Effect of Feed Allowance on Selection, Intake and Nutrient Utilization of Green Maize (*Zea mays*) by Goats

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ABSTRACT : The influence of feed allowance on intake and nutrient utilization by Barbari goats given green maize (*Zea mays*) and potential feeding value of left-overs were studied. The goats were offered food at 3 levels to give left-overs of about 20% (T-1), 35% (T-2) and 50% (T-3) DM of offered amount. A marked effect of refusal rate on intake and digestibility of nutrients was found. The DMI, g/kg $W^{0.75}$ increased from 39.86 in T-1 to 50.91 and 66.55 g in groups T-2 and T-3, respectively. Allowing selective consumption at higher levels (T-2 and T-3), the intake of TDN and DCP from green maize was found not only to meet the maintenance requirement but provided surplus energy and protein for substantial production. The variability in diet selectivity between goats under different treatments was pronounced. As the level of food excess increased to T-3, the left overs had a higher IVDMD and crude protein and decreased cell wall constituents ($p<0.05$). Considering the substantial increase in intake and digestibility from feeding green maize at high allowances to goats, further studies are needed to develop practical feeding strategies. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 4 : 483-486*)

Key Words : Green Maize, Food Allowance, Intake, Digestibility, Leftovers, Goat

INTRODUCTION

It is increasingly being proposed to use high food allowances as a means to increase the performance of ruminants offered heterogenous roughages under stall-feeding. Evaluation of this approach requires determination of the responses of animals to increasing levels of food allowances in terms of feed intake, diet selectivity and nutrient utilization. The present study was undertaken to examine the influence of food allowance on extent of diet selection by Barbari goats within green maize (*Zea mays*) and its effect on intake and nutrient utilization of ingested food.

MATERIALS AND METHODS

Animal feeding and management

Twelve Barbari male goats of about 15 months age (Av. body Wt. 14.78±2.26 kg) were used for the experiment and given green maize fodder harvested at blooming stage. The foliage included leaves, leaf sheath, stem component and inflorescence. The goats (4 goats/treatment) were offered chaffed green maize *ad libitum* to give leftovers of about 20% (T-1), 35% (T-2) and 50% (T-3) DM of offered amount. The amount of forage offered was adjusted daily on the basis of the previous day's intake during the entire feeding period. Animals were provided with free access to water and weighed at weekly intervals.

Digestibility trial

After 60 days feeding period, a 7-days digestion trial was conducted. Samples of feeds offered and refused were collected daily. Pooled samples were ground and stored for chemical analysis. Total daily (24 h) faeces out-put was recorded and a 20% sub-sample collected and dried in a forced draught oven overnight at 100±5℃ to a constant weight for dry-matter estimation. Representative samples of each daily faecal collection were drawn, pooled for seven days and preserved in diluted (1:4) sulphuric acid for N-estimation. The other samples were retained for further chemical analysis.

Chemical and statistical analysis

The dried samples were analysed for proximate composition (AOAC, 1981) and fibre fractions (Goering and Van Soest, 1970). The *in vitro* DM digestibility (IVDMD) of refusals from different groups was undertaken (Tilley and Terry, 1963) in buffalo rumen liquor to determine the potential feeding value of leftovers. The data analysed according to complete random block design for testing differences between treatments (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

Voluntary intake

The DMI per unit metabolic body weight of Barbari goats increased ($p<0.01$) with the level of feed offered and there was a proportional increase in the amount of refusals (table 1). The refusal rates achieved were also close to the target. The results obtained support the hypothesis that intake of roughages would increase if the amount offered and proportion refused were allowed to be higher than the

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Received April 1, 1999; Accepted June 22, 1999

conventional rate of 15-20% (Wahed et al., 1990; Owen, 1994). The positive effect of selective consumption on voluntary intake could be attributed to large differences in quality between morphological components of the plants (Zemmelink, 1980). The heterogeneity of major plant parts in green maize like leaves, leaf-sheath and stem appear to have offered ample opportunity of selection to goats. The present experiment and the results from some of the recent stall feeding experiments with goats and sheep fed pearl millet stover (Rivera et al., 1994), oat hay (Sharma et al., 1997) *Gliricidia sepium* and *Leucaena leucocephala* (Bosman et al., 1995) and cattle fed finger millet straw (Rao et al., 1994) clearly demonstrate that the amount consumed steadily increase with the increase in amount offered. At 24% refusal rate (T-1) the estimated DMI (g/kg $W^{0.75}$/day) of green maize was 39.86 which increased to 50.91 with 36.22% refusal in T-2, whereas the animals in group T-3 consumed 66.55 with 46.17% residue (table 1). DMI of goats varied considerably from nearly 2.04% of body weight in T-1 to 3.38% in T-3 indicating that optimum amount of feed that should be offered to maximize intake may not be uniform and likely to be influenced by animal and food factors (Badrudeen et al., 1994). In the present study, intake of green maize was still increasing even at the highest offer level (T-3) studied which made an accurate estimation of maximum potential intake impossible. Thus, a wider range of offer level is imperative. to obtain a reliable estimation of the relationship between feed offered and intake.

Table 1. Intake and refusals at graded levels of green maize

Variable	Treatments			SEM
	T1	T2	T3	
Body weight (kg)				
Initial	14.81	14.75	14.75	2.26
Final	15.02	15.05	15.10	2.20
Weight gain	0.21	0.30	0.35	0.05
DM offered (g/kg $W^{0.75}$)	52.95^{c}	84.30^{b}	112.55^{a}	6.53
DMI (g/kg $W^{0.75}$)	39.86^{c}	50.91^{b}	66.55^{a}	1.15
DMI (kg/100 kg LW)	2.04^{c}	2.59^{b}	3.38^{a}	0.05
OMI (g/kg $W^{0.75}$)	36.63^{c}	46.46^{b}	60.20^{a}	0.96
Refusals (%)	24.04^{c}	36.22^{b}	46.17^{a}	0.98

^{a,b,c} Means marked with different superscripts are significantly different ($p<0.01$).

Nutrient utilization

The nutrient digestibility of green maize was significantly ($p<0.05$) affected by the level of feed offered (table 2). Digestibilities of DM, OM, EE, NDF and ADF increased ($p<0.05$) significantly when level of refusal was increased from 24% (T-1) to 36% (T-2) but there after no improvement was evident with further increasing the level of feeding from T-2 to T-3. There was, however, no significant difference in CP digestibility of green maize between the treatments. The nutrient density in terms of TDN was significantly higher ($p<0.05$) in T-3 followed by T-2 and T-1. There was no apparent difference in the values of DCP obtained in different dietary groups.

Table 2. Digestibility and nutrient density of green maize at different levels

Attribute	Treatments			SEM
	T1	T2	T3	
Digestibility (%)				
DM	74.66^{b}	80.60^{a}	80.58^{a}	0.49
OM	76.25^{b}	81.57^{a}	81.32^{a}	0.47
CP	80.08	83.96	82.54	0.52
EE	79.53^{b}	83.65^{a}	85.81^{a}	1.20
NDF	71.25^{b}	79.31^{a}	79.03^{a}	0.59
ADF	66.73^{b}	79.23^{a}	78.88^{a}	2.49
Nutrient density (%)				
DCP	12.40	12.69	12.17	0.30
TDN	73.50^{b}	76.00^{ab}	78.43^{a}	1.34
Nutrient intake (g/kg $W^{0.75}$)				
DCP	4.93^{c}	6.59^{b}	8.11^{a}	0.23
TDN	29.33^{c}	42.36^{b}	50.91^{a}	1.09
DOM	27.49^{c}	46.46^{b}	60.20^{a}	0.90

^{a,b,c} Means marked with different superscripts are significantly different ($p<0.05$).

The increased digestibility of green maize at the higher levels as compared to lower level of refusal may be due to quality difference between the selected material. It was observed that goats preferred leaves, leaf sheath and soft portion of stem of green maize which are more digestible than the hard (lignified) stem portion. Higher offer levels of green maize in group T-2 and T-3 increased the possibility to select the better digestible portion resulting in an increasing digestibility of the DM in the offer range studied. This is evident from the fact that animal left uneaten food with a higher concentration of ADF and lower concentration of CP than that of the food offered (table 3). However, the difference in composition between food offered and leftovers decreased as more food was given in excess due to diminishing selection response. It is understandable if we accept that the constraining factor was the amount of fodder available from which to select the more digestible parts and selection can not be expected to increase linearly beyond a certain maximum limit of the animal. These findings are in confirmity with earlier reports which

demonstrate that an increase in DMI does not depress digestibility when it is associated with selective consumption (Schiere et al., 1990; Wahed et al., 1990; Prabhu et al., 1995).

The TDN and DCP requirement for maintenance of goats is 28.35 g and 2.5 g/kg $W^{0.75}$ respectively (Kearl, 1982). The goats in group T-1 consumed 29.33 g TDN and 4.93 g DCP/kg $W^{0.75}$ per day (table 2) which is sufficient to fulfill the maintenance requirements. However, goats fed at higher level in group T-2 and T-3 showed a TDN and DCP intake of 42.36-50.91 and 6.59-8.11 g/kg $W^{0.75}$ respectively, which would not only meet the maintenance requirement but provide surplus energy and protein for substantial production requirements. These results are in agreement with the observation that high producing animals benefit most from selective consumption (Prabhu et al., 1995; Wahed et al., 1990; Aboud, 1991).

Feeding value of left overs

The goats ingested green maize with a higher concentration of crude protein and cell component and left refusals with a higher concentration of cell wall constituents than that of the food offered (table 3). The variability in diet selectivity between goats under different treatments was pronounced. As the level of food excess increased to T-3, the animals were more selective and the leftover had a higher potential value in terms of increased IVDMD, crude protein and cell contents and decreased cell wall constituents. Similar observations have been recorded in rams fed on pearl-millet stover leaves (Rivera et al., 1994). However, actual consumption and digestibility of nutrients of refused leftovers need to be determined under practical feeding conditions for devising a feasible strategy by using refusals.

Table 3. Proximate and fibre fractions of green maize (offered and left overs) at different levels (% DM)

Attributc	Green maize	Treatments			SEM
		T1	T2	T3	
CP	14.00	9.57[b]	12.09[a]	12.69[a]	0.42
EE	2.00	2.00	2.38	2.25	0.36
Ash	8.15	4.83[b]	6.88[a]	6.10[a]	0.37
ADF	41.16	50.42[a]	46.88[b]	46.06[b]	2.14
NDF	69.35	75.44[a]	74.22[ab]	72.68[b]	1.30
Cell contents	30.65	24.56	25.77	27.32	1.30
IVDMD (%)	-	48.78[b]	52.80[b]	55.86[a]	1.03

[a,b] Means marked with different superscripts are significantly different ($p<0.05$).

The results indicate that intake and nutrient utilization of green maize by goats markedly increased when the animals are allowed to refuse in between 35-50% of the feed offered, instead of the conventional rate. The formulation of a practical feeding strategy based on these findings along with reported by earlier workers (Wahed et al., 1990; Aboud, 1991; Rivera et al., 1994) would however depend on availability of roughages, desired level and type of animal production and efficient use of leftovers. The practical implications of these interactions deserve further research.

ACKNOWLEDGEMENT

We thank the Director of the Institute and Head, Division of Animal Nutrition for providing facilities.

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