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Effect of utilization of corn cobs in total mixed ration on growth performance and nutrient utilization of growing goats

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Abstract

The study involved 18 Osmanabadi growing goats of 4-5 months of age which were divided into three equal groups viz., T₀ (Control), T₁ and T₂, having six goats in each group. The goats in the control group (T₀) were fed total mixed ration (Concentrate: 30 parts, Dry roughages- Jowar straw (*Kadbikutti*): 50 parts and Green roughages- DHN₆: 20 parts) to provide nutrients as ICAR (2013) [6], whereas in the T₁ group, goats were fed total mixed ration as per Group T₀ where in *Kadbikutti* of dry roughage was replaced by corn cobs at 25% level, while in T₂ group, the goats were fed total mixed ration as per Group T₁ + fibrolytic enzymes @ 300 g/ton of feed. The trial lasted for 90 days duration. The average body weights of growing goats from group T₂ were significantly ($p < 0.01$) higher than group T₁ and control, however difference between group T₀ and T₁ were statistically non-significant. The average gain in weight was comparable among various experimental groups. The average daily dry matter intake of growing goats from group T₂ was significantly ($p < 0.01$) higher than group T₀ and T₁. The average TDN intake of group T₂ was significantly ($p < 0.01$) higher than group T₀ and T₁. The average DM, TDN and DCP required per kg gain in weight revealed non-significant effect among various experimental groups. The average digestibility coefficients of nutrients revealed significant effect of feed treatments. The highest net profit was realized in group T₂ followed by control group T₀ and then group T₁. Thus, it is concluded that replacement of *Kadbi kutti* by 25% corn cobs in TMR along with supplementation of fibrolytic enzymes @ 300 g/ton of feed shows beneficial effect on growth performance, nutrient digestibility of growing Osmanabadi goats and such replacement and supplementation is also cost effective. It is also concluded that replacement of *Kadbi kutti* by 25% corn cob in TMR without fibrolytic enzyme supplementation did not adversely affect growth performance and nutrient utilization in growing Osmanabadi goats and can sustain goats during period of scarcity.

Keywords: Osmanabadi goats, replacement, lower straw, corn cob, growth, nutrient digestibility

Introduction

To overcome the scarcity of dry fodders there is an urgent need for tapping some unconventional dry roughage sources. Corn cobs, a byproduct of maize production obtained after harvesting of maize grains, are a good alternate roughage source and can be utilized in ruminant rations. It can serve as an alternate source of feed. It is among the most accessible and plentiful agricultural wastes (Kategile *et al.*, 1981) [7]. They have low nutritional value, but in the agricultural sector they are used as fuel, bedding for chickens and other animals, and even as feed for ruminants. These cobs are abundant in hemicellulose and cellulose but low in crude protein, making them a viable alternative feed source for ruminants. This significant amount of maize cobs may be used as an alternate source of roughage for ruminants and as a cheaper feeding option. The high amount of complex carbohydrates in corn cobs results in lower utilization; this might be improved if corn cobs are included in total mixed ratio in (TMR) form. Furthermore, it is reported that supplementation of fibrolytic enzymes to crop residues-based rations enhances utilization of feed and nutritional value of feed positively affecting performance of animals in terms of growth and lactation. When fibre digestion is impaired and energy is the diet's first-limiting nutrient, animals respond more strongly to enzyme supplements (Beauchemin *et al.*, 2003) [4].

Forage fed with exogenous enzymes decreased pH value, ammonia nitrogen, and CH₄ production while increasing the digestibility of dry matter, neutral detergent fibre, and total volatile fatty acid yield.

Thus, crop waste like corn cobs could be used as a roughage source in total mixed ration of ruminants which will act as good alternative roughage source during scarcity situation when there is a shortage of conventional roughage sources. Further, the utilization and nutritional value of such crop wastes can be enhanced by supplementation of fibrolytic enzymes.

Considering the above facts in mind and huge availability of corn cobs in the area of research work, present research work was planned to evaluate the effect of utilization of corn cobs in total mixed ration on the growth performance and nutrient utilization of Osmanabadi growing goats with the following objectives.

Materials and Methods

All the experimental procedures were as approved by the Institutional Animal Ethical Committee constituted by Committee for the Purpose of Control and Supervision of Experiment on Animals (CPCSEA), Department of Animal Welfare, Ministry of Forest, Environment and Climate Change, Government of India which is established under chapter 4 Section 15 (1) of the Prevention of Cruelty to Animals Act, 1960. (Approved No.XV/24, Dated. 14/08/2024). The present experiment was carried out during for three months at the Livestock Farm Complex, College of Veterinary and Animal Sciences, Udgir, Maharashtra, having latitude 18.3942886, longitude 77.1176 and altitude 2086 ft. During the trial period, maximum 30 °C and minimum 24 °C temperature and 823 mm precipitation was recorded.

The study involved 18 Osmanabadi growing goats of 4-5 months of age which were divided into three equal groups viz., T₀ (Control), T₁ and T₂, having six goats in each group. The goats in the control group (T₀) were fed total mixed ration (Concentrate: 30 parts, Dry roughages- Jowar straw (*Kadbikutti*): 50 parts and Green roughages- DHN₆: 20 parts) to provide nutrients as ICAR (2013) [6], whereas in the T₁ group, goats were fed total mixed ration as per Group T₀ where in *Kadbikutti* of dry roughage was replaced by corn cobs at 25% level, while in T₂ group, the goats were fed total mixed ration as per Group T₁ + fibrolytic enzymes @ 300g/ton of feed. The trial lasted for 90 days duration. The trial lasted for ninety days.

The total mixed ration (TMR) comprising of 50% dry roughages -dry *kadbikutti*, 20% green fodder DHN₆ and 30% concentrate mixture, was prepared every day in the morning

at farm and fed throughout the experimental period of 90 days. The corn cobs utilized in treatment groups were obtained in coarsely ground form after threshing of corn grains from grain producing crops cultivated at ILFC, COVAS, Udgir. The corn cobs were again ground to appropriate size so that it can be mixed thoroughly in TMRs of treatment groups. The fibrolytic enzyme used in the present experiment was in a free-flowing powder form, easy to mix in feed. The fibrolytic enzyme consists of cellulase and hemicellulase (xylanase) enzymes which were helpful in efficient breakdown of cell wall and enhancing fibre digestibility. The said enzyme was procured from the market. The enzyme was supplemented to experimental animals through concentrate mixture which was included in TMR of group T₂.

The representative samples of concentrate mixtures, green fodder (DHN₆), *kadbi kutti*, corn cobs and various TMRs utilized for feeding of experimental growing goats were collected at fortnight interval throughout the experimental period, oven dried and the pooled samples were analyzed as per AOAC (2007) [1]. The fecal samples obtained while conducting digestibility trial were also analyzed. The chemical composition (% DMB) of concentrate mixtures, green fodder (DHN₆), *Kadbi Kutti* and corn cobs is presented in Table 1. Three different types of TMRs were prepared every day and used for feeding respective experimental groups to meet their nutrient requirements (ICAR, 2013) [6]. The ingredient composition of experimental TMRs is given in Table 2 and the percent chemical composition (% DMB) of total mixed ration of various experimental groups is presented in Table 3.

Experimental growing goats were fed under stall feeding system with commonly routine managerial practices. *Ad libitum*, feeding practice was followed throughout the experimental period and feed left over weighed next day morning to calculate total dry matter intake.

All the experimental animals were weighed at the start of experiment before feeding and watering and thereafter weighing was done every fortnightly at the same time. The digital weighing balance of 200 kg capacity was used for weighing the experimental animals. In the last week of the experiment a digestibility trial of seven days duration was conducted by total collection method. All the growing goats from each group were used for the digestibility trial.

Observations of various parameters recorded during experimental period were tabulated and data were statistically analyzed as per Snedecor and Cochran (1994) [12], by using Randomized block design and Completely Randomized Design.

Table 1: Average chemical composition (%DMB) of Concentrate mixture, DHN₆, Jowar straw and Corn cobs

Nutrient%	Concentrate mixture	DHN ₆	Jowar straw	Corn cobs
Moisture	8.76	72.45	8.13	5.20
Dry matter	91.24	27.55	91.87	94.80
Organic matter	95.03	89.88	92.30	95.90
Crude protein	19.22	8.45	5.88	3.20
Ether extract	3.74	2.20	1.50	0.60
Crude fibre	8.87	27.56	38.00	33.80
Nitrogen free extract	63.20	51.67	46.92	58.30
Total ash	4.97	10.12	7.70	4.10
Nutrient%	Concentrate mixture	DHN ₆	Jowar straw	Corn cobs
Moisture	8.76	72.45	8.13	5.20
Dry matter	91.24	27.55	91.87	94.80
Organic matter	95.03	89.88	92.30	95.90
Crude protein	19.22	8.45	5.88	3.20
Ether extract	3.74	2.20	1.50	0.60
Crude fibre	8.87	27.56	38.00	33.80
Nitrogen free extract	63.20	51.67	46.92	58.30
Total ash	4.97	10.12	7.70	4.10

Table 2: Percent ingredient of TMRs of various experimental groups

Ingredients	TMR T ₀	TMR T ₁	TMR T ₂
Maize	9	9	9
Groundnut extract	6	6	6
Wheat bran	7.5	7.5	7.5
Udidchuni	6.9	6.9	6.9
Mineral mixture	0.3	0.3	0.3
Salt	0.3	0.3	0.3
Corn cob	0	12.5	12.5
Jowar straw	50	37.5	37.5
DHN ₆	20	20	20
Total	100	100	100

Table 3: Percent chemical composition (% DMB) of total mixed ration of various experimental groups

Nutrient%	TMR T ₀	TMR T ₁	TMR T ₂
Moisture	22.00	21.75	21.75
Dry matter	78.00	78.25	78.25
Organic matter	92.63	93.08	93.08
Crude protein	10.40	10.06	10.06
Ether extract	2.05	1.94	1.94
Crude fibre	27.17	26.65	26.65
Nitrogen free extract	53.01	54.43	54.43
Total ash	7.37	6.92	6.92

Results and Discussion

The overall performance of growing goats from different experimental groups is presented in Table 4. The average body weights of growing goats from group T₂ were significantly ($p < 0.01$) higher than group T₁ and control; however, the difference between group T₀ and T₁ was statistically non-significant. The significant ($p < 0.01$) higher average fortnight wise body weights in group T₂ supplemented with fibrolytic enzymes might be due to better degradation of cell wall components and enhanced utilization of crude fibre. These results observed in present study are similar with results of Cruywagen and Goosen (2004) [5] who reported significant improvement in cumulative weight gain in Merino lambs fed with pre-enzyme treated wheat straw-based diets. Saleem *et al.* (2011) [11] also reported improvement in body weight for male sheep by the feeding of paddy straw-based complete feed supplemented with fibrolytic enzyme mixture. NE *et al.* (2017) [9] also observed a significant ($p < 0.05$) increase in total gain and average daily gain in growing barley lambs supplemented with exogenous fibrolytic enzyme @ of 2.5g m/h/day than that of control group.

The average gain in weight was comparable among various experimental groups. These results are similar with results of Babale *et al.* (2015) [3] who observed no significant difference in weight gain in Red Sokoto bucks fed concentrate mixture consisting of raw corn cobs replacing maize bran at 10 and 20% level. Aregheore (1995) [2] also observed no significant differences in body weight gain among goats fed the different residues viz. ground nut shell, corn cobs and cocoa pod husk.

The average daily dry matter intake of group T₂ was significantly ($p < 0.01$) higher than group T₀ and T₁, however, difference between group T₀ and T₁ was comparable. The % DMI and DMI per unit metabolic body size of growing goats from various experimental groups was comparable. This also indicated that there was no adverse effect of replacing jowar straw with corn cobs in TMR ration supplemented with or without fibrolytic enzymes on palatability of feed. The finding of present study resembles with Olamilusi *et al.* (2019) [10] who observed highest dry matter intake in west African dwarf rams fed polyezyme treated corn cob-based

diet than polyezyme untreated corn cob-based diet. In contrast Yuangklang *et al.* (2017) [13] observed no difference on dry matter intake of goats received rice straw base ration TMR with or without supplemental fibrolytic enzymes.

Average TDN intake was significantly ($p < 0.01$) higher for group T₂ than group T₀ and T₁, but difference between group T₀ and T₁ were comparable. The higher TDN intake in group T₂ might be due to higher digestibility coefficients of all nutrients of TMR ration provided to group T₂. The findings of the present study corroborated with NE *et al.* (2017) [9], who observed higher TDN intake in growing Barkey lambs fed ration supplemented with fibrolytic enzymes. The average DCP intake of growing goats from various experimental groups was comparable.

The efficiency of feed utilization when considered in terms of DM, TDN and DCP required per kg gain in weight showed non-significant difference among various experimental groups. These results corroborated with Babale *et al.* (2015) [3] who observed no significant difference in feed conversion ratio in Red Sokoto bucks fed concentrate mixture consisting of raw corn cobs replacing maize bran at 10 and 20% level. Contrary to the findings of present study López-Aguirre *et al.* (2016) [8] observed significant ($p < 0.05$) effect of supplementation of exogenous enzymes on FCE and FCR of growing Pelibuey lambs. Cruywagen and Goosen (2004) [5] also found significantly higher feed conversion efficiency in Merino lambs received pre-enzyme treated wheat straw-based diets.

The average digestibility coefficients of nutrients (Table 5) revealed significant effect of feed treatments. The average digestibility coefficients for dry matter of group T₂ were significantly ($p < 0.01$) higher than T₀ and T₁ group. Further, it was seen that digestibility coefficient of dry matter for control group was significantly ($p < 0.01$) higher than group T₁. The average digestibility coefficients for organic matter and crude protein of group T₁ were significantly ($p < 0.01$) lower than T₀ and T₂ groups. Further, it was also seen that average digestibility coefficients of organic matter and crude protein for groups T₀ and T₂ were comparable. The average digestibility coefficients for ether extract, crude fibre and nitrogen free extract of group T₂ was significantly ($p < 0.01$)

higher than T₀ and T₁ groups. Further, it was revealed that digestibility coefficients for ether extract, crude fibre and nitrogen free extract were significantly ($p < 0.01$) higher in control group than group T₁. The percentage TDN of TMR of group T₂ was significantly ($p < 0.01$) higher than T₀ and T₁ groups, however, between group T₀ and T₁ it was significantly ($p < 0.01$) higher in group T₁ than T₀. The percentage DCP of TMR of group T₀ was significantly ($p < 0.01$) higher than T₁

and T₂ groups. Further, it was also seen that DCP of group T₁ and T₂ was comparable. Findings of the present study resembles those of NE *et al.* (2017)^[9], who reported improved dry matter, crude protein, crude fibre and nitrogen free extract as compared to control group when treated group of lambs were fed control ration plus 2.5 g exogenous fibrolytic enzyme.

Table 4: Overall performance of growing goats from different experimental groups

Parameters	Groups			Stat. Sig.
	T ₀	T ₁	T ₂	
Initial average body wt. (kg)	9.36 ± 0.33	9.42 ± 0.30	9.40 ± 0.21	-
Final average body wt. (kg)	13.38 ^a ± 2.34	13.19 ^a ± 2.48	13.49 ^b ± 2.32	**
Total gain in weight (kg)	8.20	7.60	8.37	-
Average weekly gain in wt.(g)	1.37 ± 0.05	1.27 ± 0.09	1.40 ± 0.08	NS
Average daily gain wt. (g)	91.11	84.44	93.00	-
Average daily DM intake (g)	0.594 ^b ± 0.05	0.589 ^b ± 0.05	0.612 ^a ± 0.05	**
DM intake (%)	4.21 ± 0.08	4.25 ± 0.05	4.30 ± 0.06	NS
DMI per unit metabolic body size (g)	81.30 ± 2.69	81.75 ± 2.30	83.24 ± 2.74	NS
Average daily TDN intake (g)	0.384 ^b ± 0.03	0.378 ^b ± 0.03	0.399 ^a ± 0.04	**
Average daily DCP intake (g)	0.044 ± 0.00	0.042 ± 0.00	0.044 ± 0.00	NS
DM required (kg) per kg gain wt.	6.50 ± 0.53	7.10 ± 0.69	6.65 ± 0.62	NS
TDN required (kg) per kg gain wt.	4.21 ± 0.34	4.55 ± 0.44	4.34 ± 0.40	NS
DCP required (kg) per kg gain wt.	0.48 ± 0.04	0.51 ± 0.05	0.48 ± 0.04	NS

Note: The means having common superscript in the same row do not differ significantly NS: Non-significant *Significant ($p < 0.05$) **Significant ($p < 0.01$)

Table 5: Average digestibility coefficients, TDN and DCP contents for experimental total mixed rations

Nutrients	Digestibility Coefficients%			Stat. Sig.
	TMR T ₀	TMR T ₁	TMR T ₂	
Dry matter	66.68 ^b ± 0.08	65.32 ^c ± 0.11	67.32 ^a ± 0.05	**
Organic matter	68.78 ^a ± 0.03	67.25 ^b ± 0.07	68.92 ^a ± 0.03	**
Crude protein	71.68 ^a ± 0.09	70.82 ^b ± 0.05	71.89 ^a ± 0.05	**
Ether extract	78.24 ^b ± 0.07	76.84 ^c ± 0.04	78.45 ^a ± 0.08	**
Crude fibre	59.42 ^b ± 0.08	58.12 ^c ± 0.03	60.12 ^a ± 0.03	**
Nitrogen free extract	70.82 ^b ± 0.05	70.14 ^c ± 0.03	70.92 ^a ± 0.06	**
DCP %	7.45 ^a ± 0.06	7.13 ^b ± 0.06	7.23 ^b ± 0.04	*
TDN %	64.75 ^b ± 0.07	64.14 ^c ± 0.15	65.28 ^a ± 0.13	**

Note: The means having common superscript in the same row do not differ significantly NS: Non-significant *Significant ($p < 0.05$) **Significant ($p < 0.01$)

The input-output relationship of the present study indicates that inclusion of fibrolytic enzyme in the group fed with TMR by partial replacement of 25% *kadbi-kutti* with corn cob, decreased the feeding cost and fetched more profit by Rs. 203.26 over control group fed TMR without corn cobs. However, net profit for control group was higher by Rs. 42.13 than group T₁, fed with TMR by partial replacement of 25% *kadbi-kutti* with corn cob without fibrolytic enzyme supplementation.

Conclusion

From overall results of the present study it is concluded that the replacement of *Kadbi kutti* by corn cobs @ 25% in TMR with or without supplementation of fibrolytic enzymes has no adverse effect on growth performance and nutrient utilization of growing Osmanabadi goats. The replacement of *Kadbi kutti* by corn cobs @ 25% in TMR along with supplementation of fibrolytic enzymes @ 300 g/ton is found cost effective.

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Conflict of Interest: The authors affirms that they do not possess any known competing financial interests or personal relationship that could be perceived to impact the integrity of the work reported in this paper

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