

Entire sugar cane or sugar cane residues for feeding sheep. Performance traits of hairless sheep

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Summary

A total of 21 male sheep of the hairless (Pelibuey) genotype (20.2 ± 3.1 kg) was randomly allotted to three treatments to be given during 56 days three diets formulated to contain 50% of either green, ground and fermented entire sugar cane; burnt, ground and fermented sugar cane or burnt, ground and fermented sugar cane residues. Daily gain was 92, 130 and 106 g whereas feed conversion was 13.53, 10.57 and 12.68 kg feed/kg gain, with no significant ($P>0.05$) differences among treatments.

It is suggested that burnt sugar cane as crop residues which are ground and fermented, can bring about a new feedstuff for feeding sheep in Nayarit, where a considerable amount of crop residues are yearly produced during sugar cane harvest.

Key words: Pelibuey, performance traits, processed sugar cane crop residues, sheep

Introduction

Feeding farm animals, either monogastric or ruminant species, are usually carried out by the employment of high amounts of milling products from cereal and legume grains, which in turn establish an open competence with human beings from the point of view of use of the same resources of foods. This is the cause why a search is done for other alimentary options promoting the use of raw materials for ruminants which are not susceptible of use in human feeding.

Feeding either cattle or small ruminants with sugar cane remains up to date in the tropics, since sugar cane yields high amounts of biomass. Moreover, in the dry tropical climate of Nayarit, Mexico, sugar cane is harvested during the dry season, when other grasses are evidently scanty. However, it must be taken into account feed supplementation to correct nutritional deficiency which could occur if the characteristics of sugar cane are not

considered, which in turn contribute to attain an optimum of its productive potential (Martín 1981).

The utilization of different physical and biological procedures in sugar cane and its crop residues in order to increase its feeding value has determined better animal response in ruminants (Elías et al 1988). Traditionally, the use of fresh sugar cane or its crop residues has been used as a substitute of grasses and other forages during the dry season, which in turn coincide with high yields of DM and energy, as a result of a proper management of sugar cane harvesting during to favorable environmental conditions.

In adverse conditions of forage production, even in the rainy season, it is considered viable to design feeding system based on sugar cane and its residues for other periods of the year, although the main task is the difficulty derived from soil humidity, which in fact limits this option. Therefore, ensiling sugar canes and its residues during summer, represents a viable procedure, which has allowed setting up a functional system in other tropical countries, such as Cuba, consisting in the use of fresh sugar cane and its residues during the dry season, then silage made from these two products in the rainy season (Molina et al 1997).

Preston et al (1976a) claimed that an advantage of ensiling sugar cane is based in a controlled anaerobic fermentation, which increases the true protein content and lactic acid concentration. On the other hand, the use of sugar cane and its fibrous derivatives has been improved after being subjected to several processes (Martin 1981; Cabello 1986). It is evident the increased relationship between cattle production and the use of derivatives from sugar cane industry. In fact, positive results from the point of view of animal production and of economy are derived when high amounts of sugar cane residues and by-products originated in the sugar cane mill are used for feeding ruminants (Naseveen 1986; Namer 1991), as well in the conservation of the environment (Stuart 1990).

The aim of the present experiment was to apply the technology for conservation of sugar cane forage and its residues after harvesting, by the use of fermentative processes and by the aid of chemical additives for regulating its nutritive value, in order to feed sheep in Nayarit conditions of animal production.

Materials and methods

Place of experimentation

Sugar cane products obtention, processing and preparation, and the performance test were conducted in “La Lobera” farm, whose owner was a farmer from the ejido “San Leonel”, municipality of Santa María del Oro, in the Mexican State of Nayarit. This place was in the km number 721 of the route N° 15 México-Nogales. The farm is located in 21° 19′ 40.8″ west longitude and 104° 49′ 43.3″ north latitude, at 1193 m over sea level. Average year round temperature and rain fall are 20.9°C and 1 250 mm (García 1987).

Preparation of experimental feeds

Sugar cane and its crop residues were from the selected MEX 69-290, and the materials were obtained by hand and from only one plot, and samples were taken according the technique of Lopez et al (2003). The products were ground to a particle of 1-5 mm by a chopping machine commonly used for fresh forage. A total of 1 000 kg were prepared for out of three experimental materials. These materials were subjected to different processing methods, determining three different treatments. The first treatment consisted of entire sugar cane, green and ground, which was fermented with additive according to the methods assayed by Magaña et al (2009). The second treatment consisted of sugar cane which was burnt and ground, and later on subjected to the same fermentation procedure otherwise containing the same additives as in the first treatment. Finally, burnt and ground sugar cane crop residues were prepared as in the first treatment.

Briefly, sugar cane products were extended over a dry plate in order to be thoroughly mixed with 1.1% urea, 0.5% mineral salts, including Ca, P and trace elements, and 0.5% zeolite. After mixing, the materials were put in 40-kg black polyethylene containers. The products were packed to top and hermetically closed. Thereafter, the containers were stored in a roofed room, in order to permit the fermentative process during 30 days at room temperature (from 19.5 to 32.9°C).

Performance trial with sheep

A performance test was conducted, using 21 hairless sheep, male, averaging 20.24 ± 3.19 kg initial body weight. Two days after arrival to the farm, the animals were deparasited subcutaneously with 1% Ivermectine. Additionally, double bacterin vaccine against synthomatic carbuncle and sheep pasteurellosis was injected via intramuscular (Aguirre 2001). In the seventh day of adaptation, the animals were intramuscularly injected with a polycomplex of vitamins A, D and E.

At the start of the experiment the animals were identified, weighed and allotted at random into three groups. Treatments consisted of diets prepared with every type of sugar cane products prepared by grinding, fermentation and inclusion of additives (50.06% of the diet in dry basis) plus maize forage prepared from the aerial part of the entire maize which was ground in the same manner of sugar cane products, after being sun dried. The botanical and chemical characteristics of the maize forage meal were described elsewhere (Magaña et al 2009). A certain proportion of soybean meal was added to the rations in order to meet NRC (1985) requirements for crude protein. The characteristics of the experimental diets are shown in table 1.

Table 1. Composition of the experimental diets (in per cent)¹

	Entire sugar cane		Sugar cane residues
	Green	Burnt	
Maize plant	43.13	45.90	43.13
Soybean cake	6.81	4.04	6.81
Green entire sugar cane	50.06	-	-
Bunt entire sugar cane	-	50.06	-

Sugar cane residues	-	-	50.06
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¹ In any case, sugar cane and sugar cane residues were ground and fermented. See text for other details

Some details of the chemical composition of experimental diets are shown in table 2. It may be noted that there were no great differences in the characteristics of the evaluated diets, in spite of its diverse origin, from the point of view of sugar cane products.

Table 2. Chemical characteristics of the experimental diets (in per cent)¹

	Entire sugar cane		Sugar cane residues
	Green	Burnt	
Dry matter	94.93	94.56	91.60
Ash	3.39	3.48	3.36
NDF	59.24	60.15	58.69
ADF	27.89	34.70	30.24
Hemicellulose	31.35	25.45	28.45
Soluble carbohydrates	40.76	39.85	41.31
Ether extract	4.39	4.39	4.39
Crude protein (Nx6.25)	11.38	11.43	10.61

¹ In any case, sugar cane and sugar cane residues were ground and fermented. See text for other details

Sheep were housed in three pens with capacity for seven animals each. The pens had an area of 12 m², with no floor and a roof made of asbestos sheets. Every pen was provided of through were mineral salts were provided ad libitum. The ration were prepared daily and then immediately offered to sheep. An amount roughly representing from 3 to 4.5% body weight was offered every day, in order to assure that ad libitum conditions were prevalent, and the feeds were given in two aequal rations, served at 7:00 and 15:00 hours. Feed refusal was collected every day in the morning before the morning meal. The experiment length was nine weeks, consisting in one week of adaptation of the animals to the diets and another eight for the growth trial.

The animals were weighed every week, in fasting conditions, during the morning. Different performance traits, consisting in feed consumption, daily gain and feed conversion were determined according to Obregón (2003) recommendations.

Data were subjected to an ANOVA according to the GLM of SAS (2002)

Results and discussion

Results corresponding to the different performance traits of sheep are in table 3.

Table 3. Performance traits and cost of hairless sheep fed sugar products¹

	Entire sugar cane		Sugar cane residues	SEM ±
	Green	Burnt		
Initial weight, kg	20.45	20.23	20.71	3.19
Final weight, kg	25.50	27.55	26.67	4.10
Daily gain, g/day	92	130	106	24
Feed intake, kg/day	1 253	1 382	1 349	-
Feed conversion, kg/kg	13.53	10.57	12.68	1.52 ²
Cost, Mexican pesos/t ³	1 307.04	1 189.44	1 391.04	-

¹ In any case, sugar cane and sugar cane residues were ground and fermented. See text for other details

² Estimated

³ One North American dollar equals 10.4 Mexican pesos (2008)

There were not significant ($P>0.05$) effect of diets on sheep feed intake, although the consumption of feed was slightly higher, 10.2 and 7.6% respectively for diets based on burnt sugar canes and sugar cane residues. These findings could be explained since burnt sugar cane contain less lignified parts as compared to not burnt, green entire sugar canes. On the other hand, these data were higher than others observed in sheep fed on either green or burnt, ground and fermented sugar cane, which accounted for 780 and 865 g/day respectively (Cuarón and Shimada 1981). Pérez (2000) reported a lower feed intake than those obtained in the present investigation, when animals were feed buffel grass (1 095 g/day) and Obregón et al (2006) reported values ranging from 1 166 to 1 216 g/day in sheep fed either chickpea crop residue, linseed or canola meal. However, data herein presented were lower than that reported by Landaeta et al (2004), averaging 1 225 g/day per sheep in diets based on sugar cane bagasse, rice polishing and poultry litter.

Sheep fed on diet based on either burnt sugar cane or sugar cane residues had a better, although not significant ($P>0.05$) daily gain than diet containing green entire sugar canes; in fact animals fed on burnt entire sugar canes showed 41.3 and 14.9% higher values in daily gain in this case. These results were probably influenced by a higher feed intake in those treatments. The obtained data were higher than those reported by Landaeta et al (2004) in sheep fed sugar cane bagasse, and Cuarón and Shimada (1981) evaluating different types of processed sugar cane for sheep. On the other hand, Castillo et al (2004) observed lower values, 60 and 82 g/day, in animals fed sugar cane and distiller grains. Results obtained in the current investigation were similar to those of Pedraza (2000), in animals fed fermented sugar cane bagasse. On the other hand, the daily gain herein reported were lower than in other feeding trials with sheep with several types of diets, from Obregón et al (2006) who fed sheep with chickpea crop residues, to Pérez et al (2006) who used rice polishing, and even González et al (2006) feeding sheep with buffel grass and Cuarón and Shimada (1981) when integral sugar cane was utilized after being ground, added some products and fermented. The explanation for a high daily gain as those found in other studies where sheep intake was evaluated on diets supplemented with legume and other protein supplements, could be based on the nature of those supplements (Aguirre 2001).

It was found in the current investigation that significant ($P < 0.05$) differences were not found in feed conversion of Pelibuey sheep fed the experimental diets. On the other hand data herein presented were clearly higher than those found by Obregón et al (2006) in animals fed on chickpea residues, canola and cartamo cake, and either González et al (2006) obtained when sheep were fed 22% rice polishing in the diet, or Pedraza (2000) working with animals exhibiting a consumption of diets containing 55% sugar cane bagasse. A very marked effect of rice polishings (of 0 to 1,2 kg/ daily and minerals) in increasing voluntary intake of sugar cane, live weight gain and in improving feed conversion, was reported by Preston et al (1976b). On the other hand, Cuarón and Shimada (1981) found feed conversion ranging from 5.8 to 6.5 kg feed/kg gain in sheep fed on burnt and ensiled integral sugar cane. These differences in efficiency of feed conversion could be influenced by the nutritional value of the employed type of feedstuff, voluntary feed consumption, age, initial live weight for fattening, and the genetic potential in confined animals. However, values found in this study for feed conversion were better than those reported by Landaeta et al (2004) in animals fed diets based on sugar cane bagasse, supplemented by rice bran and poultry litter.

From the point of view of cost of diets, it could be observed that diet containing entire burnt canes could determine the highest profits as compared to the other two diets. Diet based on entire green canes was found to be more expensive than diet based on sugar cane residues due to the fact that only collection and transportation of sugar cane residues should be assigned to these products since there are not economical prices for them.

This experiment clearly shows that sugar cane and sugar cane residues must be considered an alimentary alternative for feeding ruminants. Even so, due to its low protein and mineral content, sugar canes are not convenient for use as the only feedstuff in rations for animals. However, integral sugar cane either burnt or green, when it is ground and mixed with some additives to be fermented later on, determine performance traits in confined sheep which in turn are worth to be considered.

From the economical point of view, it was observed that sugar cane residues, after being ground, mixed with several additives and ensiled, lowered costs of production due to the fact that these crop residues have no values for animal producers. In this connection, sugar cane residues become a main potential for feeding ruminants in Nayarit, through a process of grinding, addition of several compounds and fermentation.

In fact, the use of integral sugar cane as forage for ruminant animal production emerges as another alternative, even from the point of current price of sugar cane to be destined to the industry. Nevertheless, more research is needed for validation of this technology concerning the use and level of replacement of concentrates for sugar cane to be used in meat and milk production from ruminants.

Literature cited

Aguirre O J 2001 Consumo voluntario y valor nutricional de *Cynodon plectostachyus* fertilizado o abonado, con suplementación proteica a corderos pelibuey. Tesis doctoral. Universidad Autónoma de Nayarit. Tepic, Nayarit, México

Cabello A 1986 Caña de azúcar y alimentación animal. La industria de los derivados de la caña de azúcar. ICIDCA. Ed. Científico-Técnica. La Habana, p 383-395

Castillo E L H, de Oliveira L J A and Oldakowski C F 2004 Página Saf Agri Veracruz. Desempeño productivo de borregos raza Santa Inez suplementados con diferentes niveles de levadura viva (Procreatin 7®)

Cuarón M L and Shimada A S 1981 Manipulación de la fermentación en ensilajes de caña de azúcar y su valor alimenticio para corderos. 2. Adición de monensín sódico al suplemento y tratamiento físico y alcalino (NaOH) de la caña de azúcar en el comportamiento animal. Revista Cubana de Ciencia Agrícola 15:177

Elías A, Lezcano P, Lezcano O, Cordero J and Quintana L 1988 La saccharina. Nuevo producto energético proteico para la alimentación animal. XXV Aniversario del Instituto de los Derivados de la Caña de Azúcar. Resumen. La Habana

García E 1987 Modificaciones al sistema de clasificación climática de Koppen (para adaptarlo a condiciones de México). 4ª. ed., Ed UNAM, México. 246 pp

González M I M, Gutiérrez O E, Morales T H, Bernal B H and Colin N J 2006 Consumo voluntario de dietas a base de zacate buffel ofrecido a borregas pelibuey de diferentes pesos vivos. Memorias de XXXIV Reunión Anual de la Asociación Mexicana de Producción Animal, Mazatlán Sinaloa. p 102-104

Landaeta R M, Novel B G, Sánchez B R, Rojas C J, Jiménez J L 2004 Evaluación de cama de pollo mezclada con salvado de arroz y bagazo de caña de azúcar para el engorde de corderos en confinamiento. Livestock Research for Rural Development 16: <http://www.lrrd.org/lrrd16/10/land16084.htm>

López I, Aranda E, Ramos J, Mendoza G 2003 Evaluación nutricional de ocho variedades de caña de azúcar con potencial forrajero. Revista Cubana de Ciencia Agrícola. 37: 381-386

Martín P C 1981 Utilización de subproductos fibrosos de la caña de azúcar por los rumiantes. 6. efecto de la suplementación en el comportamiento de novillas lecheras alimentadas con bagacillo predigerido. Revista Cubana de Ciencia Agrícola 15:9-13

Molina A S, Febles I and Sierra J F 1997 Ensilaje de caña de azúcar con síntesis proteica. Formulación de los aditivos. Revista Cubana de Ciencia Agrícola 31:271-274

Namer I 1991 Incremento de la digestibilidad de los residuos fibrosos de la caña de azúcar. 2. Residuos de centro de acopio. Revista ACPA 1/90:8

Naseeven M R 1986 Sugarcane tops as animal feed. In: Sugarcane as Feed. FAO Animal Production and Health Papers. Rome <http://www.fao.org/docrep/003/s8850e/S8850E10.htm>

NRC 1985 The Nutrient Requirements of Sheep. National Research Council (6th edition). ASA-National Academy Press. Washington, D C

Obregón J F, Dávila R H, Ríos R F G, Estrada A A, Barajas C R, Ibarra C E and Villalba A N E 2006 Respuesta productiva de ovinos de pelo en finalización con dietas isoproteicas elaboradas con pasta de canola, pasta de cártamo y rezaga de garbanzo. In: Memorias de XXXIV Reunión Nacional de la Asociación Mexicana de Producción Animal. Mazatlán, p 172-175

Obregón J F 2003 Valoración nutricional del garbanzo (*Cicer arietinum L.*) en dietas integrales para ovinos en engorda intensiva. Tesis doctoral. Universidad Autónoma de Nayarit, Tepic, pp 32

Pedraza O R M 2000 Bagazo rico en proteína (Bagarip) alimento animal obtenido por fermentación en estado sólido. Revista de Producción Animal 12:41-51

Pérez H J A, Salinas Ch J, García C R F and Arbola A A C 2006 Efecto de raciones con distintos niveles de pulido de arroz sobre el comportamiento productivo de ovinos en engorda. In: Memorias de XXXIV Reunión Nacional de la Asociación Mexicana de Producción Animal. Mazatlán, p 80 –83

Preston T R, Hinojosa C and Martínez L 1976a Ensilaje de caña de azúcar con amoníaco, miel y ácidos minerales. Producción Animal Tropical 1 (2): 24 143-150 http://www.utafoundation.org/TAP/TAP12/1_2_11.pdf

Preston T R, Carcaño C, Alvarez F J and Gutiérrez D G 1976b Rice polishings as a supplement in a sugar cane diet; effectf level of rice polishings and of processing the sugar cane by derinding or chopping. Tropical Animal Production 3: 1 http://www.utafoundation.org/TAP/TAP13/1_3_1.pdf

SAS 2002 User's Guide. Statistical Analysis System (SAS) Institute. Cary

Stuart J R 1990 Crianza de bovinos con residuos de centros de limpieza de la caña de azúcar como dieta básica. In: Producción de Carne en el Trópico. Editorial EDICA. La Habana, p 190