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Effect of Replacement of Conventional Feeds by *Prosopis juliflora* Pods and *Citrullus lanatus* Seed Cake on Nutrient Utilization in Marwari Goats

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ABSTRACT

A study was organized to evaluate the effect of replacement of barley and cottonseed cake by mesquite *Prosopis juliflora* pods (PJP) and watermelon seed (WMS) cake, respectively in complete feed with sixteen Marwari buckling goats. They were divided into four groups of four animals in each. Four complete feed designated as T_1, T_2, T_3 and T_4 were prepared. T_1 served as control having all the conventional ingredients whereas barley of control was replaced by mesquite PJP in T_2, cottonseed cake was replaced by WMS *(Citrullus lanatus)* cake in T_3 and both barley and cottonseed cake were replaced by mesquite PJP and WMS cake in T_4, respectively. The DM intakes, digestibility of DM and gross nutrients, digestible nutrient intake, feed efficiency, were worked out for all the groups. Significant effects of treatment on DM intake, digestibility of CP were observed whereas effects on digestibility of DM, EE, CF and NFE were non-significant. It is concluded that both barley and cottonseed cake could be safely and effectively replaced by the mesquite PJP and WMS cake alone or in combination in the complete feed of goats.

HIGHLIGHTS

- Evaluation of effect of replacement of conventional feeds by nonconventional feeds.
- To study the effect on nutrient utilization in goats.
- Effectively replaced the barley and cottonseed cake by mesquite PJP and WMS cake.

Keywords: Digestibility, mesquite *Prosopis juliflora* pods, watermelon seed cake

Chronic feed shortage exhibit a major constraint to animal production in developing and underdeveloped countries due to the increasing human and livestock population and their activities continue to impose tremendous pressure on available feed resources. It has deflected most of the research in the field of animal nutrition to look into all prospects to conquer this nutritional crisis. The most viable proposition could be the inclusion of new non-conventional feed resources *viz.* tapioca waste, PJP, WMS cake and karanj cake, etc. in ration with suitable complete feed technology (Chharang *et al*., 2019).

Prosopis juliflora is a very variable, evergreen tree or shrub distributed in the arid part of tropical and subtropical regions. The ripen highly palatable pods produced as fruit, are moderate in crude protein (12.58%) and rich in free sugar (19.51%) giving sweet taste to it; making potentially usable for the feeding of livestock (Hintsa *et al.,* 2015). Similarly, watermelon (*Citrullus lanatus*) is also a naturally grown xerophyte found in abundance in hot arid and semi-arid areas. The seeds obtained from this plant are gaining

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

Feed ingredients	DM	OM	CP	EE	CF	NFE	Ash	Ca	P
Complete feeds									
T_1	91.84	90.88	13.94	2.81	22.19	52.00	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	49.50	8.98	1.15	0.37
T_4	92.28	90.36	13.73	3.50	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	88.70	95.79	11.62	1.75	4.51	77.91	4.21	0.16	0.33
Mesquite PJP	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
WMS cake	91.07	90.84	23.95	8.46	37.60	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	29.60	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, PJP-Prosopis juliflora pod, WMS-watermelon seed.

commercial importance due to its high oil contents and cake is obtained as a by-product (Chharang *et al*., 2005). After extraction of oil from seeds, huge edible biomass is available for the feeding of animals having about 25.4% CP, 27.4% CF and 7.84% EE (Mustafa and Alamin, 2012).

The aim of the current study was to evaluate the effects of incorporation of mesquite PJP and WMS cake in complete feed on nutrient utilization of goats.

MATERIALS AND METHODS

Experimental design, animals and diets

Sixteen Marwari buckling goats of 7-8 months age were taken and divided into four groups of four animals in each using a completely randomized block design. Four iso-nitrogenous and nearly iso-caloric complete rations were formulated on DM basis and designated as T_1, T_2, T_3 and T_4 as shown in Table 1. In T_1 (control) barley and cottonseed cake were incorporated in the complete feed as conventional energy and protein sources. Whereas in T_2 the barley of control was replaced by non-conventional mesquite PJP, in T_3 cottonseed cake of control was replaced by non-conventional WMS cake and in T_4 both barley and cottonseed cake were replaced by mesquite PJP and WMS cake (Table 2).

Table 2: Parts composition of complete rations

Sl. No.	Ingredients	T_1	T_2	T_3	T_4
1	Sewan grass	50	50	50	50
2	Barley	20	—	20	—
3	Mesquite PJP	—	20	—	20
4	Cottonseed cake	18	18	—	—
5	WMS cake	—	—	18	18
6	Guar korma	10	10	10	10
7	Mineral Mix	01	01	01	01
8	Salt	01	01	01	01

PJP-Prosopis juliflora pod, WMS-watermelon seed.

Digestibility trials

All the animals were subjected to feeding trial of 105 days, followed by seven days digestibility trial for estimation of digestibility of the different nutrients. The faeces, collected in 24 hrs, were weighed and mixed uniformly. A representative sample of about 10% of the total faeces excreted by each animal was taken for determination of DM in a hot air oven and these oven-dried samples were weighed and ground to about 1 mm size. The DM intakes, digestibility of DM and gross nutrients, digestible nutrient intake, feed efficiency, were worked out for all the groups

for the entire experimental period. The feed and faecal samples were analyzed for proximate constituents by procedures of AOAC (1990).

Statistical methods

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

Ethical considerations

All applicable national, international and institutional guidelines for the care and handling of animals were followed during experiment.

RESULTS AND DISCUSSION

The acceptability of feed is apparently one of the prime parameters for ascertaining utilizability of the new non-conventional feed resource. The overall DM intakes in all treatment groups are shown in Table 3. The statistical analysis revealed significantly lower palatability in T_2, T_3 and T_4 in comparison to control, i.e. T_1. However, mean palatability in T_2, T_3 and T_4 did not exhibit significant differences from each other.

Table 3: Overall mean and standard error values of DM Intake (kg/100 kg body wt.) and feed efficiency at fortnight intervals (Period 105 days) in all treatment groups

Parameters	T_1	T_2	T_3	T_4
DM Intake	$3.81^{b} \pm 0.05$	$3.70^{a} \pm 0.03$	$3.68^{a} \pm 0.04$	$3.64^{a} \pm 0.03$
Feed Efficiency	$0.108^{b} \pm 0.006$	$0.096^{ab} \pm 0.006$	$0.096^{ab} \pm 0.007$	$0.077^{a} \pm 0.006$

P<0.05, P<0.01.

The digestibility of DM and gross nutrients as shown in Table 4 could not reveal any significant differences due to effect of treatment except the crude protein which exhibited significantly higher digestibility in T_1 and T_2 in comparison to T_3 and T_4. Practical nutritional worth, i.e. DCP, TDN and NR and intake of digestible nutrients are shown in Table 4.

Regarding feed efficiency, as shown in Table 3, significant differences were observed among the treatment groups with maximum efficiency in T_1 and minimum in T_4.

Table 4: Digestibility coefficient of nutrients, digestible nutrient component and intake of digestible nutrients in all treatment groups

Parameter	T_1	T_2	T_3	T_4
Digestibility coefficient (%)				
DM	64.82 ± 2.18	62.42 ± 2.90	65.18 ± 0.85	61.40 ± 1.69
CP	$72.49^{b} \pm 1.00$	$72.89^{b} \pm 0.97$	$67.79^{a} \pm 1.54$	$67.52^{a} \pm 1.65$
EE	78.05 ± 3.45	79.88 ± 1.10	82.48 ± 1.50	84.19 ± 1.63
CF	57.49 ± 3.19	53.69 ± 5.44	60.27 ± 1.49	55.83 ± 4.06
NFE	67.18 ± 1.86	66.40 ± 1.66	68.12 ± 1.63	65.91 ± 1.01
Digestible nutrient component (%)				
DCP	10.10	10.24	9.23	9.27
TDN	62.72	55.51	63.72	61.28
NR	1:5.21	1:4.42	1:5.90	1:5.61
Intake of digestible nutrients (g/day)				
DCP	68.58	69.53	61.84	62.66
TDN	425.87	376.91	426.92	414.25

P<0.01.

DCP- Digestible Crude Protein, TDN- Total Digestible Nutrients, NR- Nutritive ratio.

The nutrient contents of the mesquite PJP and WMS cake used in the current study were observed similar to previous studies (Batista *et al*., 2002; Obeidat *et al*., 2013) and (Mustafa and Alamin, 2012), respectively. However, CP contents in processed WM seeds were observed by Rekha and Rose (2016) and Milala *et al.* (2018) as 68.4% and 68.04%, respectively.

A significant drop in palatability and a non-significant drop in DM intake in T_3 are in agreement with the earlier finding of Swami (1995). No adverse effect due to the inclusion of mesquite PJP in T_2 and T_4 on DM intake could be attributed to the fact that both barley and mesquite PJP are equally acceptable to the buckling goats.

The high acceptability of mesquite PJP have also been reported earlier by Sharma (1997) in sheep and Talpada

et al. (2002) in cattle, Obeidat *et al*. (2013) in sheep and observed no adverse effect on DM intake due to inclusion of mesquite PJP in the ration. However, results were inconsistent in sheep and goat with Abdullah and Hafes (2004) and Mahgoub *et al*. (2005), respectively.

The results of digestibility of DM in present investigation fall in line with finding of Talpada *et al*. (2002) and Obeidat *et al*. (2013) as they observed no adverse effect or even a little increase in the digestibility of DM in ruminants on feeding mesquite PJP in the complete feeds replacing conventional ingredients. Sharma *et al*. (1997) also observed no significant effect of replacement of conventional energy sources by mesquite PJP in ruminants. However, the result was inconsistent with Abdullah and Hafes (2004). The non-significant effect of replacement by WMS cake on DM digestibility has also been in agreement with earlier findings of Swami (1995) and Sharma (2001). However, Mustafa and Alamin (2012) observed lower DM degradability in WMS cake than whole WM Seeds and pulp, respectively.

The statistical analysis of the digestibility of crude protein revealed highly significant (P<0.01) effect of treatment. The comparison of means indicated significantly lower per cent digestibility of crude protein in animals of T_3 and T_4 groups in comparison to that observed in animals of T_1 and T_2 groups. However, the significant differences could not be noticed between T_1 and T_2 where barley was replaced by mesquite PJP as well as between T_3 and T_4 where cottonseed cake was replaced by WMS cake alone (T_3) and in combination with mesquite PJP replaced barley (T_4). These results suggest that replacement of barley by mesquite PJP did not adversely affect the digestibility of crude protein and the finding is also in agreement with Talpada *et al*. (2002). But, the inclusion of WMS cake in T_3 and T_4 alone or combination exhibited a decrease in digestibility of crude protein. A decrease in digestibility of crude protein has also been reported by other workers *viz.,* Singh *et al.* (1992) and Swami (1995). However, Mustafa and Alamin (2012) observed higher CP degradability in WMS cake following the pulp and whole seed.

The statistical analysis of data did not show any significant effect of treatment on ether extract and crude fibre digestibility. The results obtained are in line with the earlier findings of Swami (1995), Sharma *et al*. (1997) and Talpada *et al*. (2002). However, the values obtained in all the four treatment groups fed complete feeds in the present investigation are higher for ether extract and lower for crude fibre than the values obtained by Sharma (2001) on feeding complete feed to goats.

The statistical analysis of NFE revealed a non-significant effect of treatment. Results found by Sharma (1997) and Talpada *et al*. (2002) on feeding the non conventional mesquite PJP supports the result. No adverse effect was observed on NFE digestibility on the inclusion of WMS cake in T_3 and T_4. The NFE digestibility values are in accordance with the earlier results of Talpada *et al*. (2002) in calves and Sharma (2001) in kids on feeding complete feeds. Contrary to it, Swami (1995) observed an increase in NFE digestibility.

The DCP and TDN values of T_2 feed are in accordance to the findings of Talpada *et al*. (2002) as they found DCP and TDN values of complete feed having mesquite PJP to be 12.00% DCP and 55.90% TDN. The DCP and TDN recorded for T_3 feed, however, do not correspond with values obtained by Sharma (2001) in goats.

The non-significant effect on feed conversion efficiency attests the earlier results on the inclusion of mesquite PJP by Sharma (1997) and Talpada *et al*. (2002) and WMS cake by swami (1995) and Sharma (2001). The feed efficiency in T_4 was noticed to be significantly lower than T_1, i.e. control. Whereas, mean feed efficiency in T_2 and T_3 groups were neither significantly different from T_1 nor T_4 and were almost same in both the treatment groups. The findings indicate that replacement of conventional feed by non-conventional feed has not adversely affected the efficiency of complete feeds.

CONCLUSION

It is concluded that both barley and cottonseed cake could be effectively replaced by the mesquite *Prosopis juliflora* pods (PJP) and watermelon seed (WMS) cake alone as well as in combination in complete feed.

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