Study on the effects of incorporating various levels of cactus pear (*Opuntia ficus-indica*) on the performance of sheep.

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Abstract

Poor feed quality and lack of water are the major constraints for livestock production under arid conditions. To solve these problems, looking for potential plants is mandatory. Cactus pear (*Opuntia ficus-indica*) is an extremely drought tolerant, highly productive, multipurpose and succulent plant. It has incomparably high water and land use efficiency. In cactus pear producing regions of Ethiopia its fruits play life-saving role during rainy seasons while livestock depend mainly on its cladodes during dry seasons and drought years. Under the latter circumstances, diarrhoea and bloat are reported to be major problems. In spite of its vital forage use, the nutritive value of cactus pear is little researched. This study aimed at determining the optimum level of inclusion of cactus pear and its contribution as source of water. A three-months experiment, laid out in a randomised complete block design (RCBD) with eight growing male sheep per treatment, was conducted. Cactus pear replaced the basal diet (grass hay) at 0, 20, 40, 60 and 80% (*T*1, *T*2, *T*3, *T*4, and *T*5, respectively), on dry matter basis. Diets were offered in individual troughs twice daily. Common salt licks were available ad libitum. Feed and water consumption and refusals were recorded daily. Animals were weighed weekly. Data were subject to ANOVA using the SAS software JMP5. Highly significant differences (*p*<0.001) were observed for total dry matter intake (DMI), water consumption and live weight change. The highest DMI (100 g/kgW0.75) was recorded in sheep in *T*4 (60% cactus) followed by *T*3 and the lowest (77 g/kgW0.75) was recorded in the control, *T*1. Sheep in *T*1 consumed the highest amount of water (1.24 l) followed by *T*2 (0.068 l) while sheep in *T*3, *T*4 and *T*5 drunk negligible amount of water (0.008, 0.016 and 0.006 l, respectively). Live weight change was relatively high (+33.0 g/day) in *T*2. It is concluded that cactus pear could optimally substitute grass hay up to 60%. It has a substantial contribution in satisfying the water requirement of sheep. Thus, cactus pear could play a significant role in mitigating feed and water shortage in drought prone areas of the tropics and sub-tropics.

Key words: Cactus pear, *Opuntia ficus-indica*, pasture hay, feed intake, water consumption, sheep performance

Introduction

Livestock plays an important role in Ethiopia's economy and the livelihood of the majority of its people. Poor feed quality and lack of water are the major constraints for livestock production under arid conditions in Ethiopia and elsewhere. To solve these problems, there is a need to look for locally available potential feed resources for the dry seasons so that herds and flocks are able to survive critical periods of short-fall and prolonged droughts. Cactus pear (*Opuntia ficus-indica*) is an extremely drought tolerant, highly productive, multipurpose and succulent plant. It has incomparably high water and land use efficiency. In cactus pear producing regions of
Ethiopia its fruits play life-saving role during rainy seasons while livestock mainly depend on its cladodes during dry seasons and drought years. In spite of its vital forage use, the cactus pear is given limited research attention. In addition, diarrhoea and bloat have been reported to be major problems when cactus pear is fed in high levels, about which information is lacking. This study aimed at determining the optimum level of inclusion of cactus pear and its contribution as source of water.

Materials and methods

A three-months feeding trial was laid out in a randomised complete block design (RCBD). It was conducted in Mekelle University, which is located at 13° 28’ N and 39° 29’ E, Tigray, northern Ethiopia. The soil on which the cactus pear was grown is of litosol type (Fassil Kebede, 1998, personal communication). The altitude is about 2100 m a.s.l. and the rainfall pattern is erratic and irregular with an annual average of 600 mm.

Cactus pear naturally grown along the marginal lands in the premises of Mekelle University and native pasture hay grown in the University compound, were used. The top one or two cladodes were collected, spines singed by burning and chopped using a standard chopper. Cactus pear replaced the basal diet (pasture hay) at 0, 20, 40, 60 and 80% (T1, T2, T3, T4, and T5, respectively) on a dry matter basis.

Forty (40) growing male sheep were bought from a local market where cactus production and utilisation as livestock feed is practised. Breed (highland), sex (male), age (about 14 months) and weight (19 ± 1 kg) were used as basic criteria for sheep purchase. Animals were quarantined for one month during which time they were sprayed against ecto-parasites and treated for their internal parasites, using appropriate drugs, before being allotted to the treatments. They were then housed in individual pens. Treatment feeds were offered in individual troughs twice daily at 9:00 and 16:00 o’clock. Common salt licks were available *ad libitum*. Feed and water consumption and refusals were recorded daily. Animals were weighed weekly on the same day before being fed and watered.

Dry matter DM, crude fibre (CF), crude protein (CP), ether extract (EE) and ash were determined according to proximate method while neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined according to Goering and van Soest (1970). Data were subjected to analyses of variances using the SAS software JMP 5. Significant differences between treatment means were tested by Tukey’s pairwise comparison.

Results and discussion

Chemical composition of treatment feeds

The mean chemical composition of cactus pear and hay is shown on Table 1. The cladodes had low DM content (12.23%), which is in agreement with previous reports (Gregory and Felker, 1992; Felker 1995; Lopez et al., 2001). Comparable values of crude protein (CP) content have been reported by De Kock (1980), Flachowsky and Yami (1985) and Hanselka and Paschal (1990), for cactus pear grown on poor soils. Compared to literature values, it appeared to be lower in fibre related parameters (NDF, ADF and ADL) (Mengistu, 2001; Batista, et al., 2003). In agreement with the report of Flachowsky and Yami (1985) for Ethiopian cactus pear the average ash percentage of the DM was close to 20%.

<table>
<thead>
<tr>
<th>Feeds</th>
<th>DM (%)</th>
<th>CP</th>
<th>EE</th>
<th>NDF</th>
<th>ADF</th>
<th>ADL</th>
<th>CF</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cactus pear</td>
<td>12.23</td>
<td>5.06</td>
<td>1.19</td>
<td>23.88</td>
<td>16.24</td>
<td>3.06</td>
<td>10.92</td>
<td>19.89</td>
</tr>
<tr>
<td>Hay</td>
<td>92.95</td>
<td>9.41</td>
<td>1.31</td>
<td>68.53</td>
<td>38.60</td>
<td>4.97</td>
<td>33.65</td>
<td>11.48</td>
</tr>
</tbody>
</table>
Dry matter intake (DMI) and water intake (WI)
Treatment effects on DMI are presented on Figure 1. Total DMI increased as the proportion of cactus was increased up to 60% (T4) of inclusion, at which level sheep consumed the highest DM (100 g/kgW₀.⁷⁵). This could be attributed to the high palatability and passage rate of cactus pear (Nefzaoui and Ben Salem, 2001). The lowest DMI was recorded for hay alone (T₁) followed by 80% cactus pear inclusion level (T₅). The latter was possibly due to the high moisture content of cactus pear (Table 1). Fortunately, this effect may be small and of no disadvantage in arid and semi-arid areas in Ethiopia where pastoralists water their cattle once every 4-5 days (Solomon Desta, 2000) and sheep every 6-8 days for sheep (Mesfin Asfaw, 2000). In agreement with Nefzaoui and Ben Salems’ (2001) finding, there was no digestive disturbance observed on any of the treatment feeds.

![Figure 1: Total dry matter intake](image)

Treatment mean of water intake is presented in Table 2. Sheep in T₁ drunk significantly higher (p<0.001) amount of water (1.24 l) followed by sheep in T₂ (0.068 l) while there were no significant differences (p>0.05) among treatments 3, 4 and 5; sheep in the latter treatments drunk negligible amount of water (0.008, 0.016 and 0.006 l, respectively). A similar result was obtained by Ben-Salem et al. (1996) who observed total absence of water intake as the level of cactus pear in the diet of sheep increased beyond 300 g DM/day.

<table>
<thead>
<tr>
<th>Treatment groups*</th>
<th>Water drunk (ml)**</th>
<th>Cactus's contribution (ml)</th>
<th>Total water consumed (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(0%C)</td>
<td>1242ᵃ ± 394</td>
<td>0</td>
<td>1242</td>
</tr>
<tr>
<td>2(20%C)</td>
<td>68ᵇ ± 171</td>
<td>1830</td>
<td>1898</td>
</tr>
<tr>
<td>3(40%C)</td>
<td>8ᶜ ± 73</td>
<td>3215</td>
<td>3223</td>
</tr>
<tr>
<td>4(60%C)</td>
<td>16ᶜ ± 127</td>
<td>3803</td>
<td>3819</td>
</tr>
<tr>
<td>5(80%C)</td>
<td>6ᶜ ± 51</td>
<td>3825</td>
<td>3831</td>
</tr>
</tbody>
</table>

*C stands for cactus pear

**Different superscripts show presence of statistical differences (p<0.001)
Live weight change

Highly significant differences (p<0.001) were observed for live weight change (Table 3). Live weight change was relatively high (+33.0 g/day) in T2 and sheep on the control diet maintained their live weight (0.0 g/day). Compared to the high DM intakes recorded (Figure 1) the performance of the sheep was low which could partially be explained by the nutrient imbalance in cactus pear (De Kock, 2001, Nefzaoui and Ben Salem, 2001) and the presence of oxalate (Ben Salem, et al., 2005, in press).

Table 3: Mean daily live weight change of sheep during the feeding trail

<table>
<thead>
<tr>
<th>Treatment groups</th>
<th>Initial weight (kg)</th>
<th>Final weight (kg)</th>
<th>Live weight gain (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(0% cactus)</td>
<td>20.0</td>
<td>21.0</td>
<td>11.0^d</td>
</tr>
<tr>
<td>2(20% cactus)</td>
<td>20.0</td>
<td>23.0</td>
<td>33.0^a</td>
</tr>
<tr>
<td>3(40% cactus)</td>
<td>19.8</td>
<td>22.0</td>
<td>25.0^c</td>
</tr>
<tr>
<td>4(60% cactus)</td>
<td>19.5</td>
<td>22.0</td>
<td>28.0^b</td>
</tr>
<tr>
<td>5(80% cactus)</td>
<td>19.0</td>
<td>19.0</td>
<td>00.0^e</td>
</tr>
</tbody>
</table>

*Different superscripts show presence of statistical differences (p<0.001)

Conclusions

Results of this study demonstrated that cactus pear could optimally substitute pasture hay to a level of 60%. It, in addition, has a substantial contribution in satisfying the water requirement of sheep. The ability of the sheep feeding on cactus up to 80% to maintain their live weight during the period demonstrated the nutritional significance of the feed resource for dry seasons and drought periods.

References


