Evaluation of Milk Production of Dairy Goats Fed on Ensiled Sugarcane Tops with Mulberry and *Calliandra Calothyrsus*

*Nyakira B. S.*, **Tuitoek J. K.** and **Onjoro, P. A.**

1Kenya Agricultural Research Institute (Kakamega), P.O. Box 169, Kakamega, Kenya Tel: +254-721551733;
2Egerton University, Njoro. P.O. Box 536, EGERTON, Kenya Tel: +254-724849662; E-mail: jk_tuitoek@yahoo.com Tel: +254-722720604; E-mail: evponjoro@yahoo.com

*Corresponding Author: bnyakira@yahoo.com*

Abstract

A study was conducted to compare the effects of feeding *Morus alba* (Mulberry) with *Calliandra calothyrsus* (Calliandra) legume forages as protein supplements to a basal diet ensiled sugarcane tops. Twelve (12) dairy goats (Toggenburg, Alpine and their crosses) were used to measure feed intake and milk yields. Sugarcane tops silage was offered as a basal diet and supplemented with Mulberry and Calliandra each at two levels of 200g and 300g. The total DMI was significantly higher (P<0.05) in the supplemented groups than the unsupplemented group but not different among supplemented groups. The total DMI was lower (P<0.05) for the unsupplemented animals. Daily milk yields ranged from 0.12 to 0.28 kg/d. Total milk yields were similar across the groups. However, the highest total milk yield was produced by the group fed 300g Mulberry. Does fed diet D (200g Calliandra) had the highest DMI although milk yield was highest for does fed diet C (300g Mulberry).

**Key words:** Sugarcane top silage, dairy goats, Mulberry leaves, Calliandra, milk yield

Introduction

One of the major setbacks of the livestock industry is high quality pasture. The amount of high-quality pasture is usually sufficient during the rainy season but, as maturity advances, the nutritive value decreases (Shayo and Msangi, 1989). During the dry season, available feed resources such as hay, maize stover and sugarcane tops are usually unable to provide sufficient nutrients for reasonable livestock productivity, and livestock generally lose weight, become susceptible to diseases and have reduced breeding performance. Ensiling the sugar cane tops would improve digestibility.
resulting to higher milk yields and growth rates. Supplementation of low quality grass based diets with legumes has been shown to increase dry matter intake and animal performance (Kaitho 1997).

The goat’s potential to produce milk is utilized for purposes of supplementing income and/or self support of the family, at subsistence level with very little or no commercial production. Goats have a greater efficiency for milk production per unit body weight and also show higher survival rates than cattle (Ndikumana et al., 2000). They show considerable milk output ability in spite of their relatively higher metabolic rate and lower relative capacity for dry matter intake. Feed efficiency in milk production is higher for goats since they have an advantageous ratio of body weight to milk yield. Coupled with the lower maintenance needs and higher conversion of nutrients into milk, the goat seems the more efficient milk animal (Devendra and Burns, 1970).

In Western Kenya, the Toggenberg and Alpine breeds have produced two litres of milk per day per goat though a few farms have realized four litres hence there has been a strong demand for such animals, and that even poorer farmers are able to support and benefit from these goats through formation of farmers groups.

This study was conducted to determine the feeding value of supplemented ensiled SCT. Specifically, the study was designed to determine voluntary feed intake and milk yield of dairy goats fed ensiled sugarcane tops supplemented with *Morus alba* and *Calliandra calothyrsus*.

**Materials and Methods**

**Study Site**
It was the same as for experiment on growth rates.

**Animals**
Twelve (12) Toggenburg dairy goats at different lactation stages were used. They had an average weight of 34.8 kg.

**Treatment Diets**
Ensiled SCT was used in the experiment as the basal diet. The forage supplements were offered twice daily before feeding of basal diet. The treatment diets were as follows:
(a) SCT ensiled with Molasses
(b) SCT ensiled with Molasses + 200g Mulberry
(c) SCT ensiled with Molasses + 300g Mulberry
(d) SCT ensiled with Molasses + 200g Calliandra
(e) SCT ensiled with Molasses + 300g Calliandra
(f) Fresh sugarcane tops

**Experimental Procedure and Design**

12 dairy goats (Toggenburg, Alpine and their crosses) were allocated the dietary treatments in a double 6 x 6 Latin square design with each period of the experiment consisting of a 7 day adaptation and a 14 day data collection period.

The ensiled sugarcane tops were offered as a basal diet ad libitum by giving a weighed amount twice a day at 8.00 hours and 14.00 hours so that there was some left over in the next feeding. Mulberry and *C. calothyrsus* were used to form the supplements. Incremental levels (0, 200 and 300g/head/day) of *Mulberry* and *C. calothyrsus* were offered. Milking was done twice daily at 5.30 hour and 17.00 hours and milk production of does monitored for a period of two months by measuring milk using graduated cylinders for precision. This was done by trained personnel.

**Digestibility Study and Rumen Liquor Collection**

During the last 7 days of the feeding trial, goats fed each diet were used to measure diet digestibility. Urine and faeces were collected for N and faecal DM analysis in the last 7 days of the trial. Urine was collected over 25ml of 1% sulphuric acid and a sample refrigerated pending analysis. 10% of total faecal output per animal was dried in an oven at 60°C for 48 hrs and stored for later analysis. At the end of the collection period, the urine and faecal samples for each animal were bulked, mixed and a sub sample obtained for DM, N determination.

During the last three days of the trial, 50ml rumen liquor was extracted from the goats in the morning before feeding using a stomach tube at 0, 3, 6 and 12 h after feeding. The pH of the sample collected was measured using a pH meter. 15ml of the sample was strained using a clean cotton cloth, 1 ml 7.5M sulphuric acid added then stored until analyzed for rumen ammonia nitrogen (NH$_3$-N).

**Statistical Analysis**

Data from the experiment was subjected to analysis of variance using the general linear model (GLM) of the SAS computer package (Statistical Analysis Systems 1998). Treatment means was separated using Least Significant Difference (LSD).
Results

The forages had higher CP contents than the sugarcane tops (Table 1). Mulberry had high levels of ash unlike *C. calothyrsus*. *C. calothyrsus* also had the highest concentration of TET as compared to Mulberry.

**Table 1: Chemical composition (% DM) of feedstuffs used in the experiment**

<table>
<thead>
<tr>
<th></th>
<th>DM</th>
<th>OM</th>
<th>Ash</th>
<th>CP</th>
<th>CF</th>
<th>EE</th>
<th>NDF</th>
<th>ADF</th>
<th>ADL</th>
<th>TET</th>
<th>P</th>
<th>Ca</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Sct</td>
<td>96.37</td>
<td>93.06</td>
<td>6.94</td>
<td>4.71</td>
<td>41.20</td>
<td>3.05</td>
<td>87</td>
<td>45</td>
<td>24</td>
<td>Nil</td>
<td>0.19</td>
<td>1.46</td>
</tr>
<tr>
<td>Sct Silage</td>
<td>93.96</td>
<td>91.85</td>
<td>8.15</td>
<td>10.10</td>
<td>31.09</td>
<td>34.09</td>
<td>78</td>
<td>46</td>
<td>18</td>
<td>Nil</td>
<td>0.16</td>
<td>1.78</td>
</tr>
<tr>
<td>Mulberry</td>
<td>95.33</td>
<td>84.63</td>
<td>15.36</td>
<td>19.35</td>
<td>11.51</td>
<td>40.66</td>
<td>46</td>
<td>40</td>
<td>36</td>
<td>0.5</td>
<td>0.18</td>
<td>1.69</td>
</tr>
<tr>
<td>Calliandra</td>
<td>95.30</td>
<td>99.85</td>
<td>1.5</td>
<td>20.60</td>
<td>19.67</td>
<td>12.69</td>
<td>59</td>
<td>53</td>
<td>29</td>
<td>4.0</td>
<td>0.16</td>
<td>2.78</td>
</tr>
</tbody>
</table>

*DM = dry matter, OM = organic matter, CP = crude protein, CF = crude fibre, EE= ether extract, NDF = neutral detergent fibre, ADF = acid detergent fibre, ADL = acid detergent lignin, TET = total extractable tannins, P = phosphorus, Ca = calcium.*

Table 2 shows the daily feed intake and milk yield. Total dry matter intake (TDMI) of the basal diet ranged between 1291-2190 g/d. Supplementation as in the previous experiment had a significant effect on feed intake compared to the control group (diet F) which had the lowest intake of 1291 g/d. The group fed diet D had the highest DMI of 2190 g/d. Similarly, overall milk production was better for the supplemented groups. Total milk yields ranged from 2.6-5.9 kg with the group on diet A having the lowest milk yield. The results of rumen pH, NH3-N are shown in Table 3.

**Table 2: Dry matter intake (DMI) and milk yield of lactating does fed ensiled SCT supplemented with Calliandra and Mulberry**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>DMI (g/d)</td>
<td></td>
</tr>
<tr>
<td>Total DMI</td>
<td>1804</td>
</tr>
<tr>
<td>Total milk yield (kg)</td>
<td>2.6</td>
</tr>
<tr>
<td>Daily milk yield (kg)</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Letters with similar superscripts are not significantly different while letters with different superscripts are significantly different.
Table 3: Rumen NH$_3$-N 0h% and Rumen pH of lactating does fed ensiled SCT supplemented with Calliandra and Mulberry

<table>
<thead>
<tr>
<th>Parameter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rumen pH 0h</td>
<td>7.560</td>
<td>7.783</td>
<td>7.895</td>
<td>7.655</td>
<td>8.150</td>
<td>7.774</td>
</tr>
<tr>
<td>Rumen pH 3 h</td>
<td>7.320</td>
<td>8.590</td>
<td>8.24</td>
<td>7.635</td>
<td>8.590</td>
<td>8.038</td>
</tr>
<tr>
<td>Rumen pH 6h</td>
<td>8.510</td>
<td>8.517</td>
<td>8.325</td>
<td>8.418</td>
<td>8.415</td>
<td>8.730</td>
</tr>
<tr>
<td>Rumen NH$_3$-N 0h (mg/l)</td>
<td>4.3</td>
<td>1.5</td>
<td>8.5</td>
<td>4.2</td>
<td>3.5</td>
<td>77</td>
</tr>
<tr>
<td>Rumen NH$_3$-N 3h (mg/100ml)</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>4.5</td>
<td>3.2</td>
<td>14</td>
</tr>
<tr>
<td>Rumen NH$_3$-N 6h (mg/100 ml)</td>
<td>36</td>
<td>140</td>
<td>37</td>
<td>72</td>
<td>2.5</td>
<td>45</td>
</tr>
<tr>
<td>Rumen NH$_3$-N 12h (mg/100 ml)</td>
<td>24</td>
<td>19</td>
<td>3.5</td>
<td>42</td>
<td>18</td>
<td>35</td>
</tr>
</tbody>
</table>

Discussion

Dry matter intake results in this study are in agreement with work done by (Saddul et al., 2005) who found Mulberry to be suitable as a supplement, particularly to low quality roughages, in providing a source of rapidly available nitrogen to the rumen microbes, hence improving the roughage degradability and intake. Milk yield results are also in agreement with Ba et al (2005) who found that milk production increased with increasing the levels of Mulberry offered to goats. Rojas et al (1994) also found milk increases from 2.0 to 2.5 kg/d when Mulberry supplementation went up from 1.0 to 2.6% of liveweight on DM basis.

The daily dry matter intake (DMI) was between 1291 and 2189 g. The animals supplemented with forage legumes consumed more feed than those in the control (diet F) and unsupplemented (diet A) groups. The group fed 200 g Calliandra had the highest total DMI while the control group had the lowest. In this study, it was found that animals did not have any reluctance in accepting mulberry as feed. Increasing the amount of Mulberry resulted to an increase in DMI. This is similar to results for the growth rates.

The daily milk yields were low as the does could produce between 1.5 to 2 kg of milk at peak lactation. Daily milk yields ranged from 0.12 to 0.28 kg/d. Total milk yields were similar across the groups. However, the highest total milk yield was produced by the group fed 300 g Mulberry. From figure 2 it can clearly be seen that does fed diet D (200 g Calliandra) had the highest DMI although milk yield was highest for does fed diet C (300 g Mulberry). Milk yield was low for both the groups which were not supplemented (diets A and F). However, milk yield was higher for the control group (3.4 kg) than
for the group fed ensiled SCT without supplementation (2.6 kg) despite the fact that feed intake was lower for the control group than the latter. The highest milk yield was seen in the group fed 300g Mulberry (diet C). Since Mulberry leaves are rich in nitrogen, sulphur and minerals (Singh and Makkar, 2002) their use for ration supplementation could increase the efficiency of utilization of crop residues in ruminant feeding systems. Ba et al., (2005) found that milk production increased with the levels of Mulberry offered to goats. This is also in agreement with Rojas et al (1994) who found milk increases from 2.0 to 2.5 kg/d when Mulberry supplementation went up from 1.0 to 2.6% of liveweight on DM basis. Mc Dowell (1997) also suggested that higher Ca content in Mulberry leaves (2.4-4.7%) than the required level in diet (0.19-0.82%) could be useful for high yielding ruminants during early stages of lactation.

The group fed 200 g Calliandra (diet C) was second in terms of milk yield despite having the highest DMI. Increasing Calliandra levels to 300g depressed milk yield. This was due to the high tannin levels in Calliandra. High concentrations of condensed tannins in Calliandra have been associated with low palatability and digestibility (Jackson et al., 1996; Larbi et al., 1998). The tannins form complexes with proteins making them available for milk production.

Rumen pH like in the previous experiment was not affected by supplementation. The values were in the range of 7.3 - 8.9 which was much higher than the range of 6.2-7.0 reported by Ørskov (1982) as optimum for cellulolytic bacterial growth and fibre digestion. NH$_3$-N shows how protein is degraded in the rumen. High protein feeds will have more NH$_3$ released in the rumen after digestion especially feeds with no anti nutritive factor. This was contrary in some cases to some results in the current experiment. Rumen NH$_3$-N at 0h decreased with supplementation. At 6h there was an increase in NH$_3$-N for the group fed 200g Mulberry but a drop in the group fed 300g Mulberry. This was also the case for the group fed Calliandra at these levels. When comparing the forage legumes, the group fed Calliandra had a lower release of NH$_3$-N. This is in agreement by Wambui (2005) who recorded the lowest release of NH$_3$-N for Calliandra.

Nitrogen intake tended to increase on supplementing with legumes implying additional nitrogen supply in the diet. However, there were no significant differences in N intake among the supplemented groups. The group fed Calliandra had the highest faecal N loss. This could be due to the high tannin levels in Calliandra which form complexes with N. Nitrogen retention has been found to increase and decrease with inclusion of tannins in the diet.
(Barry et al., 1986; Reed et al., 1990 as cited by Merkel et al., 1996), hence the protein tannin complexes are protected from rumen degradation but released further down the digestive tract and digested. Feecal N loss was low in groups fed Mulberry meaning that most of it was degraded in the rumen. Urine nitrogen loss was highest for the group fed SCT silage without supplementation. There was no significant difference in urine N loss among treatment diets.

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**Conclusion**

1. This study demonstrated that SCT can be used as a dry season feed as long as supplementation is done using locally available forage legumes.
2. It also demonstrated that the feeding of mulberry leaves, which have a high crude protein (about 20% of DM) and low crude fibre (about 12% of DM) content, resulted in a high apparent digestibility of the feed when fed to dairy goats.
3. Mulberry leaves have the potential to be used as a supplementary feed for increasing milk production crop residue-based livestock systems.

**References**


