EFFECT OF FEEDING MAIZE SILAGE SUPPLEMENTED WITH CONCENTRATE AND LEGUME HAY ON NUTRIENT DIGESTIBILITY IN NELLORE RAM LAMBS

M.Venkateswarlu, Y.Ramana Reddy and D.Nagalakshmi

Department of Animal Nutrition, College of Veterinary Science, Sri Venkateswara Veterinary University, Rajendranagar, Hyderabad-500030, India.

ABSTRACT

An on-farm experiment was conducted in growing Nellore ram lambs (n=42, 3-4 months old) by feeding intensively for five months period with sole maize (Zea mays) silage (R-I), silage + concentrate at 0.5 (R-II), 1.0 (R-III) and 1.5 (R-IV) per cent body weight, silage + lucerne hay (R-V) and silage + groundnut haulms/straw (R-VI) and sweet sorghum bagasse based complete diet (R-VII). The results showed that, the DMI in g/d was significantly (P<0.01) higher by 25.19, 29.74, 34.82, 31.04, 27.6 and 26.56 per cent. The mean digestibility coefficients (%) of dry matter, organic matter, crude protein, ether extract, crude fibre and nitrogen free extract in ram lambs fed R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII rations were non significantly different among the seven rations. Average neutral detergent fibre, acid detergent fibre, hemicellulose and cellulose digestibilities were comparable and insignificantly increased as the level of concentrate increased in the ration. Based on these results, it was concluded that digestibilities of nutrients were not affected due to supplementation of concentrate or legume hay with maize silage in growing sheep and hence, maize silage can be supplemented with concentrate at 1.5% body weight and or legume hay to meet 25% of dry matter requirement would optimize the lamb production.

Key words: Maize silage, concentrate, legume hay, nutrient utilisation, Nellore ram lambs

INTRODUCTION

Fodder maize (Zea mays) is a nutritious feed for small and large ruminants. It has a high protein efficiency ratio (PER), relatively high digestible energy (DE) and total digestible nutrients. Thus maize fodder can play an important role in supplying animal feed throughout the year if we cultivate it. (Desai, and Deore, 1984). Feeding of silage based rations is becoming popular among the farmers rearing sheep on commercial basis in India particularly in Andhra Pradesh and Karnataka.

However, a feeding system based on silage needs to be developed for rearing of ram lambs on commercial basis since literature on silage feeding in ram lambs is limited. Silage, which is anaerobically fermented green fodder, is valued throughout the world as a source of animal feed during lean months (Ragothaman Venkataraman et al., 2010). Maize is the third most important cereal crop of the world. It is used as food, feed and forage. Maize fodder can safely be fed at all stages of growth without any danger of oxalic acid, prussic acid as in case of sorghum or other fodders. Therefore,
green maize fodder is referred as ‘king of crops’ suitable for good silage making (Muhammad et al., 1990). Very limited numbers of sheep farmers are feeding their animals with silage in India. Farmers in Andhra Pradesh are showing interest in preparing and feeding of silage particularly to small ruminants such as growing sheep to obtain optimum body weight. In view of the farmers’ awareness on feeding of silage to small ruminants for meat production, an attempt was made to feed maize silage by supplementing it with concentrate and legume hay at different levels to study the digestibilities of various nutrients in growing Nellore ram lambs.

**MATERIALS AND METHODS**

This on-farm experiment was carried out with maize silage at Indugula village in Tipparthi mandal of Nalgonda district, Andhra Pradesh which is 140 km away from Hyderabad.

**Silage preparation**

The farmer who reared the experimental ram lambs had 100 sheep which were being maintained by grazing on open fields. The land used to grow the maize crop for silage making was ploughed thoroughly 3 times with a tractor and about 2 tons of farm yard manure per acre was applied as a basal fertilizer. Nitrogen, phosphorus and potassium fertilizers were applied at the rate of 60, 24 and 10 kg per acre, respectively. A 36V92 variety of maize seed was selected for growing the maize fodder for silage making. Physical or chemical treatment of seed was not done prior to sowing. Maize fodder was harvested on 87th day after sowing when the cob containing one fourth to half milky grains. Harvested green fodder was allowed to wilt in the field for 4-6 h to reduce the moisture content to around 65 per cent.

Two silo pits were constructed near the experimental animal shed with the dimensions of 9’L x 9’W x 8’H so as to accommodate about 10 tons of silage in each pit. The inside walls and bottom of silo was cemented to prevent seepage of ground water if any. All the sides of the silo was covered with HDPE plastic cover before filling the pit with chopped maize fodder.

Harvested and wilted green fodder was brought to the site of silage pit from the field using a tractor. A chaf cutter was arranged at one edge of the silo pit in order to allow the chaffed green fodder to fall directly into the pit. The size of the chaffed fodder was ½ to ¾ inches. Sugarcane molasses, urea (fertilizer grade) and common salt were added at 1, 0.5 and 0.5 per cent, respectively while making the silage. They were mixed in water (50 litres/ton of fodder) in a plastic drum thoroughly with a stick and were sprinkled uniformly all over the maize fodder during the chaffing process. While filling the silo the chaffed maize fodder was compacted manually to prevent trapping of air in the pit so as to maintain strict anaerobic environment in the silo.

After filling about 2 feet’s above the ground level sealing of silo was done by covering with HDPE plastic covers and placing heavy weight bags filled with sand. Pit slope to one side was maintained to drain water quickly in case of rain. Silo was opened on 39th day after sealing for the feeding of experimental ram lambs.

**Preparation of other experimental feeds**

Concentrate mixture with 17% CP and 70% TDN was prepared according to formula (Table 1) and used for feeding of ram lambs.
Lucerne (Medicago sativa) was grown at the farmer’s fields and was harvested at 50-60% flowering stage. Harvested green lucerne fodder was dried under shade for 3-4 days so as to reduce moisture to 12-14%. During drying turning was done three times a day to prevent growth of fungus and to hasten the process of drying. Prepared hay was bagged and stored for feeding of experimental ram lambs. Groundnut (Arachis hypogea) haulms were purchased (Rs. 3.00 per kg) for the feeding of experimental ram lambs. Sweet sorghum bagasse (SSB) was procured from ICRISA to prepare complete ration. Complete ration with 50 per cent level SSB was prepared in mash form according to the formula (Table 1) using hammer mill to feed the experimental ram lambs.

Forty nine, 3-4 months old growing Nellore ram lambs with an average body weight of 14.26±0.24 kg were purchased and were randomly distributed into seven groups of seven animals each. The average body weight (kg) of ram lambs in seven treatments was 14.33±0.85 (T₁), 14.33±0.47 (T₂), 14.20±0.56 (T₃), 14.23±0.87 (T₄), 14.30±0.46 (T₅), 14.32±0.62 (T₆) and 14.10±0.86 (T₇), respectively.

**Experimental groups and feed offered**

Rams grouped in to seven experimental groups were fed with respective rations as mentioned below for a period of five months.

The first group were fed sole maize silage at ad libitum. (Ration R-I). The second group were fed concentrate mixture @ 0.5 per cent of body weight + maize silage ad libitum. (Ration R-II). The third group were fed concentrate mixture @ 1.5 per cent of body weight + maize silage ad libitum. (Ration R-IV). The fifth group were fed lucerne hay to meet 25 per cent of dry matter requirement and maize silage ad libitum. (Ration R-V). The sixth group were fed groundnut haulms (straw) to meet 25 per cent of dry matter requirement and maize silage ad libitum. (Ration R-VI). The seventh group were fed solely on SSB based complete ration (50:50) (Ration R-VII).

**Housing and management of experimental animals.**

The ram lambs were housed according to groups in well ventilated, clean pens (24’LX10’W) with an open area (24’LX10’W) for movement during the day time. All the experimental ram lambs were offered their respective feeds at 9.00 and 15.00 h by weighing on an electronic digital balance and residue if any was weighed after 24 h. The growth trial was conducted for a period of 150 days. All the experimental animals were offered clean, fresh drinking water round the clock. Hygienic surroundings were maintained throughout the experimental period. All the animals were treated for external and internal parasites with Ivermectin and Fenbendazole drugs, respectively, in the beginning as well as after three months of experimental period. Animals were vaccinated against PPR disease after seven days of first deworming.

**Digestibility study**

Digestion cum metabolic studies was conducted at the end of the feeding trial in ram lambs to assess the nutrient utilization of the experimental rations. The animals were kept in clean, well ventilated individual metabolic cages (40” length, 26” width) with feeding and watering arrangement during the metabolic trial.
Animals were shifted to metabolic cages 3 days prior to collection period to acclimatize them to metabolic cage environment.

The collection period lasted for seven days. During the collection period the daily feed consumption, leftover as well as faeces and urine voided were recorded at 9.00 h before feeding. During the period of metabolism trial 24 h collection of faeces was made using faecal bags harnessed to the ram lambs. The daily urine output of each lamb was measured by collecting urine in glass bottles kept at the bottom of the metabolic cages. Few drops of toluene was added to the urine collection bottles daily to avoid nitrogen loss.

Representative samples of feed offered and left over were collected and pooled for 7 days. Daily DM was estimated from respective samples and were pooled and preserved for estimation of other nutrients. The samples of all the experimental feeds and leftover after drying were ground separately in a laboratory Wiley mill through a 1 mm screen and preserved in air tight bottles for subsequent analysis. Faeces from each animal was collected in separate containers, weighed, mixed thoroughly and aliquoted for dry matter and nitrogen estimation.

For dry matter, aliquots of 1/10th of daily faeces voided by each animal was taken in previously weighed petri dishes and dried overnight in hot air oven at 100±5°C. The daily sample from each animal for seven day collection period was pooled, ground in Wiley mill through a 1 mm screen and stored in polythene bags for further analysis. For faecal nitrogen estimation, from urine 1/20th part of total urine voided daily by individual animal, after thorough mixing, was pipetted out in duplicate into Kjeldahl flasks containing 30 ml of concentrated sulfuric acid. The aliquots, thus pooled in the flasks, were maintained separately for each animal. Dry matter, crude protein, crude fiber, ether extract and total ash were estimated according to AOAC (1997).

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1994). Analysis of variance was utilized to test the significance of various treatments and the difference between treatment means was tested for significance by Duncan’s Multiple Range and F Test (Duncan, 1955).

RESULTS AND DISCUSSION

Digestibility coefficients determined for various nutrients in ram lambs fed different rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII are presented in table 2. DM digestibility was increased non significantly by 1.9, 5.57, 7.43, 7.29 and 4.08 per cent with R-II, R-III, R-IV, R-V and R-VI rations, respectively in comparison to R-I ration and DM digestibility of SSB based ration was 2.15 per cent lower in comparison to R-I ration. Chauhan and Brar (1989) reported increased DM digestibility with supplementation of concentrates to maize silage based rations in buffalo calves. Devasena and Krishna, (1996) reported increased DM digestibility with supplementation of legume forages in sheep. Veereswara Rao et al. (1993) also reported increased DM digestibility with supplementation of legume forages to basal forage of NB21. Singh and Samantha (1998) reported increased DM digestibility with supplementation of legume forages to basal forages.
Non significantly increase in OM digestibility by 2.38, 4.42, 5.55, 3.77 and 1.42 per cent was observed with R-II, R-III, R-IV, R-V and R-VI rations, respectively in comparison to R-I ration. OM digestibility of SSB based ration was 5.93 per cent lower in comparison to R-I ration. Chauhan and Brar (1989) reported increased OM digestibility with supplementation of concentrate to maize silage based rations in calves. Singh and Samantha (1998) reported increased OM digestibility with supplementation of legume forages to basal non legume forages. Insignificant increase in OM digestibility was observed by Veereswara Rao et al. (1993) in lambs by supplementing NB21 green forage with legume fodder.

CP digestibility was increased insignificantly by 1.91, 3.97, 11.37, 12.02, 9.92 and 6.91 per cent in R-II, R-III, R-IV, R-V, R-VI and R-VII rations, respectively in comparison to R-I ration. Pratap Reddy et al. (1989) reported insignificant increase in CP digestibility when concentrate was supplemented with basal forage rations. Increased CP digestibility with supplementation of concentrates at different levels with maize silage based rations in calves was reported by Chauhan and Brar (1989). Varaprasad et al. (1995) reported increase in CP digestibility in lambs fed Co-1 grass supplemented with concentrate. Devasena and Krishna, (1996) reported increased CF digestibility with supplementation of legume forage to basal ration in sheep.

Numerical increase (P>0.05) in EE digestibility by 0.81, 1.14, 2.02, 6.37 and 2.47 per cent with R-II, R-III, R-IV, R-V and R-VI rations, respectively in comparison to R-I ration and EE digestibility of SSB based ration was 3.91 per cent lower than R-I ration. Chauhan and Brar (1989) reported non significantly increased EE digestibility with supplementation of concentrates to maize silage based rations in calves. Pratap Reddy et al. (1989) reported insignificant increase in EE digestibility when concentrate was supplemented to h basal forage rations.

Non significant increase in CF digestibility by 1.13, 2.13, 3.51, 7.41 and 3.97 per cent with R-II, R-III, R-IV, R-V and R-VI rations, respectively in comparison to R-I ration and CF digestibility of SSB based ration was 4.94 per cent lower than R-I ration. Pratap Reddy et al. (1989) reported insignificant increase in CF digestibility when concentrate was supplemented to basal forage rations. Varaprasad et al. (1995) reported increase in CF digestibility in lambs fed Co-1 grass supplemented with concentrate. Devasena and Krishna, (1996) reported increased CF digestibility with supplementation of legume forage to basal ration in sheep.

Numerical increase in NFE digestibility by 2.57, 3.48, 4.04, 2.00 and 0.06 per cent in lambs fed R-II, R-III, R-IV, R-V and R-VI rations, respectively in comparison to those fed R-I ration and NFE digestibility of SSB based ration was 4.88 per cent lower than R-I ration. Pratap Reddy et al. (1989) reported insignificant increase in NFE digestibility when concentrate was supplemented to basal forage rations. Varaprasad et al. (1995) also reported increase in NFE digestibility in lambs fed Co-1 grass supplemented with concentrate. Similar findings were noticed by Devasena and Krishna.
(1996) in sheep fed colonial guinea grass supplemented with groundnut cake plus maize premix.

The digestibility coefficients of fibre fractions were comparable among the experimental maize silage based and SSB based rations. However, insignificantly numerical increase in digestibility of fibre fraction in the silage rations supplemented with concentrate at 0.5%, 1.0% and 1.5% of body weight as well as silage supplemented with legume hay and legume straw was observed. Cell wall constituent digestibility of SSB based ration (R-VII) was comparable with sole silage ration (R-I). Singh and Samantha (1998) reported increased NDF digestibility with supplementation of legume forages to basal non legume forages. Marina et al. (2007) reported almost similar results in sheep fed maize silage alone as noticed in the R-I ration (sole silage) of present study.

Increased digestibility of forage based rations supplemented with concentrate mixture is due to improved fermentation facilitated by improved availability of higher digestible nutrients to the microbes (Sehgal et al. 1999). Supplements which provide critical nutrients enhance the rumen ecosystem so as to increase the microbial growth, rate of fibre digestion and propionate production (Lindsay, 1970). Digestibility of total diet generally increased with increased proportions of concentrates in the diet (Xu et al., 2008). Numerically lower digestibility of nutrients in R-I ration in comparison to other R-II, R-III and R-IV rations indicated that without concentrate supplementation it was not possible to supply sufficient amount of rumen degradable N and other nutrients required by rumen microbes for optimum rumen microbial activity (Leng, 1990).

Based on these results, it was concluded that the supplementation of concentrate or legume hay to maize silage could not affect the digestibilities of nutrients in ram lambs and could be supplemented either with lucerne hay, groundnut haulms (to meet 25% of dry matter requirement) or concentrate at 1.5% of body weight depending on the availability for obtaining optimum growth rate.

ACKNOWLEDGEMENTS

We are profound thankful to the authorities of NAIP-NRC on Meat project for providing financial assistance to carry pot this experiment at Department of Animal Nutrition, College of Veterinary Science, Rajendranagar, Hyderabad.

REFERENCES


Table 1. Ingredient composition (g/kg) of concentrate mixture and SSB based complete ration fed to ram lambs.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Concentrate mixture</th>
<th>SSB based complete ration (50:50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize grain</td>
<td>400.0</td>
<td>155.0</td>
</tr>
<tr>
<td>Groundnut cake</td>
<td>150.0</td>
<td>82.50</td>
</tr>
<tr>
<td>Sunflower cake</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Cottonseed cake</td>
<td>220.0</td>
<td>—</td>
</tr>
<tr>
<td>Deoiled rice bran</td>
<td>100.0</td>
<td>115.0</td>
</tr>
<tr>
<td>Molasses</td>
<td>—</td>
<td>25.0</td>
</tr>
<tr>
<td>Urea</td>
<td>—</td>
<td>7.5</td>
</tr>
<tr>
<td>Mineral mixture</td>
<td>20.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Salt</td>
<td>10.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Sweet sorghum bagasse (SSB)</td>
<td>—</td>
<td>500.0</td>
</tr>
<tr>
<td>Cost (Rs.)/kg feed</td>
<td>11.80</td>
<td>6.56</td>
</tr>
</tbody>
</table>

Vitamin A, D₃ supplement was added at 10 g/quintal feed.
Table 2: Per cent apparent nutrient digestibility in growing Nellore ram lambs fed different rations (DMB)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>R- I</th>
<th>R- II</th>
<th>R- III</th>
<th>R- IV</th>
<th>R- V</th>
<th>R- VI</th>
<th>R- VII</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proximate principle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry matter</td>
<td>65.67±3.22</td>
<td>66.94±2.30</td>
<td>69.54±2.67</td>
<td>70.94±1.99</td>
<td>70.83±0.65</td>
<td>68.46±2.78</td>
<td>64.29±1.03</td>
<td>0.88</td>
</tr>
<tr>
<td>Organic matter</td>
<td>68.96±2.82</td>
<td>70.64±2.41</td>
<td>72.15±0.52</td>
<td>73.01±1.52</td>
<td>71.66±3.74</td>
<td>69.95±3.57</td>
<td>65.06±2.06</td>
<td>0.99</td>
</tr>
<tr>
<td>Crude protein</td>
<td>62.60±3.54</td>
<td>63.82±2.50</td>
<td>65.19±4.85</td>
<td>70.63±1.48</td>
<td>71.15±6.03</td>
<td>69.49±5.03</td>
<td>67.25±1.28</td>
<td>1.34</td>
</tr>
<tr>
<td>Ether extract</td>
<td>62.43±1.93</td>
<td>62.94±2.29</td>
<td>63.15±1.78</td>
<td>63.72±3.01</td>
<td>66.68±2.80</td>
<td>64.01±2.67</td>
<td>60.08±2.67</td>
<td>0.90</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>60.26±4.80</td>
<td>60.95±3.93</td>
<td>61.57±4.40</td>
<td>62.45±4.88</td>
<td>65.08±4.05</td>
<td>62.75±5.28</td>
<td>57.41±5.00</td>
<td>1.61</td>
</tr>
<tr>
<td>Nitrogen-free extract</td>
<td>64.08±2.27</td>
<td>65.77±2.95</td>
<td>66.39±3.16</td>
<td>66.78±2.04</td>
<td>65.39±1.86</td>
<td>64.12±2.69</td>
<td>61.1±1.97</td>
<td>0.89</td>
</tr>
<tr>
<td><strong>Cell wall constituent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral detergent fibre</td>
<td>62.32±2.42</td>
<td>64.51±2.68</td>
<td>65.65±2.37</td>
<td>65.81±3.1</td>
<td>62.58±1.53</td>
<td>62.09±2.50</td>
<td>60.86±2.81</td>
<td>0.91</td>
</tr>
<tr>
<td>Acid detergent fibre</td>
<td>59.43±3.37</td>
<td>60.44±0.88</td>
<td>62.28±2.27</td>
<td>62.29±2.98</td>
<td>62.14±1.05</td>
<td>59.79±2.97</td>
<td>58.61±1.06</td>
<td>0.81</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>60.94±0.48</td>
<td>62.49±2.00</td>
<td>65.41±2.21</td>
<td>66.63±3.55</td>
<td>64.23±2.95</td>
<td>62.83±1.39</td>
<td>60.31±1.90</td>
<td>0.83</td>
</tr>
<tr>
<td>Cellulose</td>
<td>57.56±4.24</td>
<td>59.63±2.35</td>
<td>62.07±3.11</td>
<td>64.00±2.51</td>
<td>61.61±2.15</td>
<td>58.37±1.24</td>
<td>57.17±2.42</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Each value is the mean of four observations; Mean values between treatments do not differ significantly.