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Research Article

PERFORMANCE OF GOATS FED CROP RESIDUE BASED COMPLETE RATIONS

B. DEVASENA* and J. RAMA PRASAD[1]
Department of Animal Nutrition, College of Veterinary Science
SVVU, Tirupati-517 502

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ABSTRACT

A metabolism trial was conducted in adult goats to evaluate groundnut haulms (GNH; *Arachis hypogia*) and red gram bhusa (RGB; *Cicer arietum*) based complete rations (CR-I and CR-II, respectively) with roughage:concentrate ratio of 70:30. The GNH and RGB contained 10.3 and 9.8% crude protein, respectively. The average DMI during metabolism trial was 90.2 and 86.3 g/ $kgw^{0.75}$ in goats fed CR-I and CR-II rations, respectively. The digestibility coefficients of various nutrients were statistically similar between two groups. But slightly higher (P>0.05) digestibility of CP and EE was observed in CR-II, while CF and NFE digestibility was more in CR-I. The DCP intake (g/d) was 89.6 and 88.1 and that of TDN intake (g/d) was 650.3 and 758.4 in animals fed CR-I and CR-II, respectively. The animals showed positive nitrogen balance in both the groups which indicated better utilization of protein in complete diets. The growth trial conducted in weaner kids of 4 months age for a period of 120 days resulted in an average daily gain (g/d) of 52.17 in CR- I and 50.00 in CR-II.

Key words: Complete rations, growth, metabolism, nutrient digestibility

India produces 540 million tonnes of crop residues and coarse straw (Ramachandra *et al*., 2006). Feeding of crop residues particularly leguminous straws for livestock as a major roughage source has been observed during harvest season as they are most abundantly available. Leguminous straws/ bhusa appears to be a valuable edible biomass due to its high nutritive value and feeding quantities and can serve as a potential feed resource during the lean period. These crop residues could be incorporated as basal roughage in the complete diets of small ruminants up to 60% (Rama Prasad *et al.*, 2000). Such crop residues after fortification of deficit nutrients provide adequate balanced diet to the animals as well as overcome associated problems of handling and storage. The complete feeding system is a promising method of ensuring supply of diet of same composition by mixing roughage and concentrate to form a uniform mixture. Enhanced nitrogen balance and growth response with complete rations containing legume straw has been reported (Bonsi *et al*., 1994). The complete feed system also provides stable rumen environment, reduced fermentation losses and less fluctuation in release of ammonia. Feeding of goats with complete rations by incorporating crop residues appears to be the promising feeding system for improving their productivity in developing countries like India (Reddy, 1989; FAO, 2012). The merits of complete feed system are also related to economization of feed cost, avoiding refusal of unpalatable portion of crop residues and enables use of locally available ingredients.

*Corresponding author: devasenabusisneni@yahoo.com

Hence the present study was aimed to evaluate the effect of groundnut haulms (*Arachis hypogia*)/ red gram bhusa (*Cicer arietum*) based complete rations on nutrient utilization, growth performance and nitrogen balance in nondescript local goats.

MATERIALS AND METHODS

Experimental Rations: The crop residues viz. groundnut haulms (GNH) and red gram bhusa (RGB) were dried and ground through medium mesh screen before mixing with other feed ingredients to prepare complete rations. The complete rations (CR-I and CR-II) were prepared to contain roughage:concentrate ratio of 70:30 by adding 50% of each crop residue, 20% sugar cane bagassee along with concentrate ingredients (maize grain-14%, de-oiled groundnut cake-9%, molasses-5%, salt-1% and mineral mixture-1%).

Metabolism Trial: The study was conducted in two phases, a metabolism trial with 4 local nondescript adult bucks (32.5±0.45 kg) with 2x2 switch over switch back design. A 21 day preliminary period was followed by seven day collection period. The animals were housed in individual stalls having provision for feeding and watering. The animals were offered respective complete

rations (CR-I and CR-II) *ad libitum* and daily DM intake, feed refusal, total faeces (measured by harnessing faecal bags to individual animals) and urine passed were recorded. Water was made available continuously during the entire day in stalls. Mature animals were considered for conducting the metabolism trial to have the correct assessment of nutrient utilization while young animals were considered for growth trial.

Growth Trial: The growth trial was conducted for 120 days, with 12 local nondescript weaner kids (13.33±0.62 kg) randomly divided equally into two treatment groups. The animals were offered respective experimental feeds CR-I and CR-II. Daily feed intake was calculated by subtracting the amount of feed residue left over on the next day from total feed offered. The kids were housed in well ventilated, clean pens with an open area for movement during the day time. All the experimental kids were provided feed and water *ad libitum*. Feed was offered twice daily at 9.00 and 15.00 h and residue was weighed after 24 h. All the experimental animals were offered clean, fresh drinking water round the clock. All the animals were treated with ivermectin and fenbendazole in recommended doses for external and internal parasites in the beginning and again after four months of experimental period. Animals were vaccinated against the infectious diseases seven days after the initial deworming. The animals were weighed fortnightly on two consecutive days before offering the feed and water in the morning. Average daily gain (ADG) and feed conversion efficiency (FCE) was calculated.

Analysis of Data: The feed samples of crop residues, concentrate feeds, complete rations and faeces were dried at 70^{0}C for 48h, ground to pass through 2 mm medium mesh screen and analyzed for proximate composition as per AOAC (1995). The urine samples were analysed for nitrogen by Kjeldahl's method (AOAC, 1995). The data was subjected for statistical analysis according to the methods described by Snedecor and Cochran (1967) and Duncan (1955).

RESULTS AND DISCUSSION

The nutrient composition of crop residues, feed ingredients and complete rations has been given in Table 1. The GNH and RGB contained 10.3 and 9.8% CP; 87.4 and 93.6 OM; 38.0 and 46.9% NFE, respectively which were within the values of organic nutrients reported by Garg *et al*. (2009) and Dhuria *et al*. (2009). The DMI (g/d) values were more ($p<0.05$) in group CR-I as compared to group CR-II (Table 2). The average DMI in bucks during metabolism trial was 90.2 and 86.3 g/ kg $w^{0.75}$ which is equivalent to 3.8 and 3.6 kg/100 kg body weight in groups CR-I and CR-II, respectively. Although non-significant differences were observed; the DMI in groups I and II indicated that the palatability of complete rations was quite acceptable to the animals. High acceptability of complete feed in processed form by improved DMI has also reported by Reddy and Reddy (1985). The improved feed intake seems to be driven partly by an improved rate of fibre break down as indicated by the digestibility coefficient of CF and partly improved by duodenal flow (Garg *et al*., 2009) of absorbed amino nitrogen in group CR-I as compared to group CR-II.

The digestibility coefficients of various nutrients in the experimental rations (CR-I and CR-II) were statistically similar between two groups. However, slightly higher digestibility of CP and EE was observed in group CR-II, while CF and NFE were higher ($P>0.05$) in group CR-I. Slightly higher digestibility of CF (49.29 to 67.38%) was also reported by Rajmane and Deshmukh, (2000) in goats fed complete rations as compared to the present study (46.6 - 48.3%) This can be attributed to

Table 1
Proximate analysis (%DM) of different feed resources and complete feeds

Parameter	Proximate analysis						
	GNH	RGB	Maize	GNC	Bagasse	CR-I	CR-II
OM	87.4	93.6	98.7	94.8	94.8	92.6	93.8
CP	10.3	9.8	10.6	42.0	3.0	12.1	11.8
EE	2.1	1.6	3.7	2.5	0.7	2.6	1.9
CF	37.0	35.3	1.8	7.5	41.7	31.6	28.9
TA	12.6	6.4	1.3	5.2	5.2	7.4	6.2
Nitrogen free extract	38.0	46.9	82.6	42.8	49.4	46.3	51.2

the higher amount of CF (Table 1) due to the inclusion of bagasse at 20% level in the present study. The DCP values (7.3 and 7.5%) were comparable in both groups while TDN (53.2 and 64.3%) contents indicated significant (P<0.05) differences for the rations CR-I and CR-II. Owing to the marginally higher intake of DM in group CR-I, with similar digestibility of nutrients in both the rations, more (P<0.05) TDN intake was observed in group CR-II as compared to group CR-I which could be due to higher digestibility of EE in group CR-II. The observations of Rajmane and Deshmukh (2000) in goats and Rama Prasad *et al*. (2000) in sheep also supported the findings of the present study. The DCP intake (g/d) of 91.7 and 84.1 and that of TDN intake (g/d) of 652.8 and 754.9 was noticed in CR-I and CR-II fed group, respectively. The reported nutrient requirements suggested by ICAR (1998) were 940 g of DM, 48 g of DCP and 450 g of TDN for goats for maintenance and 1,170 g of DM, 71 g DCP and 645g of TDN for growth. In the present study the DCP and TDN intakes were higher than recommended level for maintenance, but lower than the growth requirements. Moreover there was an improvement in body weight of the animals during the experimental period. Proportionate intake of roughage and concentrate might have resulted in optimum rumen environment and hence animals had better performance (Dhuria *et al*., 2009).

The animals showed positive nitrogen balance 7.9 and 8.3 (g/d) in CR- I and CR-II, respectively (Table 3). Nitrogen retention as percentage of N intake and percentage of N absorbed was statistically similar in both groups. Reddy and Reddy (1999) also reported similar nitrogen balance and further reported that various species can maintain themselves satisfactorily on complete feeds. Singh *et al*. (2007), Dhuria *et al.* (2009) and Garg *et al*. (2009) also reported higher nitrogen balance in processed complete feed than loose feed in sheep and other species of animals (Reddy and Reddy, 1999).

The weaner kids in both groups in this study indicated an overall gain in body weight to the tune of 6.26 and 5.88 kg in CR- I and CR-II groups, respectively. Average daily gain (g/d) was 52.17 in CR- I and 50.00 in CR-II which was approx. 4.0% more in CR-I as compared to CR-II. The higher DMI values in CR-I group might have resulted in better weight gains in group CR- I as compared to CR-II. Dhuria *et al*. (2009) observed up to 19% improvement in live weight in Magra lambs fed complete feed. In complete feed

Table 2
Intake and digestibility of nutrients in goats fed complete feeds

Parameter	CR-I	CR-II	SEM
Initial body weight (kg)	32.3	32.4	6.7
Final body weight (kg)	33.9	34.1	3.3
Dry matter intake (g/d)*	1227^a	1174^b	88
DMI % live wt.	3.8	3.6	0.3
DMI g/kgw$^{0.75}$	90.2	86.3	9.7
CPI (g/d)*	146.5^a	138.6^b	28.5
CPI g/kgw$^{0.75}$	10.9	10.2	2.7
Nutrient digestibility (%)			
DM	61.8	60.3	8.9
CP	60.3	63.4	9.5
CF	48.3	46.6	3.2
EE	70.1	72.8	6.1
Nitrogen free extract	74.2	73.6	5.3

*Means bearing different superscripts in a row for a parameter differ significantly (P<0.05)

Table 3
Plane of nutrition and nitrogen balance in goats fed complete feeds

Intake of digestible nutrients	CR-I	CR-II	SEM
DCP intake (g/d)	89.6	88.1	23
DCP intake (g/ kgW$^{0.75}$)	6.6	6.5	0.2
TDN intake (g/d)*	650.3^b	758.4^a	54
TDN intake (g/kgW$^{0.75}$)*	47.8^b	55.8^a	15
Plane of nutrition			
DCP content (%)	7.3	7.5	0.9
TDN content (%)*	53.0^b	64.6^a	5.2
N balance			
N intake	23.4	21.2	2.1
Faecal N	9.7	7.8	0.21
Urinary N	5.8	6.1	0.05
Total N excretion	15.5	13.9	1.1
Retention of N (g/d)	7.9	7.3	0.3
% of N intake	33.9	37.3	9.8
% of N absorbed	55.2	57.7	8.3

*Means bearing different superscripts in a row for a parameter differ significantly (P<0.05)

Table 4
Average daily gain (g/d) of kids fed complete feeds

Parameter	CR-I	CR-II	SEM
Initial body weight (kg)	13.32	13.34	0.05
Final body weight (kg)	19.58	19.34	0.11
Gain in body weight (kg)	6.26	6.00	0.21
Average daily gain (g/d)	52.17	50.00	0.22
Feed efficiency	23.52	23.48	0.34

proportionate intake of roughage and concentrate causes optimum rumen environment and hence animals showed better performance. Venkateswarlu *et al.* (2013) reported that crop residue based complete ration feeding had a significant effect on growth rate (93.5 to 103.3 g/day) in comparison to traditional grazed animals (48.5 g/day) with no concentrate in ration. The feed efficiency observed in the present study in both the groups was comparable. Venkateswarlu *et al*. (2013) also reported significant effect on feed conversion efficiency of ram lambs fed crop residue based complete ration.

The results of present study thus indicated that converting the crop residues like groundnut haulms and red gram bhusa into complete feeds resulted in enhanced intake without affecting digestibility, which positively affected nitrogen balance improved growth performance and feed conversion efficiency in bucks.

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