

Nutrient utilization and growth performance of goats on pelleted complete diets prepared from gram (*Cicer arietinum*) straw and arhar (*Cajanus cajan*) stalks

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ABSTRACT

Local goats (18) were fed for 120 days in 3 groups i.e. CMF complete mash feed (T₁), GSP gram straw pellets (T₂) and ASP arhar stalk pellets (T₃) having 12% CP and 60% TDN. The daily DMI revealed significant (P < 0.01) differences among treatments. The feed conversion efficiency and ADG was significantly (P < 0.01) better in T₂ and T₃ groups as compared to control. The digestibility coefficients of different nutrients revealed significant (P < 0.01) differences for CP, NFE, EE and were higher in test diets as compared to control. The goats in all the groups were in positive N, Ca and P balance. The rumen liquor profile studied fortnightly revealed significant (P < 0.01) differences for pH and NPN; being higher in test groups. The blood biochemicals studied fortnightly revealed significant (P < 0.01) variations for calcium, total protein and globulin. It was concluded that goats fed on gram straw and arhar stalk based pelleted complete diets performed better in respect of weight gain and can fulfill the requirement of goats growing at 70–75 g per day.

Key words: Arhar stalks, Arhar straw, Goats, Gram straw, Nutrient utilization, Pelleted complete diet

In India, goats are registering a spectacular increase at 4% per annum despite regular slaughter of millions every year (Prasad 2004). Lower livestock productivity in India is mainly due to scarcity of feeds and unbalanced feeding practices. Crop residues and byproducts comprise the main feeds, accounting for 40% of the total consumption of different livestock species. Recent estimates indicated that in India the dry fodder shortage is about 31%, green fodder 23% and concentrate 47% in meeting the nutritional demand of existing livestock strength (Pradhan 2004). Situation becomes worse when droughts occur. To overcome this problem the use of crop residue and agro-industrial by-products assumed importance. In India due to cultivation of commercial crops, huge quantities of different types of crop residue and agro-industrial byproducts are produced every year. These if fed as such may not provide sufficient nutrient even for maintenance, can be utilized after processing which increase their nutritive value. The availability of arhar and gram straw in Maharashtra is 2.7 and 1.5 million tonnes respectively (Rekhate *et al.* 2004). The straw and chunni of these pulses are used for animal feeding. The arhar stalks in addition to feeding are also used for fuel or organic manuring purpose. Its availability is around 5.5 and 2.68 million tonnes in Maharashtra and Vidarbha region, respectively. Therefore

an attempt has been made to utilize arhar stalks and gram straw as roughage source in the pelleted complete diet of goats and to study its feeding effects on growth performance, rumen and blood biochemical profile.

MATERIALS AND METHODS

Experiment was conducted on eighteen local male goats of 4.90 month age for 120 days. The goats were divided into three groups of six in each treatment. The goats in control (T₁) group were fed, arhar, gram and soybean straw (22:22:22) as roughage and in T₂ and T₃ this was replaced

Table 1. Composition of mash and pelleted complete diet

Ingredients	Groups		
	T ₁	T ₂	T ₃
Arhar stalks	—	—	60
Gram straw	22	60	—
Arhar straw	22	—	—
Soybean straw	22	—	—
Jowar grains	7	8	8
Arhar chunni	4	10	8
Cotton seed cake	21	20.5	22
Groundnut cake	2	1.5	2
Mineral mixture**	1	1	1
Common salt **	1	1	1

** Mineral mixture and salt-over and above.

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with gram straw (GS) and *arhar* stalks (AS). Minor adjustment in composition (Table 1) of test diets were done from *jowar* grains, *arhar* chunni, cottonseed cake and groundnut cake. Straw and stalks were pulverized through hammer mill (8 mm sieve size) and mixed in horizontal mixture and complete feed mash of test diets were moistened with water maintaining 30% moisture level and conditioning was done for 30 min. Pellets of experimental diets was having 8 mm diameter were prepared. The parameters like DMI, CPI and weight gain were recorded. The metabolic trial with 7 days collection period was conducted in each animal during the experiment and the samples were preserved in 2% sulphuric acid solution for analysis. After two hours of feeding the rumen liquor was collected at every fortnight by Ryle's stomach tube from each animal and analysed for pH, ammonia nitrogen [NH₃-N] (Conway 1957), total volatile fatty acids [TVFA] (Bernett and Reid 1957), total nitrogen (AOAC 1990), tricarboxylic acid precipitate nitrogen [TCAppt-N] (McKenzie and Wallace 1954) and non protein nitrogen [NPN]. Similarly blood samples were also collected at every fortnight from each animal and serum was analysed for calcium (Trinder 1969), phosphorus (Varley 1980), total protein (Dumas 1971), albumin (Dumas 1971), glucose (Tietz 1979) and globulin. The feed, faeces and urine samples collected were estimated for proximate composition (AOAC 1990) and fibre fraction (Van Soest 1967). The data collected during the study were analyzed statistically as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The diets formulated were isonitrogenous and isocaloric

Table 2. Chemical and fibre composition of complete mash and pelleted feed (% DM basis)

Composition	Groups			Gram straw	<i>Arhar</i> stalk
	T ₁	T ₂	T ₃		
DM	91.78	94.81	91.84	92.20	92.35
OM	92.81	93.35	92.66	91.75	91.75
CP	11.86	11.75	11.92	7.83	7.30
CF	37.52	31.60	32.65	35.10	40.75
EE	2.00	3.78	2.85	2.83	1.17
TA	7.19	6.38	7.34	8.25	8.25
NFE	41.43	46.50	45.25	45.99	42.53
NDF	53.58	56.01	56.47	52.65	51.60
ADF	34.08	36.51	41.03	32.50	36.14
Hemicellulose	19.50	19.49	15.44	20.15	15.46
Cellulose	24.35	29.37	33.85	23.88	21.70
Lignin	5.12	5.45	6.88	7.87	12.37
Silica	0.77	0.71	0.88	0.52	0.70
Ca	1.36	1.98	1.46	0.04	0.68
P	0.72	0.99	0.85	0.17	0.15
TDN*	61.28	62.55	61.01	-	-

* Calculated.

(Table 2) and the nutrients in the diets were as per the standard (Ranjhan 1991). The performance of goats on complete feeds (Table 3) revealed that the DMI under T₁ was significantly ($P < 0.01$) lower than T₂ and T₃, may be due to the pelleting of feed. The observations on dry matter intake are in accordance with Rekhate *et al.* (2004^b) and Raut *et al.* (2002). The ADG was significantly ($P < 0.01$) higher in T₂ than T₁ group and comparable with T₃, and is due to higher content of protein and energy (TDN) in this group as compared to others. The daily dry matter intake in this group was also higher indicating higher palatability of test diets. The ADG observed in present study corroborates with Raut *et al.* (2002) and Rekhate *et al.* (2004) for complete diet of various straws. The better weight gain observed for the treatment group may be due to pelletization of feed. The feed conversion efficiency in test diets was better ($P < 0.01$) than control and is in agreement with Rekhate *et al.* (2005) in goats fed gram straw based pelleted complete rations. The findings of better FCE in test diets is due to better utilization of nutrients in test diets as compared to control. The differences were significant ($P < 0.05$) for the digestibility of CP, EE and NFE among

Table 3. Performance of goats on complete feed

Parameters	Groups			SEM
	T ₁	T ₂	T ₃	
<i>Performance of goats</i>				
Initial BW (kg)	12.35	12.80	12.55	0.13
Final BW (kg)	19.42	21.94	21.32	1.24
ADG** (g)	58.47 ^a	75.98 ^b	72.94 ^b	8.32
DMI** (g/d)	841.50 ^a	957.60 ^b	921.60 ^b	40.30
DMI/kg W ^{0.75} *(g)	90.07 ^a	99.04 ^b	97.98 ^b	6.03
FCE**	14.52 ^b	12.56 ^a	12.64 ^a	2.08
<i>Digestibility of nutrients (%)</i>				
DM	54.29	60.48	56.56	3.30
OM	56.60	63.08	58.46	3.09
CP*	67.08 ^a	78.10 ^b	68.87 ^a	2.40
CF	55.91	62.61	60.28	2.84
EE**	72.52 ^a	82.90 ^b	75.81 ^a	2.61
NFE*	64.11 ^a	77.35 ^b	64.73 ^a	2.51
NDF	60.12	64.58	60.09	3.32
ADF	50.52	57.39	58.73	3.44
Cellulose	53.14	60.97	58.81	3.75
Hemicellulose	54.87	62.89	61.88	4.43
<i>Nitrogen balance (g/d)</i>				
Nitrogen Intake	16.08	17.96	17.58	1.64
Faecal outgo	5.78	5.19	5.49	0.79
Urinary outgo	3.99	3.20	2.56	0.50
Nitrogen Balance	6.31	9.57	9.55	1.45
<i>Calcium balance (g/d)</i>				
	5.03	9.29	7.95	0.19
<i>Phosphorus balance (g/d)</i>				
	2.99	5.36	4.33	0.26
<i>Nutritive value (%)</i>				
DCP*	7.96 ^a	9.18 ^b	8.21 ^{ab}	0.28
TDN*	60.07 ^a	72.76 ^b	62.81 ^a	2.39

Different letters (a, b) in the same line show statistical difference

** ($P < 0.01$), * ($P < 0.05$).

Table 4. Rumen liquor and blood biochemical profile of goats on complete feed

Parameters	Groups			SEM
	T ₁	T ₂	T ₃	
<i>Rumen liquor profile</i>				
pH**	6.41 ^a	6.71 ^b	6.68 ^b	0.06
NH ₃ -N (mg/100 ml SRL)	20.19	19.45	20.14	0.32
TVFA (m Eq/100 ml SRL)	10.41	10.72	10.67	0.42
Total – N (mg/100 ml SRL)	91.68	89.84	88.72	1.23
TCA-ppt-N (mg/100 ml SRL)	47.40	47.04	48.77	0.97
NPN** (mg/100 ml SRL)	44.50 ^b	42.80 ^{ab}	39.95 ^a	1.03
<i>Blood biochemical profile</i>				
Calcium** (mg/dl)	9.13 ^b	9.25 ^b	8.65 ^a	0.26
Phosphorus (mg/dl)	4.50	4.60	4.69	0.08
Total protein** (g/dl)	6.19 ^a	6.96 ^b	6.83 ^b	0.11
Albumin (g/dl)	3.83	3.88	3.84	0.03
Globulin** (g/dl)	2.36 ^a	3.08 ^b	2.98 ^b	0.13
Glucose (mg/dl)	54.31	54.99	54.55	0.22

Different letters (a, b) in the same line show statistical difference ** (P < 0.01).

treatments. Higher digestibility of CP, EE and NFE in test diets is due to high energy ration coupled with increased nitrogen retention indicating that the protein component could be efficiently utilized, as supported by Sridhar *et al.* (1996). The findings corroborates with the findings of Raut *et al.* (2002) and Rekhate *et al.* (2004^a) for dry matter digestibility in arhar based diet and Rekhate *et al.* (2005) for gram straw based diet. The goats under all the treatments were in positive nitrogen, calcium and phosphorus balance. The N balance found in present study is in accordance with the results of Rekhate *et al.* (2004^a) and Rekhate *et al.* (2005).

The DCP and TDN contents of test diets were higher as compared to control and is due to higher digestibility of nutrients. These values for DCP are in agreement to those reported by Raut *et al.* (2002) and lower for DCP and higher for TDN than those reported by Rekhate *et al.* (2004^a).

The rumen liquor and blood biochemical profile (Table 4) studied fortnightly revealed significant (P < 0.01) differences among treatments for pH; NPN and calcium; total protein and globulin. The values for rumen liquor pH are comparable with Rekhate *et al.* (2004^b) in goats fed various straw based pelleted complete feeds and Dhuria *et al.* (2005). However, the values for pH in different treatments were in normal physiological range as 6.2 to 7.2 reported by Radostitis *et al.* (2003) for ruminants. There were no difference among treatments for the values of TVFA, ammonia nitrogen and TCA-ppt-nitrogen in rumen liquor and the values are in agreement to those reported by Singhal and Mudgal (1983), Rekhate *et al.* (2004^a) and Rekhate *et al.* (2005). In blood biochemical profile the significant (P < 0.05) differences were observed for the values of calcium, total protein and globulin. The calcium and

phosphorus were within the normal range reported by Behera *et al.* (1993) in Black Bengal goats. The total protein is in accordance with Parwe *et al.* (1990). From this study it is concluded that goats performed better on gram straw and arhar stalks in terms of higher ADG and better FCE when used in complete pelleted diet as compared to control, hence can be used as roughage sources for goat in pelleted complete ration.

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