



Impact of Feeding *Prosopis juliflora* Pods and *Citrullus lanatus* Seed Cake on Nitrogen and Mineral Metabolism in Goats

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Abstract

An experiment was conducted to study the impact of feeding mesquite *Prosopis juliflora* pods and *Citrullus lanatus* seed cake on nitrogen and mineral metabolism in sixteen goats. Four iso-nitrogenous and iso-caloric complete feed designated as, T1, T2, T3 and T4 were prepared, in which T1 served as control having all the conventional ingredients. Whereas, mesquite pods in T2 and *Citrullus lanatus* seed cake in T3 were included alone and in combination in T4, in lieu of barley and cotton seed cake of control, respectively. The results revealed positive nitrogen and mineral metabolism in T2, T3 and T4 group compared to T1 group. The data did not reveal any significant effect of treatment on calcium balance but showed highly significant effect on nitrogen and phosphorus balance. It can be concluded that both the mesquite pods and *Citrullus lanatus* seed cake could be safely and effectively incorporated alone or in combination in the complete feed of goats.

Keywords: *Citrullus lanatus*, Marwari goat, Mesquite *Prosopis juliflora* pods, Metabolism

Introduction

The deficit of conventional feed resources for animal feeding deflected majority of research in the field of livestock nutrition to look into feasibilities to overcome the nutritional crisis. The most viable proposition could be the incorporation of new non-conventional feed resources *viz.* *Prosopis juliflora* (PJ) pods, *Citrullus lanatus* (CL) seed cake, karanj cake and tapioca cake, etc. in ration with suitable modification in complete feed technology (Chharang *et al.*, 2019). *Prosopis juliflora* is an evergreen tree or shrub scattered in the arid part of tropical and subtropical areas. The ripen highly palatable pods produced as fruit, are moderate in crude protein (12.16%), ether extract (3.48%) calcium (0.51%) and phosphorus (0.19%) and rich in free sugar (22.78%) giving sweet taste to it; making potentially usable for the feeding of animals (Chharang *et al.*, 2020b). Similarly, *Citrullus lanatus* (watermelon) is also a naturally grown xerophyte found in plenty in hot arid and semi-arid regions. The seeds acquired from this plant are gaining commercial attention due to its high oil contents and cake is obtained as a by-product (Chharang *et al.*, 2020a). After extraction of oil from seeds, enormous edible biomass is available for the feeding of livestock having about 23.95% CP, 37.60% CF, 8.46% EE, 0.34% calcium and 0.78% phosphorus (Chharang *et al.*, 2020b). The balances of nitrogen and minerals could be considered as the indices of growth, health and overall wellbeing of the animal. Therefore, the objective of the present study was to assess the impacts of inclusion of mesquite PJ pods and *Citrullus lanatus* seed cake in complete feed on nitrogen and mineral metabolism in kids of Marwari goat.

Materials and Methods

Experimental Design, Animals and Diets

Sixteen kids of Marwari goat of 7-8 months age and of even conformation were distributed by completely randomized block design into four groups of four kids in each. Four iso-nitrogenous and iso-caloric complete rations were prepared on dry matter basis (Table 1) and designated as T₁, T₂, T₃ and T₄. In T₁ (control) barley and cotton seed cake were incorporated in complete feed as conventional energy and protein sources.

Table 1: Chemical composition of complete feeds and different feed ingredients (per cent dry matter basis)

Feeds/ ingredients	DM	OM	CP	EE	CF	NFE	Ash	Ca	P
Complete feeds									
T ₁	91.84	90.88	13.94	2.81	22.19	52	9.06	1.15	0.44
T ₂	92.48	90.28	14.05	3.16	25.85	47.28	9.66	1.22	0.41
T ₃	91.64	90.96	13.62	3.15	24.75	49.5	8.98	1.15	0.37
T ₄	92.28	90.36	13.73	3.5	28.41	44.78	9.58	1.22	0.34
Feed ingredients									
Sewan	91.81	92.49	4.62	1.78	32.82	53.07	7.51	1.27	0.05
Barley	88.7	95.79	11.62	1.75	4.51	77.91	4.21	0.16	0.33
Mesquite PJ pods	91.88	92.78	12.16	3.48	22.78	54.36	7.22	0.51	0.19
Cottonseed cake	92.18	90.37	25.74	6.56	23.39	34.68	9.63	0.31	1.18
CL seed cake	91.07	90.84	23.95	8.46	37.6	20.83	9.16	0.34	0.78
Guar korma	96.66	91.98	45.83	3.92	7.67	35.51	8.02	1.27	0.16
Min. mixture	96.78	-	-	-	-	-	96.78	29.6	12.35
Common salt	96.23	-	-	-	-	-	96.23	-	-

DM-Dry matter, OM-Organic matter, CP-Crude protein, EE-Ether extract, CF-Crude fiber, NFE-Nitrogen free extract, PJ-*Prosopis juliflora*, CL-*Citrullus lanatus*

Whereas, in T₂ the barley of control was replaced by non-conventional mesquite PJ pods, in T₃ cotton seed cake of control was replaced by non-conventional *Citrullus lanatus* seed cake and in T₄ both mesquite PJ pods and *Citrullus lanatus* seed cake were incorporated by replacing barley and cotton seed cake, respectively (Table 2).

Table 2: Composition of complete ration

Ingredients	T ₁	T ₂	T ₃	T ₄
Sewan grass	50	50	50	50
Barley	20	-	20	-
Mesquite PJ pods	-	20	-	20
Cottonseed cake	18	18	-	-
CL seed cake	-	-	18	18
Guar korma	10	10	10	10
Mineral Mix	1	1	1	1
Salt	1	1	1	1

PJ-*Prosopis juliflora*, CL-*Citrullus lanatus*

Metabolic Trial

All the kids were subjected to feeding trial of 105 days, followed by metabolic trial of seven days for the estimation of nitrogen and mineral balance. The feed and faeces, collected in 24 hrs, were weighed and mixed uniformly. A representative sample of feed and faeces voided by each animal were taken for determination of dry matter (Sharma, 2001). Similarly, urine collected for 24 hours of each animal, in urine bags was measured by the measuring cylinder. A representative sample of 10 per cent of total urine voided was transferred in a clean bottle so that a thin layer of toluene may be formed above urine collection, samples were used for the analysis of nitrogen, calcium and phosphorus.

Statistical Methods

Different statistical attributes were analyzed using the conventional statistical procedure. The significance of mean differences was tested by Duncan's New Multiple Range Test (Steel *et al.*, 1997).

Results and Discussion

The balances expressed as g per day for nitrogen, calcium and phosphorus were estimated from the total dietary intake, faecal, urinary and total outgo in all the groups i.e., T₁, T₂, T₃ and T₄. The overall mean nitrogen retention values for T₁, T₂, T₃ and T₄ groups are presented in Table 3, Fig 1. All the kids under different dietary regimes revealed positive nitrogen balance. The results showed highly significant ($P < 0.01$) effect of replacement of cotton seed cake by *Citrullus lanatus* seed cake alone or in combination with replacement of barley by mesquite *Prosopis juliflora* (PJ) pods in T₃ and T₄ and non-significant effect of replacement of barley by mesquite PJ pods alone in T₂ as compared to control i.e., T₁. The significant ($P < 0.05$) effect of replacement of cotton seed cake by *Citrullus lanatus* seed cake alone was observed in the data of nitrogen outgo in faeces in T₃, whereas no effect was recorded in terms of dietary intake, urinary and total excretion of nitrogen in any of the groups. In another study, Jacob *et al.* (2014) revealed that the dietary intake and faecal outgo of nitrogen were not significantly different ($P > 0.05$) among various groups, whereas the urinary nitrogen excretion was significantly ($P < 0.001$) higher in treatment groups of cross-bred calves fed deoiled mahua (*Bassia latifolia*) seed cake. The non-significant effect of replacement of barley by mesquite PJ pods in T₂ is in concurrence with the findings of Sharma (1997), Talpada *et al.* (2002), Abdullah and Hafes (2004), Obeidat *et al.* (2008), Chaturvedi and Sahoo (2013) but do not corresponds well with the observations of Freeman *et al.* (2009), Kipchirchir *et al.* (2014), who observed significantly higher retention of nitrogen in goats. However, the drop in nitrogen balance in T₃ and T₄ in comparison to T₁ could be very well supported by the report of Swami (1995) recorded decrease in nitrogen retention with replacement of cotton seed cake by *Citrullus lanatus* seed cake. The findings of present investigation also get support from the work of Sharma (2001), who recorded slightly higher nitrogen balance in various groups on feeding *Citrullus lanatus* seed cake containing complete feed to goats.

The metabolism of minerals considering calcium and phosphorus often taken simultaneously were calculated with reference to intake in feed and outgo in faeces and urine. The mean \pm SE values of calcium and phosphorus retention for T₁, T₂, T₃ and T₄ groups are depicted in Table 3, Fig. 1. All the animals of four groups were found to be positive for calcium and phosphorus balance. The results of different groups indicated non-significant effect of treatment on

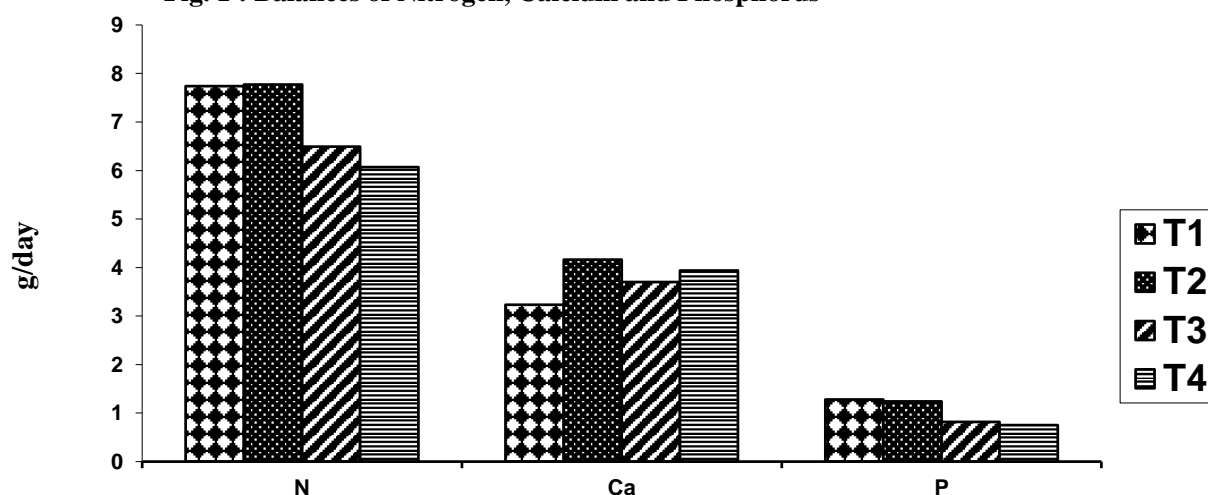
dietary intake, faecal, urinary and total excretion and balance of calcium.

Table 3: Nitrogen, calcium and phosphorus metabolism in goat supplemented with *Prosopis juliflora* pods and *Citrullus lanatus* seed cake

Attributes	T ₁	T ₂	T ₃	T ₄	P-value
Nitrogen (g/day)					
Intake	14.04 ± 0.30	13.98 ± 0.14	13.74 ± 0.29	13.45 ± 0.36	
Voided in faeces	3.85 ^{ab} ± 0.06	3.76 ^a ± 0.17	4.42 ^c ± 0.22	4.36 ^b ± 0.18	
Excreted in urine	2.45 ± 0.54	2.45 ± 0.35	2.84 ± 0.43	3.03 ± 0.50	
Total excretion	6.51 ± 0.48	6.21 ± 0.27	7.26 ± 0.50	7.38 ± 0.41	
Balance	7.74 ^b ± 0.20	7.77 ^b ± 0.28	6.49 ^a ± 0.23	6.07 ^a ± 0.20	0.01
Calcium (g/day)					
Intake	7.21 ± 0.16	7.55 ± 0.07	7.25 ± 0.15	7.47 ± 0.20	
Voided in faeces	3.67 ± 0.32	3.09 ± 0.35	3.27 ± 0.56	3.23 ± 0.27	
Excreted in urine	0.31 ± 0.06	0.30 ± 0.10	0.29 ± 0.03	0.31 ± 0.04	
Total excretion	3.98 ± 0.35	3.39 ± 0.44	3.56 ± 0.59	3.54 ± 0.26	
Balance	3.23 ± 0.33	4.16 ± 0.41	3.70 ± 0.47	3.94 ± 0.24	0.52
Phosphorus (g/day)					
Intake	2.79 ^d ± 0.06	2.58 ^c ± 0.03	2.33 ^b ± 0.05	2.10 ^a ± 0.06	
Voided in faeces	1.20 ^{ab} ± 0.12	0.98 ^a ± 0.04	1.24 ^b ± 0.07	1.04 ^{ab} ± 0.04	
Excreted in urine	0.30 ± 0.04	0.36 ± 0.02	0.28 ± 0.04	0.31 ± 0.02	
Total excretion	1.50 ± 0.12	1.33 ± 0.03	1.52 ± 0.06	1.35 ± 0.05	
Balance	1.28 ^b ± 0.06	1.24 ^b ± 0.04	0.82 ^a ± 0.04	0.75 ^a ± 0.06	0.004

Means superscripted with a different letter within a row differ significantly from each other

Fig. 1 : Balances of Nitrogen, Calcium and Phosphorus



Highly significant ($P < 0.01$) effect on intake and balance of phosphorus and significant ($P < 0.05$) effect on faecal excretion were also recorded during the study, whereas no differences were observed on urinary and total excretion of phosphorus. Further the phosphorus balance revealed significantly lower retention of phosphorus in animals of T₃ and T₄ groups in comparison to T₁ and T₂. Whereas, significant difference was observed between T₁ and T₂ as well as T₃ and T₄. The significantly lower retention of phosphorus in animals of T₃ and T₄ groups could be attributed to the lower contents of phosphorus in non-conventional *Citrullus lanatus* seed cake replacing comparatively high phosphorus containing cotton seed cake and this is in concurrence with the finding of Sharma (2001) who recorded non-significant decrease in phosphorus balance on complete replacement of groundnut cake by *Citrullus lanatus*

seed cake in complete feeds of goats and Swami (1995) recorded similar trend on replacement of cotton seed cake by *Citrullus lanatus* seed cake in concentrate in calves.

Sharma (1997), Jacob *et al.* (2014), and Singh *et al.* (2016) noticed no effect on balance of calcium and phosphorus in sheep, cross-bred calves and cows on inclusion of *Prosopis juliflora* pods, deoiled mahua seed cake and seaweed, respectively. The findings also get support from the work of Shukla *et al.* (1986) and Talpada *et al.* (2002), who recorded positive calcium and phosphorus balance on feeding mesquite pods up to 30 per cent level but, the result of present investigation do not correspond well with the results of Gujrathi *et al.* (1982) and Talpada and Shukla (1988) who found a marginal negative balance of phosphorus on inclusion of mesquite PJ pods at 30 and 45 % levels, respectively. The values of calcium balance recorded in present investigation on feeding complete feed to kids in various groups are in accordance to the values recorded by Pareek (1995) and Swarnkar (1997) on feeding neem leaves based and groundnut shells based complete feed to goats and sheep, respectively. However, values of phosphorus recorded in this study were lower than that of Swarnkar (1997).

Conclusion

The results revealed that the inclusion of *Prosopis juliflora* pods and *Citrullus lanatus* seed cake as non-conventional feed resources in complete feed of Marwari goats were found to have positive effect on nitrogen and mineral metabolism. Statistically, the data could not exhibit any significant effect of treatment on calcium balance but revealed highly significant effect of treatment on nitrogen and phosphorus balance.

Conflict of Interests

There is no conflict of interest.

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