Supplementation of Concentrate/Legume Hay with Maize Silage on Nutrient Utilization and Nitrogen Balance in Nellore Ram Lambs

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Abstract- An on-farm experiment was conducted with Nellore ram lambs by feeding intensively for five months period with sole maize silage (R-I), silage + concentrate at 0.5 per cent body weight (R-II), silage + concentrate at 1.0 per cent body weight (R-III), silage + concentrate at 1.5 per cent body weight (R-IV), silage + lucerne hay (R-V) and silage + GN haulms (R-VI) to develop a feeding system based on maize (Zea mays) silage with supplementation of concentrate mixture and or legume hay/straw at appropriate level to study the nutrient utilization and nitrogen metabolism and compared with the performance of ram lambs fed sweet sorghum bagasse based complete diet (R-VII). The DMI (g/d) was significantly (P<0.01) higher by 25.19, 29.74, 34.82, 31.04, 27.6 and 26.56 per cent respectively with R-II, R-III, R-IV, R-V, R-VI and R-VII rations in comparison to R-I ration (sole silage). The DMI (g/d) was almost similar in lambs fed rations R-III, R-V and R-VI. The lowest DMI (g/d) was observed in ram lambs fed R-I ration. The DMI (g/kg w0.75) in ram lambs was also significantly (P<0.01) different among the seven rations and was highest in ration R-III and lowest in ration R-I in comparison to the other rations. Almost similar DMI/kg w0.75 was observed in ram lambs fed rations R-II, R-IV, R-V and R-VI. Mean digestibility coefficients of DM, OM, CP, EE, CF and NFE 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 NDF, ADF, hemicellulose and cellulose digestibilities were comparable and insignificantly increased as the level of concentrate increased in the ration. The N intake (g/d) was significantly (P<0.01) higher by 41.14, 52.82, 61.87, 51.93, 37.72 and 64.94 per cent, respectively with R-II, R-III, R-IV, R-V, R-VI and R-VII rations in comparison to R-I ration. The N out go through faeces and urine in ram lambs was significantly (P<0.01) different among the seven rations. The N balance (g/d) in lambs was either significantly or non significantly higher by 41.24 (>0.05), 62.38 (P>0.05), 76.59 (P<0.01), 73.24 (P<0.01), 56.49 (P>0.05) and 72.99 (P<0.01) per cent, respectively with R-II, R-III, R-IV, R-V, R-VI and R-VII rations in comparison to R-I ration. Based on the results of this study it is concluded that, supplementation of concentrate and or legume hay did not affected the digestibilities of nutrients. However affected the nitrogen utilization in Nellore ram lambs.

Index Terms- concentrate, legume hay, maize silage, nutrient utilization, nitrogen balance

I. Introduction

Maize (*Zea mays*) is the nutritious feed for small and large ruminants have high protein efficiency ratio (PER), relatively high digestible energy (DE) and total digestible nutrients and thus maize fodder can play an important role in supplying animal feed throught the year if we cultivate them. (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 Venkataramanan *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 ruminants with silage in India. Farmers in Andhra Pradesh are showing interest in preparing and feeding of silage to their ruminant animals particularly small ruminants like 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 the maize silage by supplementing concentrate and legume hay at certain levels to study the nutrient digestibilities and nitrogen metabolism in growing Nellore ram lambs.

II. MATERIALS AND METHODS

This on-farm experiment was carried out with maize silage at Indugula village in Tipparthy mandal of Nalgonda district, Andhra Pradesh which is 140 km away from Hyderabad. The main source of irrigation for food crops or forage crops here is by rains, bore wells and small tanks. Average rainfall was 50-60 mm per annum and occurs chiefly due to southwest monsoons every year from June to September. Soil is of mostly red (chalka) type. The experimental animals faced the maximum environmental temperature of about 44^0C in the month of May and the minimum was about 23^0C during the entire experimental period.

Silage making

The farmer who reared the experimental ram lambs was having 20 acres of land with bore well as well as sprinkler irrigation facility. The farmer was already rearing 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 for 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 purchased from local market and applied at the rate of 60, 24 and 10 kg per acre, respectively. A 36V92 variety of maize seed was selected and purchased from Pioneer seeds Pvt. Ltd., Hyderabad for growing the maize fodder for silage making. Physical or chemical treatment of seed was not done prior to sowing.

Sowing, Fertilizer application and Irrigation

Seed rate was 8.5 kg/acre. While sowing with hand, the distance maintained between the rows was 1.5 feet and between the seeds was 7 inches. About 5 g of urea fertilizer was placed along with a maize seed while sowing. Corbofuron granules were placed in the rows after sowing to prevent the infestation by insects after germination. Maize seeds were sowed in the winter season (15^{th} November, 2009). Irrigation was done by sprinklers for first 60 days followed by bore well once in 15 days till harvest. Herbicide (Atrazin @ 1.5 litres in 200 litres of water per acre) was used on the next day of sowing to prevent the growth of weeds in the field. Monocrotophos an insecticide was sprayed over the growing fodder on 40^{th} day. Booster dose of urea was applied on 15^{th}, 30^{th} and 40^{th} day.

Harvesting of Maize Fodder

Maize fodder was harvested on 87^{th} 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.

Construction of Silo

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. All the inside walls and bottom of silo was cemented to prevent seepage of ground water if any. All the sides of the silo were covered with HDPE plastic cover before filling the pit with chopped maize fodder.

Chopping

Harvested and wilted green fodder was brought to the site of silage pit from the field by using a tractor. The 10 HP motor capacity chop cutter was arranged at one edge of silo in order to allow the chopped green fodder directly to fall into the pit. About 5-6 whole maize plants were kept in the chop cutter at a time so as to cut the fodder to a size of ½ to ¾ inches.

Silage Additives

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 while chopping it in a chop cutter.

Compacting and sealing

Chopped green maize fodder was trampled (compacted) with wooden planks by two persons for every one foot level in the pit Great care was taken while trampling chopped silage fodder to prevent trapping of air in the pit so as to maintain strict anaerobic environment in the silo. After filling the chopped fodder to about 2 feet's above the ground level it was tightly covered with HDPE plastic covers and heavy weight bags filled with sand were kept over the pit to prevent entry of air and water into silo. Pit slope to one side was maintained to drain water quickly if rain occurs. Silo was opened on 39th day after sealing for the feeding of experimental ram lambs.

Preparation of Concentrate Mixture

Concentrate feed ingredients were procured from the local Hyderabad market. Concentrate mixture with 17% CP and 70% TDN (Table 3) was prepared in the feed mill located at Department of Animal Nutrition, College of Veterinary Science, Rajendranagar, Hyderabad and transported to Indugula village for feeding of ram lambs.

Lucerne (*Medicago sativa*) crop was grown at the farmer's fields at Indugula village and was harvested at 50-60% flowering stage. Harvested green lucerne fodder was dried under shade for 3-4 days in order to contain 12-14% moisture. While drying, the fodder was turned upside down three times a day to prevent growth of fungus and to hasten the process of drying. Prepared hay was filled in the gunny bags and stored for feeding of experimental ram lambs. Groundnut (*Arachis hypogea*) haulms were purchased (Rs. 3.00 per kg) from another farmer in Indugula village for the feeding of experimental ram lambs. Sweet sorghum bagasse (SSB) was procured from ICRISAT, Patancheru, Hyderabad to prepare complete ration. Concentrate ingredients were purchased from local market in Hyderabad. Complete ration with 50 per cent level SSB was processed into mash according to the formula (Table 3) using hammer mill through 8 mm sieve at the feed mill of Department of Animal Nutrition, College of Veterinary science, Rajendranagar, Hyderabad and was transported to Indugula village to feed the experimental ram lambs.

Selection and Grouping of 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 from Karimnagar, Karimnagar district of Andhra Pradesh 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 (T_1), 14.33±0.47 (T_2), 14.20±0.56 (T_3), 14.23±0.87 (T_4), 14.30±0.46 (T_5), 14.32±0.62 (T_6) and 14.10±0.86 (T_7), respectively.

Experimental Silage Rations

Seven experimental groups were fed with respective rations as mentioned below for a period of five months.

The first group (T_1) of growing Nellore ram lambs was fed sole maize silage *ad libitum.*

The second group (T_2) animals were fed concentrate mixture @ 0.5 per cent of body weight + maize silage *ad libitum.*

The third group (T_3) animals were fed concentrate mixture @ 1.0 per cent of body weight + maize silage *ad libitum.*

The fourth group (T_4) animals were fed concentrate mixture @ 1.5 per cent of body weight + maize silage *ad libitum.*

The fifth group (T_5) of ram lambs was fed lucerne hay to meet 25 per cent of dry matter requirement and maize silage *ad libitum*.

The sixth group (T_6) of ram lambs was fed groundnut haulms (straw) to meet 25 per cent of dry matter requirement and maize silage *ad libitum*.

The seventh group (T_7) ram lambs were fed solely on SSB based complete ration (50:50).

Housing, Feeding Watering and Management

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. Ordinary flooring (soil) was maintained in the pens. 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.

Metabolism study

Digestion cum metabolic studies were conducted at the end of the growth trial in ram lambs to assess the nutrient utilization and nitrogen and energy balance 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.

Collection of Samples

Representative samples of each feed offered and residues 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^{o}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 1/100th part of faeces voided each day by individual animal was weighed and frozen in refrigerator for further analysis.

For nitrogen estimation, 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 concentrate sulfuric acid. The aliquots, thus pooled in the flasks, were maintained separately for each animal.

Proximate Analysis

Dry matter, crude protein, crude fiber, either extract or total ash were estimated according to procedure nos. 4.1.03, 4.2.02, 4.6.01, 4.5.01 and 4.1.02, respectively as described by AOAC (1997).

Crude protein estimation

A known quantity of the ground sample (appropriate aliquots, in case of wet faeces and urine) was digested with suitable quantity of concentrated H_2SO_4 in the presence of catalytic digestion mixture ($CuSO_4$ and K_2SO_4 in 1:10 ratio) by using Turbotherm (Gerhardt, Germany). An acid blank was also run along with the samples for correction of any N contribution by the acid itself. The digested sample was then quantitatively transferred in to a volumetric flask with repeated washing with distilled water. The N content of the sample was estimated by distilling a suitable aliquot into an auto analyzer (Vapodest, Gerhardt, Germany). The N content multiplied by the factor 6.25 gave the CP content of the sample, which was expressed as percentage on DMB. Fibre fractions in feeds, faeces and residues were performed as per the method described by Van Soest *et al.* (1991).

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).

III. RESULTS AND DISCUSSION

Chemical Composition

The chemical composition of experimental rations of maize silage fed to growing Nellore ram lambs is presented in the Table 1. The per cent DM, OM, CP, EE, CF, NFE, TA, NDF, ADF, hemicellulose, cellulose and lignin values were 29.86, 93.07, 5.49, 2.42, 23.5, 61.66, 6.93, 58.72, 41.9, 16.82, 22.15 and 7.58 for maize silage; 93.51, 89.11, 17.27, 3.59, 8.23, 60.02, 10.89, 32.05, 13.32, 18.73, 7.09 and 3.11 for concentrate mixture (17 per cent CP and 70 per cent TDN); 89.33, 90.28, 15.06, 2.14, 32.49, 40.59, 9.72, 57.66, 39.72, 17.94, 30.17 and 4.95 for lucerne hay; 91.46, 88.09, 9.23, 1.20, 36.72, 40.94, 11.91, 69.54, 46.70, 22.84, 30.52 and 6.57 for groundnut haulms; 92.67, 89.23, 11.51, 1.75, 28.64, 47.33, 10.77, 58.28, 31.29, 26.99, 24.08 and 4.35 for sweet sorghum bagasse (SSB) based complete ration (50R:50C), respectively on DM basis. The DM, OM, and CP content of whole crop maize silage prepared at two third milk line stage used in the present study was similar as observed by Shaver *et al.* (1984) whose values were 33.6, 95.9 and 6.8 per cent, respectively, for DM, OM and CP in the corn silage and the similar values were also recorded by Filya (2004) for CP (6.50%), Hemicellulose (18.30%) and cellulose (24.50%) in whole crop maize silage that the crop was harvested at two third milk line stage and the ash content (4.10) was higher in the present study maize silage. This higher ash content in the present maize silage might be due to tropical climatic effect and soil condition. Reddy and Reddy (1988) reported the chemical composition of maize silage for feeding of adult sheep as DM 30.67, OM 89.34, CP 6.94, CF 29.43, EE 0.96, NFE 52.01 and TA 10.66 per cent on DMB.

The chemical composition of maize silage reported by Marina *et al.* (2007) for sheep was DM (26.4), OM (95.5), CP (6.2), NDF (58.2), ADF (32.1) per cent, on DMB and these results were almost similar to the present study maize silage fed to Nellore ram lambs. Almost the same proximate composition of maize silage was observed by Rowghani *et al.* (2008) and Sohail *et al.* (2010).

Rama Prasad *et al*. (1999) reported the proximate composition of groundnut haulms as 86.2 (OM), 10.6 (CP), 30.70 (CF), 2.6 (EE) and 32.3 (NFE) per cent on DMB. In another study Mandal *et al*. (1999) reported the chemical composition of groundnut haulms as 27.44, 11.81, 1.5, 20.53, 46.7 and 19.46 per cent, respectively for DM, CP, EE, CF, NFE and TA. Vara Prasad *et al*. (2000) reported the chemical composition of groundnut haulms as 13.1, 21.2, 40.2, 44.9, 38.8 and 29.8 for CP, CF, NFE, NDF, ADF and cellulose, respectively on DMB. Chemical composition of GN haulms was reported by Murthy *et al*. (2001) for CP, EE, CF, NFE and TA as 13.12, 3.22, 31.86, 38.95 and 12.85 per cent, respectively on DMB. Jatinder Singh *et al.* (2009) reported the CP, CF, EE, total ash and NFE as 5.30, 33.15, 1.33, 6.37 and 53.85 per cent, respectively on per cent DM in groundnut haulms.

Ranjhan (1998) reported the chemical composition (%) of lucerne hay as DM (85), CP (21.3), CF (29.4), NFE (35.2), EE (1.4), ash (12.7), NDF (43.6) and ADF (35.8). Chemical composition of lucerne hay as reported by Sanjivkumar and Bhatt (2000). contained 85.60, 19.10, 21.60, 2.80, 42.10 and 14.40 per cent of OM, CP, CF, EE, NFE and TA, respectively on DMB. Wildeus *et al*. (2007) reported the chemical composition of alfalfa hay in terms of CP, NDF and ADF as 15.2, 70.2 and 41.5 per cent, respectively on DMB. The same author in same publication he was also reported 16.8, 64.3 and 47.3 per cent of CP, NDF and ADF, respectively on DMB in another experiment.

Metabolism Study

Dry matter intake

The dry matter intake (DMI) by ram lambs fed maize silage and SSB based rations is presented in Table 2. The DMI expressed as g/d or g/kg $w^{0.75}$ was 608.40±26.61, 68.91±3.53; 813.24±36.07, 79.38±4.51; 865.89±24.80, 86.44±1.27; 933.36±38.43, 81.62±1.01; 882.26±19.20, 80.99±3.65; 840.38±20.81, 84.59±1.61 and 828.47±57.90, 76.51±3.06 g/d in growing Nellore ram lambs fed rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII, respectively. The DMI (g/d) was significantly ($P<0.01$) higher by 25.19, 29.74, 34.82, 31.04, 27.6 and 26.56 per cent respectively with R-II, R-III, R-IV, R-V, R-VI and R-VII rations in comparison to R-I ration (sole silage). DMI (g/d) was almost similar in lambs fed rations R-III, R-V and R-VI. Lowest DMI (g/d) was observed in ram lambs fed R-I ration. DMI when expressed as g/kg metabolic body weight in growing Nellore ram lambs was also significantly ($P<0.01$) different among the seven rations and was highest in ration R-III and lowest in ration R-I in comparison to the other rations. Comparable DMI per $kgw^{0.75}$ was observed in ram lambs fed rations R-II, R-IV, R-V, R-VI.

High DMI in lambs fed R-IV ration in the present experiment might be due to higher in take of concentrate along with maize silage *ad lib* in comparison to other rations. Likewise, lower intake in R-I ration might be due to sole maize silage feeding. Silage is a bulky feed (high moisture – about 70%) which fills the gut with little amount of silage intake. Hence, the animals received less dry matter with sole silage feeding. Supplementation of forage based rations plus 75-100 g each of maize plus GNC, sunflower cake or palm kernel cake (PKC) has markedly improved the DMI in growing sheep (Pratap Reddy *et al*., 1989; Devasena and Krishna, 1996). Maximum DMI occurred when grass silage was supplemented with high level of concentrate (Keane *et al*., 2006). Similarly supplementation of legume fodder to guinea grass hay based diet has significantly increased the total DMI (Upadhyay, 1987; Ash, 1990) in goats and in sheep by Devasena and Krishna (1996). DMI per kg metabolic body weight in lambs fed sole silage ration (R-I) in the present study was in contrast to the value given by Marina *et al.* (2007) in sheep fed maize silage alone. This increase in DMI with increase in concentrate supplementation is in agreement with the results observed by Das (2008) in Sikkim local male kids supplemented with concentrate @ 0.5, 1.0 and 1.5% of body weight. Similar increase in dry matte intake with increase in level of concentrate supplementation was observed in Black Bengal kids by Das and Ghosh (2001). Previous reports suggest that DMI increased due to supplementation in low quality forage diets (Dixon and Egan, 2000; Rafiq *et al.* 2002 and Dixon *et al*. 2003). DMI when expressed as per cent body weight was not significantly different among the ram lambs fed different experimental silage based and SSB based rations.

Dry matter digestibility

Dry matter digestibility coefficients determined was 65.67±3.22, 66.94±2.30, 69.54±2.67, 70.94±1.99, 70.83±0.65, 68.46±2.78 and 64.29±1.03 per cent, respectively (Table 3, Fig. 1) for the silage rations R-I (sole silage), R-II (silage + concentrate mixture @ 0.5% body weight), R-III (silage + concentrate mixture @ 1.0% body weight), R-IV (silage + concentrate mixture @ 1.5% body weight), R-V (silage + lucerne hay to meet 25% DM requirement), R-VI (silage + groundnut haulms to meet 25% DM requirement) and R-VII (sweet sorghum bagasse based complete ration). 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 NB_{21}. Singh and Samantha (1998) reported increased DM digestibility with supplementation of legume forages to basal forages.

5.3.4.3 Organic matter digestibility

Organic matter digestibility of experimental rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII was 68.96±2.82, 70.64±2.41, 72.15±0.52, 73.01±1.52, 71.66±3.74, 69.95±3.57 and 65.06±2.06 per cent, respectively (Table 3, Fig. 1). 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 NB_{21} green forage with legume fodder.

Crude protein digestibility

Crude protein digestibility coefficient (%) was 62.60±3.54, 63.82±2.50, 65.19±4.85, 70.63±1.48, 71.15±6.03, 69.49±5.03 and 67.25±1.28 for the silage rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII, respectively (Table 3, Fig. 1). 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. This increase in CP digestibility in the present experiment might be due to gradual increase in dietary CP concentration which might have satisfied adequate N concentration for rumen microbes (Russel *et al*., 1992). These CP digestibilities were almost similar with the results of Das (2010) in Sikkim local male kids fed mixed grass supplemented with concentrate @ 0.5, 1.0 and 1.5% of body weight.

Ether extract digestibility

Ether extract digestibility coefficient determined was 62.43±1.93, 62.94±2.29, 63.15±1.78, 63.72±3.01, 66.68±2.80, 64.01±2.67 and 60.08±2.67 per cent for the rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII, respectively (Table 3, Fig. 1). 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.

Crude fibre digestibility

Crude fibre digestibility of the silage rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII was 60.26±4.80, 60.95±3.93, 61.57±4.40, 62.45±4.88, 65.08±4.05, 62.75±5.28 and 57.41±5.00 per cent, respectively (Table 3, Fig. 1). 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.

Nitrogen free extract digestibility

Nitrogen free extract digestibility coefficient of the rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII were 64.08±2.27, 65.77±2.95, 66.39±3.16, 66.78±2.04, 65.39±1.86, 64.12±2.69 and 61.10±1.97 per cent, respectively (Table 3, Fig. 1). 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.

Digestibilities of cell wall constituents

The mean NDF, ADF, hemicellulose and cellulose digestibility coefficients of R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII rations were 62.32±2.42, 59.43±3.37, 60.94±0.48, 57.56±4.24; 64.51±2.68, 60.44±0.88, 62.49±2.00, 59.63±2.35; 65.65±2.37, 62.28±2.27, 65.41±2.21 and 62.07±3.11; 65.81±3.10, 62.29±2.98, 66.63±3.55, 64.00±2.51; 62.58±1.53, 62.14±1.05, 64.23±2.95, 61.61±2.15; 62.09±2.50, 59.79±2.97, 62.83±1.39, 58.37±1.24 and 60.86±2.81, 58.61±1.06, 60.31±1.90 and 57.17±2.42, respectively (Table 3 and Fig. 2). 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).

Nutritive Value

The data on nutritive value of seven experimental silage rations in terms of DCP, TDN, DE and ME are presented in Table 4. The DCP and TDN values were 3.44±0.19, 60.51±1.70; 4.47±0.23, 61.66±1.43; 5.33±0.23, 62.15±1.62; 6.62±0.20, 63.02±1.02; 5.62±0.52, 62.78±1.15; 4.44±0.32, 60.59±1.21 and 7.74±0.15 and 55.47±2.22 per cent, respectively for the R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII rations. The DCP content was significantly ($P<0.01$) higher by 23.04, 35.46, 48.04, 38.79, 22.52 and 55.56 per cent in rations R-II, R-III, R-IV, R-V, R-VI and R-VII rations, respectively in comparison to ration R-I. Highest DCP was found with R-VII ration followed by R-IV, R-III, R-V, R-II, R-VI ration and least DCP content was observed in ration R-I. Pratap Reddy *et al*. (1989) reported increase in DCP value when concentrate was supplemented to basal forage rations. Varaprasad *et al*. (1995) in lambs fed Co-1 forage, Devasena and Krishna (1996) in lambs fed colonial guinea grass observed that, supplementation of concentrate or legume forage to basal diet increased the DCP content of the ration.

The TDN content was non significantly ($P>0.05$) higher by 1.87, 2.64, 3.98, 3.61 and 0.13 per cent in R-II, R-III, R-IV, R-V and R-VI rations in comparison to R-I ration but lower by 8.33 per cent in R-VII ration in comparison to R-I ration. The TDN value was highest in ration R-IV and lowest in ration R-VII. The DCP and TDN values were increased in the rations as the concentrate proportion increased. This might be due to high energy and protein content of concentrate feed than the maize silage feed alone. Pratap Reddy *et al*. (1989) reported increase in TDN value when concentrate was supplemented to basal forage rations. These results were also corroborating with the findings of Varaprasad *et al*. (1995) in lambs fed Co-1 forage and Devasena and Krishna (1996) in lambs fed colonial guinea grass supplemented with concentrate and/or legume fodder.

The DE and ME values determined for different experimental maize silage and SSB based rations for growing Nellore ram lambs was 11.16±0.31, 9.15±0.26; 11.38±0.26, 9.32±0.22; 11.47±0.30, 9.40±0.25; 11.63±0.19, 9.53±0.15; 11.58±0.21, 9.50±0.17; 11.18±0.22, 9.17±0.18 and 10.23±0.41 and 8.39±0.34 MJ per kg dry matter, respectively (Table 4) for R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII rations. There was a significant ($P<0.05$) difference in the DE and ME values of seven rations. The DE and ME values of ration R-I to R-VI were almost same and was lower in R-VII than the other rations. In contrast, Chauhan and Brar (1989) reported increased TDN, DE and ME values due to supplementation of concentrates to maize silage based rations in calves.

The DE and ME values (MJ/kg DM) of experimental rations fed to ram lambs was almost same in R-I to R-VI rations but it was lower in R-VII ration in comparison to other rations. This might be due to similar intake of energy by animals among the rations R-I to R-VI. The ME content (MJ/kg DM) of maize silage used in the present study is similar as was reported by Sohail *et al.* (2010). They reported ME value as 8.95 MJ/kg DM of maize silage for sheep.

Nitrogen Balance

Mean N intake, N loss through faeces, urine and also total loss (g/d) is shown in Table 5. Nitrogen intake (g/d) was 5.35±0.23, 9.09±0.31, 11.34±0.38, 14.03±0.86, 11.13±0.16, 8.59±0.22 and 15.26±1.07 in lambs fed R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII rations, respectively. The N intake (g/d) was significantly ($P<0.01$) higher by 41.14, 52.82, 61.87, 51.93, 37.72 and 64.94 per cent in lambs fed R-II, R-III, R-IV, R-V, R-VI and R-VII rations, respectively in comparison to R-I ration. Nitrogen intake in the R-IV and R-VII rations of present study was higher than the other experimental rations. This might be due to greater protein content in these rations. Mtenga and Kitlay (1990) reported higher N intake in goats when basal forage ration was supplemented with concentrate.

Nitrogen out go (g/d) through faeces and urine in ram lambs fed R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII rations was 2.01±0.24, 2.19±0.30; 3.31±0.34, 3.84±0.19; 3.92±0.16, 4.39±0.71; 4.12±0.36, 5.03±0.50; 3.24±0.73, 3.63±0.58; 2.63±0.46, 3.33±0.41 and 5.02±0.52 and 6.01±0.88 g/d, respectively. Nitrogen out go through faeces and urine in ram lambs was significantly ($P<0.01$) different among the seven experimental rations. The total N loss (g/d) in lambs fed rations R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII was 4.20±0.48, 7.15±0.37, 8.31±0.86, 9.15±0.85, 6.87±1.05, 5.96±0.75 and 11.03±1.19, respectively. The N loss through faeces and urine as well as total N loss (g/d) were also significantly ($P<0.01$) different among the ram lambs fed different experimental rations. The loss being highest in lambs fed ration R-VII and lowest in rams fed R-I ration probably due to variation in N intake in lambs fed different experimental rations. The loss being highest in lambs fed R-VII ration and lowest in rams fed R-I ration.

Nitrogen balance in experimental ram lambs was 1.14±0.42, 1.94±0.23, 3.03±1.13, 4.87±0.45, 4.26±0.95, 2.62±0.56 and 4.22±0.47 g/d and was either significantly or non-significantly higher by 41.24 ($P>0.05$), 62.38 ($P>0.05$), 76.59 ($P<0.01$), 73.24 ($P<0.01$), 56.49 ($P>0.05$) and 72.99 ($P<0.01$) per cent in lambs fed R-II, R-III, R-IV, R-V, R-VI and R-VII rations, respectively in comparison to R-I ration and the nitrogen retention expressed as per cent intake or per cent absorbed was 21.48±7.76, 32.94±11.24; 21.44±2.60, 33.54±3.73; 26.00±8.95, 38.72±11.71; 34.95±3.24, 49.28±3.63; 38.51±8.89, 52.67±8.92; 31.00±7.05, 43.39±7.72 and 28.07±3.66 and 41.47±4.70, respectively for R-I, R-II, R-III, R-IV, R-V, R-VI and R-VII rations. Pratap Reddy *et al*. (1989) reported increase in N retention when concentrate was supplemented at various levels with basal forage rations. Veereswara Rao *et al*. (1993) observed higher N retention in lambs by feeding NB21 green forage supplemented with legume fodder.

Nitrogen balance (g/d) was significantly ($P<0.01$) different among the seven experimental rations being significantly higher in rations R-IV, R-VII and R-V and lower in rations R-I and R-II rations. Higher nitrogen retention in R-IV, R-VII and R-V than other rations fed animals in the present study might be due to more nitrogen intake from respective rations. Pratap Reddy *et al*. (1989) reported increase in N retention when concentrate was supplemented to basal forage rations. Veereswara Rao *et al*. (1993) observed higher N retention in lambs by supplementing NB_{21} green forage to legume fodder. Devasena and Krishna (1996) observed higher N balance in lambs fed colonial guinea grass (*Panicum maxium*) supplemented with groundnut cake plus maize premix.

The results of this study demonstrate that feeding of sole maize silage and supplementation with concentrate or legume hay did not affected the digestibilities of nutrients. However, Nitrogen balance in the silage fed ram lambs was affected with supplementation of concentrate or legume hay.

ACKNOWLEDGEMENTS

Authors are thankful to the authorities of national agricultural innovation project (NAIP) national research centre (NRC) on meat project for providing sufficient financial assistance for conducting of this experiment.

REFERENCES

[1] AOAC. 1997. Official Methods of Analysis, 16th ed. Association of Official Analytical Chemists, Washington, DC.

[2] Ash, A. J. 1990. The effect of supplementation with leaves from the leguminous trees Sesbania grandiflora, Albizia chinensis and Glyricidia sepium on the intake and digestibility of guinea grass by goats. Animal Feed Science and Technology, 28: 225-232.

[3] Chauhan, T. R. and Brar, G. S. 1989. Effect of replacing conventional concentrate mixture with deoiled groundnut cake on the nutrient utilization in maize silage based rations of buffalo calves. Indian Journal of Animal Sciences, 59: 893-896.

[4] Das, A. 2008. Effect of different levels of concentrate supplementation on growth performance of Sikkim local kids fed mixed jungle grass based diet. Animal Nutrition and Feed Technology, 8 : 213-218.

[5] Das, A. and Ghosh, S. K. 2001. Effect of concentrate supplementation on growth performance of grazing kids. Indian Journal of Animal Nutrition, 18 (1): 79-83.

[6] Desai, S.N. and Deore, D. D. 1984. Effects of detectrate, spacing and nitrogen fertilizer on growth and forage production. Journal of Maharastra Agricultural University, 8: 109- 111.

[7] Devasena, B. and Krishna, N. 1996. Effect of feed supplementation on nutrient digestibility and nitrogen utilization in sheep fed colonial guinea grass based rations. Indian Journal of Animal Sciences, 66 (9): 949-951.

[8] Dixon, R. M. and Egan, A. R. 2000. Response of lambs fed low quality roughages to supplements based on urea cereal grain or protein meal. Australian Journal of Agricultural Research, 51: 811-821.

[9] Dixon, R. M., Karda, W., Hosking, B. J. and Egan, A. R. 2003. Effect of oilseed meals and grain urea supplements fed infrequently in digestion in sheep fed cereal straw diets. Animal Feed Science and Technology, 110: 95-110.

[10] Duncan, D. B. 1955. Multiple range and multiple F tests. Biometrics, 11: 1-12.

[11] Filya, I. 2004. Nutritive value and aerobic stability of whole crop maize silage harvested at four stages of maturity. Animal Feed Science and Technology, 116: 141-150.

[12] Jatinder Singh., Amit Sharma., Handa, M.C. and Nagra, S.S. 2009. Effect of different concentrate roughage ratio on growth performance, carcass characteristics and economics of production of Beetal kids under stall feeding. Indian Journal of Animal Nutrition, 26 (4): 354-357.

[13] Keane, M. G., Drennan, M. J. and Moloney, A. P. 2006. Comparison of supplementary concentrate levels with grass silage, separate or total mixed ration feeding, and duration of finishing in beef steers. Livestock Science, 103 (1-2): 169-180.

[14] Lindsay, D. B. 1970. Physiology of digestion and metabolism in ruminants. A.T. Phillipson pp: 438-451.

[15] Leng, R. A. 1990. Factors affecting the utilization of poor quality forages by ruminants' particularly under tropical conditions. Nutrition Research Review, 3: 277-303.

[16] Mandal, A. B., Paliwal, V. K., Yadav, K. R. and Krishna, G. 1999. Utilization of ensiled groundnut haulms and paddy straw. Indian Journal of Animal Nutrition, 16 (2): 131-134.

[17] Marina, V., Mladen, K., Kresimir, B., Josip, L. and Goran, P. 2007. Feeding of low quality grass silage supplemented with maize silage for sheep. Agricultural and Food Science, 16: 17-24.

[18] Mtenga, L. A. and Kitlay, A. J. 1990. Growth performance and carcass characteristics of Tanzanian goats fed Chloris gayana hay with different levels of protein supplement. Small Ruminant Research, 3: 9-18.

[19] Muhammad, D., Hussain, A. and Bhati, M. B. 1990. Location differences in forage yield and quality of maize cultivars. Pakistan Journal of Science and Research, 33: 454-456.

[20] Murthy, K. S., Dutta, K. S., Tajane, K. R. and Ravikala, K. 2001. Effect of varying levels of groundnut haulms in the rations on nitrogen fractions and TVFA concentration in the rumen of Gir bullocks. Indian Journal of Animal Nutrition, 18 (4): 380-382.

[21] Pratap Reddy, V., Rama Prasad, J., Krishna, N. and Anjaneya Prasad, D. 1989. Effect of supplementation of energy and protein to forage based basal ration in Nellore weaner lambs. Indian Journal of Animal Nutrition, 6: 302-306.

[22] Rafiq, M., Dixon, R. M., Hosking, P. J. and Egan, A. R. 2002. Leaf content of straw diets influences supplementation responses by sheep. Animal feed Science and Technology, 100: 93-106.

[23] Ragothaman Venkataramanan., Chirukandoth Sreekumar., Rishipal Anilkumar., Selvaraj, P., Nainar M ., Vidhya. and Iyue, Mathagowder. 2010. Effect of jaggery on the quality and intake levels of maize silage. Tropical Animal Health and Production, 42 (5): 1027-1029.

[24] Rama Prasad, J., Prabhakara Rao, Z. and Srinivasa Rao, D. 1999. Evaluation of leguminous hay based complete rations in sheep. Indian Journal of Animal Nutrition, 16 (1): 48-52.

[25] Ranjhan, S. K. 1998. Nutrient requirements of livestock and poultry, ICAR, Krishi Anusandhan Bhavan, Pusa, New Delhi pp. 10-17.

[26] Reddy, G. V. N. and Reddy, M. R. 1988. Maize silage as sole ration for sheep and goats. Indian Journal of Animal Nutrition, 5 (2): 160-162.

[27] Rowghani, E., Zamiri, M. J., Khorvash, M. and Abdollahipanah, A. 2008. The effects of Lactobacillus plantarum and Propionibacterium acidipropionici on corn silage fermentation, ruminal degradability and nutrient digestibility in sheep. Iranian Journal of Veterinary Research, 9 (4): 309-315.

[28] Russel, J. R., Irlbeck, N. A., Hallauer, A. R. and Buxton, D. R. 1992. Nutritive value and ensiling characteristics of maize herbage as influenced by agronomic factors. Animal Feed Science and Technology, 38: 11-24.

[29] Sanjiv kumar. and Bhatt, R. S. 2000. Feeding of lucerne hay to economize feed cost for Angora rabbits. Indian Journal of Animal Nutrition, 17 (1): 90-93.

[30] Sehgal, J. P., Sharma, D. D., Singhal, K. K. and Ghosh, M. K. 1999. Meat production potentiality of Indian Murrah male buffalo raised for beef on two levels of concentrate in the diet. Buffalo Journal, 15: 164-169.

[31] Shaver, R. D., Erdmann, R. A. and Vanderall, J. H. 1984. Effect of silage pH on voluntary intake of corn silage. Journal of Dairy Science, 67: 2045-2049.

[32] Singh, K. K. and Samanta, A. K. 1998. Effect of source and levels of nitrogen supplementation on the utilization of Cenchrus celiaris. Indian Journal of Animal Nutrition, 15: 69-71.

[33] Snedecor, G. W. and Cochran, W. G. 1994. Statistical Methods (8th edn). Iowa State university Press, Ames, Iowa, USA.

[34] Sohail, H. K., Muhammad, A. S., Maher, N. and Muhammad, S. 2010. Nutrients intake, digestibility, nitrogen balance and growth performance of sheep fed different silages with or without concentrate. Tropical Animal Health and Production. DOI 10.1007/s11250-010-9765-1.

[35] Van Soest, P. J., Robertson, J. B. and Lewis, B. A. 1991. Journal of Dairy Science, 74: 3583- 3590.

[36] Vara Prasad, P. V., Rama Prasad, J., Prabhakar Rao, Z. and Srinivasa Rao, D. 2000. Effect of dry legume forage supplementation to green colonial grass on growth and nutrient utilization in sheep. Indian Journal of Animal Nutrition, 17 (2): 141-146

[37] Vara Prasad, D. V., Krishna, N. and Rama Prasad, J. 1995. Nutritional evaluation of Co-1 (Cenchrus glaucus) forage in Nellore lambs. Indian Journal of Animal Nutrition, 12 (4): 247-248.

[38] Veereswara Rao, B., Parthasaradhy, M. and Krishna, N. 1993. Effect of supplementation with tree leaves on intake and digestibility of hybrid napier (NB-21) grass in Nellore brown sheep. Animal Feed Science and Technology, 44: 265-274.

[39] Wildeus, J., Luginbuhl, J. M., Turner, K. E., Nutall, Y. L. and Collins, J. R. 2007. Growth and carcass characteristics in goat kids fed grass and alfalfa-hay-based diets with limited concentrate supplementation. Sheep & Goat Research Journal, 22: 15-19.

[40] Xu, C., Cai, Y., Fukasava, M., Matsuyama, H. and Moria, N. 2008. The effect of replacing brewer's grains with barley tea grounds in total mixed ration silage on feed intake, digestibility and ruminal fermentation in wethers. Animal Science Journal, 79: 575- 581.

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