



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.03

TPI 2018; 7(3): 295-299

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www.thepharmajournal.com

Received: 16-01-2018

Accepted: 17-02-2018

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## Effect of horse gram meal on nutrient digestibility and growth performance in deccani ram lambs

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### Abstract

A growth cum metabolism study of 90 days duration was conducted to know the effect of Horse gram tannins on nutrient utilization, growth performance in Deccani ram lambs. For the study 12 Deccani ram lambs of uniform body weight ( $16.5 \pm 0.64$  kg) were randomly allotted to 2 treatments in a completely randomized design and metabolic studies conducted to determine the digestibility of nutrients. The nutrient digestibilities increased ( $P < 0.05$ ) with horse gram meal inclusion. Higher ( $P < 0.05$ ) Nitrogen, Ca and P balance was observed with horse gram meal inclusion. The increase in the digestibilities of various nutrients reflected in the growth performance of Deccani ram lambs as reflected by higher live weight ( $P < 0.05$ ), average daily gain ( $P < 0.05$ ). Feed efficiency of the animals improved as the feed conversion ratio (kg feed/kg gain) ( $P < 0.01$ ), cost of feed/kg gain ( $P < 0.01$ ) increased. It may be concluded that inclusion of tanniferous protein source increased nutrient digestibilities which reflected in growth performance, feed efficiency and results in reduced cost of production.

**Keywords:** Tannins, Horse gram, nutrients digestibility, growth performance

### 1. Introduction

Small ruminants contribute enormously towards promotion of livelihoods security and as an insurance cover (Pasha, 2000) <sup>[1]</sup>, (Misra, 2005) <sup>[2]</sup> to cope with crop failures in the semi-arid, arid and mountainous regions. The small ruminants are favored because of low investments, easy to raise and manage, low feed requirement compared to cattle, ability to thrive on different flora, high disease resistance, and superior market potential. Further, dwindling grazing resources, quantitative and qualitative shortage of feed and fodder resources, disease epidemics and frequent droughts are the major constraints for sustaining a positive growth in the small ruminant sector, especially during dry season (Rao and Ramana 2009) <sup>[3]</sup>. These grazing materials (natural pasture) and fibrous crop residues are low in nitrogen and high in fiber content. However, tannins have been recognized to modulate rumen fermentation favourably such as reducing protein degradation in the rumen, prevention of bloat, inhibition of methanogenesis and increasing conjugated linoleic acid concentrations in ruminant-derived foods. The inclusion of tannins in diets has been shown to improve body weight and wool growth and reproductive performance (Patra *et al.*, 2011) <sup>[4]</sup>. In view of the above, the present study is aimed at effect of Horse gram tannins on nutrient utilization, growth performance in Deccani ram lambs

### 2. Materials and Methods

#### 2.1 Animal, experimental design and management

Twelve growing Deccani ram lambs aged  $130 \pm 3.0$  d with average body weight of  $16.5 \pm 0.64$  kg were selected for conducting a growth trial for a period of 90 days at Central Research Institute for Dry land Agriculture (CRIDA) Livestock farm, Hyderabad. These animals were randomly divided in to two groups of six animals in each in a completely randomized design.

All the experimental animals were housed in a well-ventilated animal shed with the provision for feeding and watering. The lambs were weighed individually at fortnight intervals before feeding and watering to observe the body weight changes for an experimental period of 90 days. After 60 days of growth trial, a seven days metabolic trial was carried out on lambs to study the digestibility of nutrients in experimental diets.

#### 2.2 Experimental diets

The dietary treatments were *viz.*, G I: Basal diet (chopped sorghum stover as roughage source) (BD) + group 1 concentrate+ chopped green fodder (4kg), G II: Basal diet + Group 2

concentrate (horse gram as tannin source selected from *in vitro* studies+ chopped green fodder (4kg). Deccani ram lambs were fed the respective diets *ad lib.* to meet the nutrient

requirements (NRC, 2001) throughout 90 days of feeding trial. The ingredient and chemical composition of the experimental feeds is summarized in Table 1 & 2.

**Table 1:** Chemical composition of experimental feeds (%DM) offered to Deccani ram lambs

Nutrient	Basal diet		Concentrate mixture	
	Green fodder (HN-CO4)	Dry fodder (Sorghum straw)	Group 1 (control)	Group 2 (Horse gram inclusion)
<b>Proximate principles</b>				
Dry matter	20.38	98.59	98.03	98.35
Organic matter	87.22	92.29	91.05	91.72
Crude protein	11.75	3.02	17.96	17.94
Crude fibre	35.86	40.45	14.96	14.94
Ether extract	2.64	2.49	6.34	6.63
NFE	36.97	46.34	49.61	48.93
Total ash	12.78	7.71	8.95	8.28
<b>Cell wall constituents</b>				
NDF	71.34	83.27	48.12	58.29
ADF	41.58	52.34	19.44	19.96
Hemicellulose	29.76	30.93	28.67	38.33
Cellulose	33.78	42.93	11.71	14.4
<b>Anti-nutritional compounds</b>				
Total Phenolic compounds	-	-	0.21	0.48
Condensed Tannins	-	-	0.09	0.14
<b>Minerals</b>				
Ca	0.40	0.34	1.12	1.18
P	0.16	0.24	0.82	0.78

**Table 2:** Ingredient composition of concentrate mixtures (parts per 100) offered to Deccani ram lambs

Ingredients	Group 1 (control)	Group 2 (Horse gram inclusion)
Maize	40	40
Rice bran	32	29
Soya meal	25	00
Horse gram meal	00	28
Mineral mixture	02	02
Common Salt	01	01

**2.3 Statistical analysis**

The results obtained were subjected to analysis through software (version 17.0: SPSS,2005) by applying one-way

analysis of variance through generalized linear model and the treatment means were ranked using Duncan’s multiple range test (Duncan, 1955) [5] with a test of significance at P<0.05.. All the statistical procedures were done as per Snedecor and Cochran (1980) [6].

**3. Results and Discussion**

**3.1 Nutrient intake and digestibilities**

Horse gram meal inclusion had no effect on Dry matter intakes (DMI) and Organic matter intake (OMI) in ram lambs (Table 3). This indicated that relatively low level of condensed tannins (CT) in experimental concentrate mixtures had no effect on intake. These findings are in agreement with earlier observations of Pathak *et al.*, 2013 [7].

**Table 3:** Effect on Intake and digestibilities of DM, OM and NDF of experimental rations fed to Deccani ram lambs.

Indicators	Group 1	Group 2	SEM	P
<b>Intake</b>				
DMI kg/day	1.049 ± 0.01	0.996 ± 0.03	0.01	0.01
DMI % LW	4.80 ± 0.32	4.63 ± 0.36	0.01	0.01
OMI kg/day	0.961 ± 0.01	0.908 ± 0.02	0.01	0.02
<b>Apparent digestibilities</b>				
DM %	64.32 <sup>b</sup> ± 0.08	70.48 <sup>a</sup> ± 1.19	0.93	0.01
OM %	67.95 <sup>b</sup> ± 0.67	73.2 <sup>a</sup> ± 1.07	0.81	0.02
CP %	66.94 <sup>b</sup> ± 0.68	73.25 <sup>a</sup> ± 0.98	0.93	0.05
NDF %	68.19 <sup>b</sup> ± 0.71	73.4 <sup>a</sup> ± 1.16	0.84	0.001

Horse gram meal inclusion had increased digestibilities of DM (P<0.01), OM (P<0.02), CP (P<0.01) and NDF (P<0.01) in ram lambs. Increased nutrient digestibilities due to horse gram inclusion could be due to escape of more liable proteins from degradation in the and consequently complete digestion in lower part of the digestive tract rumen (Mangan, 1988) [8]. Tannins present in the feed decreases ruminal protein degradation and increases duodenal protein flow when provided at moderate doses (Min *et al.*, 2003) [9]. The results are in accordance with the findings of Hart *et al.* (2011) [10] who reported increased DM and OM (P<0.01) digestibility in lambs fed on low-tannin diets. Similarly

Barros-Rodríguez *et al* (2014) [11] reported increased nutrient digestibility in sheep. Beauchemin *et al.* (2007) [12] also reported increased CP digestibility in cattle supplemented with 1 and 2% Quebracho CT extract. Likewise increase in NDF digestibility is supported by Bengaly *et al.* (2007) [13] with tannins supplementation in Nguni and Boer goats. Rajei Sharifabadi *et al.* (2014) [14] reported no effect on DM, OM digestability in lambs with inclusion of pistachio by-products aqua extract (PBE) as a source of tannin. Similar results were also reported by Pathak *et al.*, (2013) [7], Dentinho *et al.* (2014) [15] and Avijit Dey A *et al.* (2014) [16].

### 3.2 Nitrogen, Ca and P Balance

All the experimental ram lambs were on positive nitrogen balance. Significantly lower ( $P < 0.001$ ) faecal nitrogen loss and higher ( $P < 0.01$ ) N balance were observed with Horse gram inclusion than control (Table 04). This an indicator of availability of amino acid-N at tissue level in animals was apparently due to better amino acid availability by increasing non-ammonia nitrogen (NAN) flux to the small intestine and apparent biological value of CT protected diets. Similar result reported by Dey *et al.* (2008) [17] who observed that lambs fed

with *Ficus infectoria* leaves as source of condensed tannins (CT) @ 1.5 and 2.0% significantly improved N utilization. Likewise Hart *et al.*, 2011 [10] reported Mean N digestibility was increased ( $P < 0.05$ ) and N excretion was significantly decreased with Quebracho Condensed Tannins (QCT) in Moghani sheep. Contrary to this Theodoridou *et al.* (2012) [19] reported had no effect of CT on body N retention and Pathak *et al.* (2013) [7] reported lower Nitrogen (N) retention with supplementation of CT.

**Table 4:** Nitrogen, Calcium and Phosphorus balance (g/day) in Deccani ram lambs as affected by feeding experimental rations

Ration	Average daily N intake		Total N intake	Outgo		Total outgo	Balance
	Fodder (green + dry)	Conc.		Faeces	Urine		
<b>Nitrogen Balance</b>							
G 1	10.46±0.09	8.48±0.00	18.94±0.09	8.78±0.11a	2.69±0.13	11.47±0.07	7.47±0.09b
G 2	10.63±0.22	8.48±0.00	19.11±0.22	7.70±0.17 b	2.86±0.30	10.56±0.45	8.56±0.51a
<b>Calcium Balance</b>							
G 1	3.68±0.03	3.29±0.00	6.98±0.03	1.97±0.16	1.41±0.11	3.38±0.15a	3.59±0.15b
G 2	3.53±0.07	3.48±0.00	7.01±0.07	1.75±0.07	1.03±0.20	2.78±0.17b	4.23±0.16a
<b>Phosphorus Balance</b>							
G 1	1.58±0.02	2.41±0.00	3.99±0.02a	1.34±0.04a	0.98±0.05	2.32±0.07a	1.67±0.08b
G 2	1.47±0.05	2.30±0.00	3.77±0.02b	1.06±0.04b	0.74±0.19	1.80±0.20b	1.98±0.16a

Means with different superscripts in a column differ significantly ( $P < 0.01$ )

Higher Ca balance ( $P < 0.05$ ), and lower Ca excretion lower ( $P < 0.05$ ) were observed with Horse gram tannins inclusion. Similarly lower faecal P excretion ( $P < 0.001$ ), total P excretion decreased ( $P < 0.05$ ) and P balance ( $P < 0.01$ ) increased with Horse gram tannins inclusion. Higher level of Ca and P balance with horse gram diet was an indication that low to moderate level of tannin had no adverse effect, rather positive influence on animals' productive performance (Paswan *et al.*, 2012) [20].

### 3.3 Plane of nutrition

Higher DCP and TDN in ration ( $P < 0.05$ ), and TDN intake ( $P < 0.05$ ) was observed with horse gram inclusion due to increase in nutrient digestibilities (Table 05). Plane of nutrition was not affected with CT supplementation (Dey *et al.* 2008) [17]; Dubey, 2010 indicating no adverse effect of dietary inclusion of CT below 5% level on nutrient intake and utilization.

**Table 5:** Plane of nutrition of Deccani ram lambs as affected by experimental rations

Parameter	Experimental groups		ICAR (1998)
	Group 1	Group 2	
Body weight (kg)	22.32±1.48	22.14±1.71	25.0
Dry matter intake/day (kg)	1.05±0.01	1.00±0.03	0.68
Dry mater intake/100 kg b.wt	4.80±0.32	4.63±0.36	2.7
DCP in ration (%) **	7.3 <sup>b</sup> ±0.08	8.1 <sup>a</sup> ±0.11	-
DCP intake (g)	77.0±1.32	80.5±2.08	33
TDN in ration (%) **	64.1 <sup>b</sup> ±0.78	71.4 <sup>a</sup> ±1.05	-
TDN intake (kg)*	0.67 <sup>b</sup> ±0.01	0.71 <sup>a</sup> ±0.02	0.31
DE intake (M.cal)	3.0±0.06	3.1±0.09	-
ME intake (M.cal)*	2.4 <sup>b</sup> ±0.04	2.5 <sup>a</sup> ±0.07	1.10

DCP: Digestible crude protein; TDN: Total digestible nutrients; DE: Digestible energy; ME: metabolizable energy;

### 3.4 Body weight changes and growth performance

Horse gram tannin inclusion in the diets of deccani ram lambs significantly increased live weight ( $P < 0.05$ ), average daily gain ( $P < 0.05$ ) and feed conversion ratio (kg feed/kg gain)

( $P < 0.01$ ) are the reflections of nutrient utilization. The cost of feed/kg gain (Rs.) was decreased by Rs 42.65 when compared to control (Table 06).

**Table 6:** Average daily gain (g), DMI and cost (Rs.) of feed per kg weight gain in Deccani ram lambs as affected by feeding experimental rations

Group	Initial weight (kg)	Final weight (kg)	Live weight gain (kg)	Average daily gain (g)	DMI/kg weight gain (kg)	Cost of feed per kg gain (Rs)
G1	16.3 ± 1.36	22.73 ± 1.32	6.43 <sup>b</sup> ± 0.41	71.44 <sup>b</sup> ± 4.57	14.68 <sup>a</sup> ± 0.88	130.05 <sup>a</sup> ± 7.55
G2	16.68 ± 0.90	24.29 ± 0.92	7.61 <sup>a</sup> ± 0.25	84.56 <sup>a</sup> ± 2.75	11.78 <sup>b</sup> ± 0.46	87.40 <sup>b</sup> ± 2.96
SEM	0.64	0.65	0.20	2.28	0.47	5.47
p	0.97	0.60	0.02	0.02	0.00	0.00

Means with the different superscripts along the row are significantly different; SEM, standard error of the mean

Increase in body weight changes and growth performance with horse gram tannin inclusion could be due to supplying of protein to the lower gut and subsequently its more efficient use for tissue growth and improved feed efficiency. Goats fed with low condensed tannin concentration gained more body weight compared to browses with high condensed tannin concentration (Makkar 2003) [22]. Similar results also reported by Piyusha *et al.*, (2013) [23], Rajei Sharifabadi *et al.* (2014) [24], Raju *et al.* (2015) [25] and Rivera-Méndez *et al.* (2017) [26]. Contrary to this no effect on animal performance was reported in crossbred steers with supplementation of Mimosa and chestnut tannins to high-grain diet (Krueger *et al.*, 2010) [27], reduced growth rate in ruminants supplemented with exceeding 60 mg/g DM CT concentrations (Huang *et al.*, 2010) [28].

#### 4. Conclusions

Based on the results of the present study, it may be concluded that, horse gram inclusion resulted in increased nutrient digestibilities, which was reflected in growth performance and feed efficiency. The study also revealed horse gram inclusion could reduce the cost of production, leading to economic benefit to the farmers in Indian conditions where sheep are primarily raised on grazing of poor quality roughages.

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