Use of sugarcane crop residue silage with different levels of inclusion in dual-purpose cow diets

Utilização de silage de resíduos culturais de cana-de-açúcar com diferentes níveis de inclusão em dietas de vacas de duplo propósito

DOI: 10.55905/oelv22n1-167

Recebimento dos originais: 21/12/2023
Aceitação para publicação: 23/01/2024

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ABSTRACT
In the sugar cane production chain, different byproducts are generated that can be used in animal feed. Their conservation in the form of silage is an important contribution towards
improving animal production in tropical regions. The objective was to evaluate the inclusion of different levels of silage from sugarcane crop residues in the diet of dairy cows in a family farming system. Nine lactating cows were used in a 3x3 Latin square design in triplicate and means were compared using the Tukey test. The treatment sequences were randomly assigned with periods of 14 days. Three treatments were formulated that included feed of mixed native grasses, supplemented with sugarcane top silage with different inclusion levels (2 kg/DM for T1, 4 kg/DM for T2 and 6 kg/DM for T3), along with commercial concentrate and corn silage. Milk production, its chemical composition, and the efficiency of feed utilization were evaluated. The average milk production, fat content and crude protein were, respectively, 9.38 kg/cow/day, 32.6 and 340.0 g/cow/day. No differences were detected (P>0.05) for any of the variables evaluated, but the inclusion of 6 kg of sugarcane residues silage improved the animals' feed efficiency. Therefore, sugarcane top silage is a viable alternative for feeding ruminants.

Keywords: animal production, family livestock farming, local resources, silage, sugarcane by products.

RESUMO
Na cadeia produtiva da cana-de-açúcar são gerados diversos subprodutos que podem ser utilizados na alimentação animal. A conservação na forma de silagem é uma importante contribuição para a melhoria da produção animal nas regiões tropicais. O objetivo foi avaliar a inclusão de diferentes níveis de silagem de resíduos de cana-de-açúcar na dieta de vacas leiteiras em sistema de agricultura familiar. Foram utilizadas nove vacas em lactação em delineamento em quadrado latino 3x3 em triplicate e as médias comparadas pelo teste Tukey. As sequências de tratamento foram distribuídas aleatoriamente com períodos experimentais de 14 dias. Foram formulados três tratamentos que incluíram pastejo de gramíneas nativas, suplementada com silagem de cobertura de cana-de-açúcar com diferentes níveis de inclusão (2 kg/MS para T1, 4 kg/MS para T2 e 6 kg/MS para T3), juntamente com concentrado e milho silagem. Foram avaliadas a produção de leite, composição química e eficiência de utilização da ração. A produção média de leite, teor de gordura e de proteína foram, respectivamente, de 9.38 kg/vaca/dia, 32.6 e 340.0 g/vaca/dia. Não foram detectadas diferenças (P>0.05) para nenhuma das variáveis, mas a inclusão de 6 kg de silagem de resíduos de cana-de-açúcar melhorou a eficiência alimentar dos animais. Portanto, a silagem de topo de cana-de-açúcar é uma alternativa viável para alimentação de ruminantes.

Palavras-chave: pecuária familiar, produção animal, recursos locais, subprodutos da cana-de-açúcar, silagem.
1 INTRODUCTION

In Mexico, sugarcane (Saccharum officinarum L.) is the second most important staple crop after corn (Zea mays L.) (Aguilar-Rivera et al., 2012). Globally, Mexico is in fifth place in sugarcane production and the sixth in sugar production, with a long tradition at the international level. The sugarcane industry is considered a fundamental pillar for the socioeconomic development of the rural population, providing local jobs and inputs, mainly along the Pacific and Gulf of Mexico coastal areas (Aguilar-Rivera et al., 2012). The state of Quintana Roo accounts for 3.4% of the country's total sugarcane output, and it has one the nation’s 57 sugar mills (in San Rafael de Pucté) (Aguilar-Rivera et al., 2012).

Sugar production entails a sequence of agricultural activities, from planting to harvesting, transportation and refining, generating wastes and byproducts. Among these are crop residues, bagasse, molasses, filter sludge and vinasse, which can be used as local raw materials (Aguilar-Rivera et al., 2011).

The crop waste left in the field after the sugarcane harvest can play a fundamental role as a carbon source, providing moisture and maintaining soil temperature, in addition to contributing to the maintenance of biodiversity. But when quantity of crop waste is excessive, it can harm the soil macro-fauna and related ecosystem services (Santos-Menandro et al., 2019). The crop wastes are generally discarded in the field, and many farmers burn the material (Xie et al., 2023; Chauhan et al., 2023). This practice causes significant environmental contamination by damaging the quality of water, soil and air (Chauhan et al., 2023).

However, the use of this waste in animal feed can mitigate the lack of forage, mainly during the dry season (Xie et al., 2023). This resource is limited by the presence of molds and rapid dehydration during storage in natura, so a conservation strategy is necessary to maximize the use of silage to improve productive performance of livestock, considering the palatability and storage time of the byproduct (Xie et al., 2023; Chauhan et al., 2023). With proper management, the use of crop residues/byproducts is viable alternative feeding strategy to minimize costs and maximize animal production.
Therefore, the objective of this study was to evaluate the inclusion of different levels of silage from sugarcane residues in the diets of dairy cows in a family farming system.

2 MATERIALS AND METHODS

2.1 LOCALE, ANIMALS AND PRE-MANAGEMENT

The farm analyzed is located in the town of Rio Verde, in the municipality of Bacalar, Quintana Roo State, Mexico, located between the geographical coordinates 18° 40' N and 88 °23' W. The climate of the region is classified as warm sub-humid (Aw1), with rain mainly in summer (García, 2004). The average annual temperature ranges from 24 to 26 °C and the warmest month is May, with daily maximum temperatures typically ranging between 43 and 45 °C. The average annual rainfall is 1260 mm. The predominant soils in the region are of the leptosol and gleisol type, according to the FAO (IUSS Working Group WRB, 2022). The study was carried out at the end of the dry season, from May 2 to June 13, 2022.

Nine Gyr cows from different crosses of local zebu breeds were used, for which the guidelines established in the Official Mexican Standards (NOM-051-ZOO-1995 and NOM-062-ZOO-1999) were followed. Before the experiment, the 9 cows were kept with the rest of the herd, under a daytime pasture grazing system with mixed native grasses for approximately 8 hours, supplemented with commercial concentrate and corn silage. During this baseline period, average milk production of 9.6 kg/cow/day was recorded during an average of 58.3 days of lactation, with milking performed manually once a day.

2.2 SUGARCANE TOP SILAGE

For silage, the sugarcane crop residues that remained in the field after the harvest in January 2022 were used. The post-harvest sugarcane waste consisted mostly of green leaves, supported by tillers (3 to 4 nodes), along with a minority of remnants of young plants and some entire mature plants that could not be lifted by the harvesting machinery. The predominant sugarcane varieties were MEX 69-290 and CP 72-2086, which were collected 2 days after harvest and fractionated with the help of a homemade chopper, and compacted in black Silo Pack type bags with thickness of 140 microns, under facultative
anaerobic conditions, tied and incubated for approximately 105 days until the experiment. Corn silage was prepared in March 2022 using the entire plant in its milky stage with a procedure similar to that of the byproduct of sugar production.

2.3 TREATMENTS

Three treatments were applied: with inclusion of different levels of sugarcane top silage (2 kg for T1, 4 kg for T2 and 6 kg for T3). All three treatments were formulated also to include 2 kg of commercial concentrate (33% sorghum, 33% corn, 16.5% soybean cake, 16.5% soybean meal and 1% premix) and 2 kg of corn silage on a fresh basis (Table 1). For inclusion of the components of each treatment, dry matter consumption of 3.2% of live weight was considered (Pozo-Leyva et al., 2021a and b), along with body condition and lactation stage, following the procedure described in NRC (2001).

Table 1. Chemical composition of the ration ingredients (g/kg DM).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Grass</th>
<th>Cane silage</th>
<th>Corn silage</th>
<th>Concentrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM (g/kg/DM)</td>
<td>353.8</td>
<td>284.2</td>
<td>296.1</td>
<td>940.2</td>
</tr>
<tr>
<td>OM (g/kg/DM)</td>
<td>865.8</td>
<td>885.8</td>
<td>921.3</td>
<td>626.5</td>
</tr>
<tr>
<td>Ash (g/kg/DM)</td>
<td>135.2</td>
<td>45.6</td>
<td>50.7</td>
<td>20.9</td>
</tr>
<tr>
<td>N (g/kg/DM)</td>
<td>15.0</td>
<td>4.0</td>
<td>14.0</td>
<td>32.9</td>
</tr>
<tr>
<td>CP (g/kg/DM)</td>
<td>93.4</td>
<td>24.7</td>
<td>87.4</td>
<td>205.3</td>
</tr>
<tr>
<td>ADF (g/kg/DM)</td>
<td>404.3</td>
<td>365.5</td>
<td>337.8</td>
<td>56.6</td>
</tr>
<tr>
<td>NDF (g/kg/DM)</td>
<td>665.6</td>
<td>627.8</td>
<td>631.5</td>
<td>211.7</td>
</tr>
<tr>
<td>Lignin (g/kg/DM)</td>
<td>15.3</td>
<td>18.4</td>
<td>11.2</td>
<td>7.8</td>
</tr>
<tr>
<td>EE (g/kg/DM)</td>
<td>4.4</td>
<td>3.1</td>
<td>3.9</td>
<td>16.1</td>
</tr>
<tr>
<td>DVMS %</td>
<td>57.8</td>
<td>60.8</td>
<td>62.9</td>
<td>84.5</td>
</tr>
<tr>
<td>eME (MJ eME/kg DM)</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.8</td>
</tr>
</tbody>
</table>

DM = dry matter, MO = organic matter, N = nitrogen, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber, EE = ether stratum DIVMS = in vitro digestibility of dry matter, eME estimated metabolizable energy (MJ eME/kg DM). Source: authors (2024).

2.4 CHEMICAL COMPOSITION OF FEED INGREDIENTS

One week before the start of the experiment, samples were taken to determine the dry matter (DM) content by drying in a forced-air oven at 65 °C for 48 h. The determination of organic matter (OM) and ash (Index No. 942.05) was carried out using a muffle furnace at 550 °C for 3 h. Neutral detergent fiber (NDF), acid detergent fiber
(ADF), and lignin were quantified by the microbag method with an ANKOM A200 fiber analyzer (ANKOM Technology, Macedon, NY, USA) (Van Soest et al., 1991). Ethereal extract (EE) (Index No. 920.39) was determined by the standard method (AOAC, 1990). The nitrogen (N) content was obtained by the dry combustion technique using a PerkinElmer 2400 Series II CHNS/O elemental analyzer (PerkinElmer Inc., Massachusetts, USA), and the crude protein (CP) was obtained using the conversion 6.25 following the procedure described by NRC (2001). The in vitro dry matter digestibility (IVDMD) was determined by incubation in ruminal fluid following the modified method reported by Tilley and Terry (1963). The estimated metabolizable energy (ME) content was calculated using the equation cited by Mackle et al. (1999):

\[
EM (MJ/Kg/MS) = 0.0156 \times IVDMD - 0.535
\]

Equation (1)

2.5 ANIMAL RESPONSE VARIABLES

Manual milking was carried out at 7a.m., during which each cow was supplied with 2 kg of commercial concentrate and 2 kg of corn silage on a fresh basis. After milking, each cow and her calf were moved to pastures of mixed grasses of *Eleusine indica* (L.) Gaertn., *Sorghum halepense* (L.) Pers., *Brachiaria brizantha* (Stapf) and *Cynodon dactylon* var. sarmentosus Pers., for approximately 8 h daily. Subsequently, the animals were stabled where the sugarcane silage was supplied individually, according to the treatment corresponding to each animal. The animals had water *ad libitum* at all times.

During the last four days of each experimental period, milk production after milking was measured using a digital scale with capacity of 30 kg (VINS-30, Vinson, Mexico). Individual samples were subsequently taken to determine the chemical composition of the milk (fat, density, lactose, non-fat solids and CP), determined with a portable ultrasonic milk analyzer (LacticheckTM®, Model LC-01, Page & Pedersen International Ltda, Massachusetts, USA). The N content was obtained by a factor of 6.38 according to NRC (2001). On the last day of each experimental period, each cow was weighed after milking using a scale with capacity of 1000 kg (Modelo RGI-20C-DVZ, Básulas Revuelta, @BasculasR, México).
2.6 FEED UTILIZATION EFFICIENCY PER TREATMENT

CP consumption was established considering dry matter consumption and N content. For N output, N content and total milk production were considered. The excretion of N in slurry (mixture of urine and manure) was estimated by the difference between the N consumed and the N excreted in milk. To determine the feed utilization efficiency (FUE), the excretion of N in milk and N consumption were considered (Pozo-Leyva et al., 2021a).

2.7 EXPERIMENTAL DESIGN

The duration of the experiment was 42 days, with 3 experimental periods of 14 days each, of which 10 were for adaptation and 4 for the evaluation of the animal response (Miguel et al., 2014).

The distribution of cows within the treatment sequence was random. In the same way, the sequence of treatments was assigned per group of animals, using a 3 × 3 Latin square design in triplicate. The comparison of means was made with the Tukey test using the Minitab® software version 19.0, considering a significance of p<0.05. The mathematical model for the animal response variables was:

\[ Y_{ijkl} = \mu + C_i + V_j(i) + P_k + t_l + e_{ijkl} \]  

Equation (2)

Where:

\[ \mu = \text{general mean}; \ C = \text{frame effect (i = 1, 2, 3)}; \ V = \text{cow effect inside the box (j=1, 2, 3...9)}; \ P = \text{effect due to the experimental period (k = 1, 2, 3); t = treatment effect (1, 2, 3); e = experimental error.} \]

3 RESULTS AND DISCUSSION

3.1 CHEMICAL COMPOSITION OF FEED

Table 1 shows the chemical composition of the feed ingredients, where it can be seen that native or naturalized grasses had the highest DM and NDF content and the lowest digestibility. The above results agree with López-Hernández et al. (2023), who reported that the availability and quality of grasslands during the dry season is limited
and strongly affects the cow-calf subsystem, given that the basis of feeding in tropical production systems is extensive grazing. Therefore, it is necessary to use industrial and agricultural byproducts. Similarly, Mahala et al. (2012) stated that native grasses have high dry matter (DM) content and low digestibility, as well as CP concentrations lower than 7%.

In a study carried out by Gomes-David et al. (2015), sugarcane was found to be an alternative food for ruminants in cases of forage shortage in tropical areas, and that a viable method for conservation is silage production. Likewise, they reported that DM content was 37.4%, CP 3.3%, EE 1.1%, NDF 64.9%, ADF 41.8% and Lignin 6.8%. Lucci et al. (2003), studying sugarcane silage pure or with 0.5% or 1% urea added, found respective values of 27.30, 26.32 and 26.57% of dry matter and 3.15, 7.07 and 11.5% of crude protein. The differences between our findings previous research may be related to the ensilage procedure, the quality of the cane and the cane varieties used (Reyes-Gutiérrez et al., 2018; Xie et al., 2023), and mainly to the fact that waste from the sugar industry was used in this work, mostly sugarcane tops. Xie et al. (2023), working with Napier silage and sugarcane tops (25:75 fresh basis), reported 26.32% DM, 91.16% OM, 6.35% CP, 71.18% NDF and 38.72% ADF. Other authors, to improve the low amount of protein in sugarcane, used strategies to ensile the cane with protein products, such as Lima et al. (2013), who ensiled sugarcane tops (20%) with soybeans (60%) and concentrate (20%), achieving 39.4% DM and 19.2% CP; Pazla et al. (2023), who used a mixture of fermented sugarcane (35%) with Mexican sunflower (Tithonia diversifolia) (18.5%), avocado residue (1.5%) and concentrate (45%), with results of 76.48% DM and 14.65% CP. In turn, Reyes-Gutiérrez et al. (2018) reported DM concentrations of 27%, OM of 91.4%, CP of 14.7%, NDF of 53.8%, ADF of 22.3% and DM digestibility of 41.9%, when adding 0.5% urea to sugarcane silage. This strategy of increasing protein in sugarcane silage not only better meets the nutritional requirements of ruminants, but also generally improves digestibility, since the digestion in the rumen of a feed rich in sucrose depends on the energy-nitrogen interaction (Russel et al., 1992).

On the other hand, Aguilar-Rivera et al. (2012) reported that corn cultivation is the main agricultural activity in Mexico, and can be used by 30% of small farmers to
reduce production costs (Robles-Jiménez et al., 2021). Corn silage compared to stubble or ground corn has greater digestibility of its components (Partida-Hernández et al., 2019).

The chemical compositions of the corn silage and commercial concentrate used in this study coincide with previous research. Pozo-Leyva et al. (2021b), in similar study in Quintana Roo, found contents of 9.13% CP, 28.9% DM, 69.8% NDF, 46.7% ADF and IVDMD of 73.8% for corn silage; while the commercial concentrate contained 15.6% CP, 90.3% DM, 32% NDF, 12.10% ADF and IVDMD of 89.2%. In contrast, Absalón-Medina et al. (2012) reported contents of 8.3% CP, 23.5% DM, 33.20% NDF and 68.6% ADF for corn silage and 17.03% CP, 92.9% DM, and 9.7% ADF for commercial concentrate in an investigation carried out in Veracruz, Mexico.

An important factor to consider in the chemical composition of the ingredients of ruminant feed is lignin, since it is part of the cell wall of the vascular tissue of plants, providing resistance to tension and structural rigidity. This substance binds cellulose and hemicellulose, making it difficult to degrade by rumen microorganisms (Pazla et al., 2023), so documenting percentages of inclusion in animal feed is of vital importance, as is the case here.

The animal response variables and the chemical composition of the milk did not differ significantly (P>0.05) for all treatments (Table 2). This can possibly be attributed to the microbial response of the rumen and milk production, since even when silage intake was increased, this did not result in any changes in milk production characteristics in the present study.
According to a study carried out by Xie et al. (2023) with water buffaloes (Bubalus bubalis), fed with sugarcane silage, milk production was 11.27 kg/day, with 4.5% protein, 8.1% fat, 9.6% nonfat solids and 4.88% lactose. These large differences with respect to our results could be due to the fact that water buffaloes, because of their genetic characteristics, have better traits regarding the composition of their milk in terms of fat, proteins and minerals compared to cows. Alemzadeh and S.Noroozy (2006), in a study carried out with sugarcane top silage in the diet of dairy cows (Netherlands), reported there was no difference in the final weight of the animals, milk production or in any of the parameters of conversion efficiency studied, when alfalfa hay (control) was replaced by 25, 50 or 75% sugarcane silage treated with 0.5% urea and 5% molasses. According to Corrêa et al. (2003), sugarcane is a viable option to feed Holstein cows during lactation stages, in which nutrient demand is not at a maximum. Sugarcane was also considered adequate for dairy cattle, producing 20 kg of milk per day, in diets formulated with about 50% the dry matter from concentrated feedstuffs (Mendonça et al., 2001).

According to Pozo-Leyva et al. (2021b), evaluating corn silage for small farm milk production systems in Quintana Roo, reported milk output of 4.4 kg/day, with 3.4% CP, 3.3% fat, 8.8% SNF and density of 30.23%, in cows from different crosses of the local zebu breeds (Brahman, Gyr and Guzerat), with live weight of 424 kg. In another study, carried out with brown Swiss cows supplemented with harvest byproducts, Salvador-Loreto et al. (2016) reported milk production and chemical composition similar
to those of this experiment, 7 kg cow/day with fat and CP contents of 3.1 and 3.0%, respectively.

The different results reported in terms of milk production and its composition may have been due to the particularities of the animal component, the study site and the transgenerational knowledge of the participating farmers, that is, the knowledge acquired empirically from generation to generation (Pozo-Leyva et al., 2019; Pozo-Leyva et al., 2021a). Additionally, our results agree with those reported by Xie et al. (2023), who observed that milk production and composition are influenced by heritability, environment and feeding strategies. The components of the diet are a critical factor, mainly in the dry season of tropical and subtropical regions.

The use of nitrogen did not show differences between treatments (P>0.05) for any of the variables studied (Table 3). Dry matter consumption is limited by the days in lactation, milk production and the live weight of the animal. CP and N consumption was numerically lower for T3 with inclusion of 6 kg of sugarcane top silage, which was reflected in the excretion of N from the manure and the efficiency of feed utilization.

Table 3. Nitrogen and feed utilization by treatment.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>Mean</th>
<th>SE</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM intake (kg/day)</td>
<td>13.5</td>
<td>13.7</td>
<td>13.8</td>
<td>13.6</td>
<td>0.204</td>
<td>0.712</td>
</tr>
<tr>
<td>CP intake (g/day)</td>
<td>1426.8</td>
<td>1408.5</td>
<td>1373.9</td>
<td>1403.1</td>
<td>19.4</td>
<td>0.282</td>
</tr>
<tr>
<td>N intake (g/day)</td>
<td>228.3</td>
<td>225.4</td>
<td>219.8</td>
<td>157.8</td>
<td>3.11</td>
<td>0.282</td>
</tr>
<tr>
<td>Milk N output (g/cow/day)</td>
<td>61.1</td>
<td>61.1</td>
<td>61.5</td>
<td>1.39</td>
<td>0.761</td>
<td></td>
</tr>
<tr>
<td>Slurry N (g/cow/day)</td>
<td>167.2</td>
<td>164.3</td>
<td>157.6</td>
<td>163.0</td>
<td>3.35</td>
<td>0.224</td>
</tr>
<tr>
<td>FUE (%)</td>
<td>26.9</td>
<td>27.2</td>
<td>28.4</td>
<td>27.5</td>
<td>0.87</td>
<td>0.270</td>
</tr>
</tbody>
</table>

T = treatment 1, 2, 3, SE = standard error of the mean, DM, dry matter; CP, crude protein; N, nitrogen, FUE, feed utilization efficiency. Source: authors (2024).

In this regard, a study carried out by Pozo-Leyva et al. (2021a) in central Mexico with cows fed mixed grasses documented N intake of 344.9 g/cow/day with excretion of N in manure of 251.3 g/cow/day, higher than that reported by Aarons et al. (2017), carried out in the USA, of 19.4%. This indicates that greater consumption of N does not automatically translate into an increase in milk production, but it does influence the efficiency of feed utilization, as found in this study, since the values reported here are
within the range of previous research, between 11 and 39%, documented by Aarons et al. (2017).

A limitation of livestock production is the low efficiency in the use of N, mainly by grazing animals, since the energy contribution from pastures is usually high due to their good digestibility, but the retention of N in the milk is low, meaning high concentration in feces and urine patches within the pasture, which causes severe environmental problems such as nitrification, nitrate leaching and ammonia emissions in the atmosphere (Bargo et al., 2003).

4 CONCLUSIONS

The use of sugarcane top silage is a viable alternative for feeding ruminants. The inclusion of 2, 4 or 6 kg of silage did not affect milk production or its composition, but better feed efficiency was observed in T3, which included 6 kg of silage. It would be feasible to consider mixing other forage species with sugarcane silage or using additives to reduce lignin concentrations and improve digestibility.
REFERENCES


International Union of Soil Sciences (IUSS), Vienna, Austria, 2022.


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PAZLA, R. et al. The impact of replacement of concentrates with fermented tithonia (Tithonia diversifolia) and avocado waste (Persea americana Miller) in fermented sugarcane shoots (Saccharum Officinarum) based rations on consumption, digestibility, and production performance of Kacang goat. Advances in Animal and Veterinary Science, v.11, p.394-403, 2023. DOI: https://dx.doi.org/10.17582/journal.aavs/2023/11.3.394.403


