7 Weight of animals that consumed chopped sugar cane + urea (kg)

Indicator	ILW	LW 15 days	LW 30 days	LW 45 days	LW 60 days	LW 75 days	LW 90 days
Mean LW/animal	21.5	23.2	24.95	26.67	28.75	30.65	32.8
Mean weight gain		1.7	3.45	5.17	7.25	9.15	11.3
Mean LWG/a/d		0.113	0.115	0.115	0.121	0.122	0.127

The animal responses to the diet based on chopped sugar cane plus urea (G1), chopped sugar cane without urea (G2), and only grass (G3), are described in table 8, with significant differences (P>0.05) among the diets supplied to each group.

Table 8 Behavior of ovines fed sugar cane + grass (kg)

Variable	G1	G2	G3	VC	SD
Food consumption	2.03a	1.85b	0.8c	42.5	0.66
Weight gain/a/day	0.137a	0.086b	0.030c	60.1	0.04
Food conversion	15.9a	21.5b	26.7c	25.2	5.40

Note: a, b, and c. Values with uncommon superscripts in the column differ from p<0.05 (Duncan, 1955).

Food consumption was 2.03a kg/day for G1, whereas it was 1.85b kg/day for G2, and 0.8c kg/day for G3. G1 had a significantly positive response in comparison to the other groups.

According to González *et al.*, (2006), the previous confirms the effect of additives like urea on the consumption of fibrous foods. Daily DM consumption varies significantly because ovines are not selective in their diet of tropical forages.

The results observed in the animals supplemented with sugar cane (G1 and G2), and the group without supplementation (G3), showed differences (P>0.05) in daily weight gains of 126.6 g/a/d (sugar cane + urea), 86.6b (sugar cane alone), and 30.0c g/a/d (grass alone). The values observed in the sugar cane plus urea diet were higher than the 103 g/a/d found by Pedraza (2000) in a diet based on fermented sugar cane bagasse. However, higher gains than this study have been reported (202 g/a/d), with the consumption of whole sugar cane plus 22% rice polish (Parré, 1995); 159.0 g/day in lamb fed Zacate and Buffel plus rice polish (González *et al*., 2006); 134.4 g/day in lamb fed whole burned fermented chopped sugar cane, with additives (Castrillón, Shimada & Calderón, 1978). The previous contrasts with the nutritional limitations of the productive response of ovines fed sugar cane alone. Nevertheless, animal performance increases with chopping, fermentation and chemical supplementation or other concentrates added to sugar cane (Buzo *et al*., 1972).

The Food conversion values of 15.9a, 21.5b, and 26.7c (food consumption kg/weight gain/kg) for G1, G2 and G3, respectively, were better for the G1 diet (sugar cane + urea + grass), which differed significantly from the rest of the diets supplied to ovines (sugar cane + grass, and grass alone). These results were different from the results reported by Castrillón *et al*. (1978) in whole unburned, chopped and ensilaged sugar cane; unburned chopped, with additives and fermented sugar cane; 5.8, 6.5, and 6.4 kg, respectively, from the 5.41 kg using whole chopped sugar cane with 22% rice polish, by Parré (1995).

Incidence of diseases and main treatment costs

Table 9 shows the occurrence of diseases for the treatments evaluated. G1 and G2 had no disease or deaths; G3 had a case of dermatophylosis caused by the lack of proper nutrition, which led to low immunity. These results coincided with Bufil (1971) in that dermatophylosis is an exudative dermatitis affecting animals, characterized by the appearance of scab. The main losses caused by the disease have repercussions in the quality and amount of fur, and animal weight loss. Table 10 shows the costs by treatment provided to the animals affected, according to Assis Barbosa (2007).

These authors said that the main sources of infection were the sick animals. The transmission of the disease may have been conditioned, in part, by predisposing factors that influenced and could deactivate the defense mechanisms of the skin and fur of animals. Some of these factors are humidity and nutritional level, which are critical in the transmission of the disease.

Table 9 Incidence of diseases during the experiment

	G1	G2	G3
Sick	-	-	1
Dermatophylosis	-	-	1
Pneumonias	-	-	-
Others	-	-	-

Treatments applied to the animals

- Cutaneous scraping
- Vaccination with oxytetracycline (3ml/animal)
- Ivermectin (1ml/animal)
- Amitraz spraying (10ml/liter of water)

Table 10 Main disease-related costs

Expenses	Sugar cane + urea	Sugar cane	Grass
Sick	-	-	600
Dermatophylosis	-	-	600
Pneumonias	-	-	-
Total	-	-	600

Costs of animal nutrition

Table 11 shows the food expenses in the treatments evaluated. G1 accounted for 3143 Kwanzas, which differed from G2, with 2700 Kwanzas. G1 and G2 received 2 kg/animal/day of sugar cane; the animals that consumed grass alone (G3) caused no expenses in supplementary nutrition.

Table 11 Expenses in animal nutrition

Expenses	G1	G2	G3
Sugar cane	2 700	2 700	-
Urea	443		-
Total	3 143	2 700	-

Income/expense ratio

Table 12 shows the income/expense ratio for each group in the study. Significant differences were observed for (P>0.05) in relation to the variables in the study. The income for G1 was 8475a Kwanzas, higher than G2 and G3, with 3143a Kwanzas as expenses, and a difference of 5332a Kwanzas between income and expenses. G2 produced an income of 5 850b with 2700b expenses; the revenue was 3.150b Kwanzas. The expenses to treat the disease for G3 were 600 Kwanzas, with a revenue of 2 025 Kwanzas.

Table 12- Income/expense ratio (Kwanzas)

	G1	G2	G3	VC
Income	8.475a	5.850b	2 625c	51.8606
Expenses	3.143a	2.700b	600c	63.25459
Income/expenses	5.332a	3.150b	2 025c	48.00851

Note: a, b, and c. Values with uncommon superscripts in the column differ from p<0.05.

These results coincided with the reports published by Lopes *et al.* (2006), who concluded that the costs of nutrition and the return, in terms of sheep meat production, were closely linked to variables food conversion and food efficiency. Therefore, it is noteworthy to mention that in face of food conversion and food efficiency deterioration, an automatic increase in feeding costs, diseases, and deaths takes place, with ensuing lower financial return.

CONCLUSIONS

Supplementation with sugar cane, plus urea on native grass during the dry season improved performance, consumption, and food conversion in ovines, which represented an economically feasible solution to farmers.

The values of consumption and weight gain were higher for the diet based on sugar cane + urea than the sugar cane alone diet administered to animals that grazed on native grass.

RECOMMENDATION

The authors of this paper suggest training farmers on the utilization of urea as an additive in diets with high fiber contents.

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