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Research Article
Feed Intake and Nutrient Digestibility of Konkan Kanyal Goats Fed Finger Millet Straw Supplemented With Varying Levels of Dried Poultry Dropping Based Diets

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Abstract

Background and Objective: Crop residues are coarse, high-fibre, low-protein and low-digestibility roughages, they play an important role as filler and have some value as a energy source for feeding ruminant animals provided they are adequately supplemented. This present study was conducted to study the effects of dried poultry dropping based diets on the feed intake and nutrient digestibility of konkan kanyal goats fed finger millet straw. **Materials and Methods:** Thirty konkan kanyal goats aged above 12 months weighing 14.00-14.67 kg were used in a randomized block design (RBD) experiment. The experimental goats were randomly assigned to 5 treatments (T_l-T_5). T_1 was goats fed with 0% dried poultry droppings based diets (DPDBD), T_2 was fed with 20% dried poultry droppings based diets (DPDBD), T_3 was fed with 40% dried poultry droppings based diets (DPDBD), T_4 was fed with 60% dried poultry droppings based diets (DPDBD), T_5 was fed with 80% dried poultry droppings based diets (DPDBD). Feed intake was monitored, digestibility coefficient was calculated. All data originating from the study were analysed with analysis of variance (ANOVA) using the general linear model (GLM) procedure of SAS. Means were separated with the use of least significant difference (LSD) test of the same package. **Results:** Mean feed intake was higher in treatment groups supplemented with dried poultry droppings based diet T_2(666.84), T_3 (780.75), T_4 (780.48), T_5 (716.00), compared to the control treatment group T_1 (588.58). Nutrient digestibility coefficient of the experimental animals was significantly ($p<0.05$) higher in treatment group supplemented with 40% DPDBD (T_3) for all the parameters measured compared to all other treatment groups. **Conclusion:** The results of this study suggests that feeding of dried poultry droppings based diets up to 80% to Konkan Kanyal goats consuming finger millet straw as basal diet would give satisfactorily performance, however, superior performance was observed at 40% inclusion, therefore, it is recommended to include the dried poultry droppings at 40% in the diet of the animals for better improved performance.

Key words: Digestibility coefficient, dried poultry droppings, feed intake, finger millet straw, konkan kanyal goats

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

With the population of 162.0 million goats, India ranks second in goat production globally FAO[1]. Goats represent key breed of domestic animals in Asia and provides immensely to food, rural employment and gross domestic product. Goats are animals with numerous utility, providing meat, milk, skin and hair. Their primary function is meat production. In India, 95% of goat meat produced is consumed locally and the per capita availability is far below the requirement. Therefore, to meet up with the per capita availability of this breed of animal, there should be concerted effort in stepping up on the production of the animals. Feeding is an essential aspect of goat rearing enterprise and may be the highest expense of any meat goat operation. Goats raised for meat need high quality feed in utmost conditions and need ideal levels of many different nutrients to achieve maximum profit potential[2].

In Konkan region where this study was carried out finger millet is the major cereal crop cultivated by the locals and its by-product fed to the animals as roughages, however, finger millet straws (FMS) which are by-product of finger millet are coarse, high-fibre, low-protein and low-digestibility roughages, they play an important role as filler and have some value as a energy source for feeding ruminant animals provided they are adequately supplemented[3]. Since FMS is of poor nutritive value it must therefore be supplemented with nitrogen and energy sources to meet maintenance and or production requirements[4]. This study was therefore conducted to study the effects of feeding dried poultry droppings based diet as supplementary diet to finger millet straw on feed intake as well as on the nutrient digestibility of konkan kanyal goats.

MATERIALS AND METHODS

Experimental site: The study was conducted at the Institutional livestock Farm, Goat Unit, Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli, District Ratnagiri, Maharashtra, India.

Climatic and weather conditions: The Institutional Livestock Farm, Goat Unit, Department of Animal Husbandry and Dairy Science farm, College of Agriculture, Dapoli is located at 280 m above mean sea level (MSL) and in the subtropical region at 17°45' North latitude and 13°12' East longitude. The area is characterized by hilly terrain. The soil is lateritic and acidic in nature. The soil is low in fertility, having poor water holding capacity. The climate is warm and humid with 3500 mm average annual rainfall. The maximum temperature at Dapoli is about 33.4°C in summer and 21.1°C in winter while, relative humidity ranges from 55-96%.

Experimental animals: Thirty konkan kanyal goats aged above 12 months and with average weight of 14.38 kg were used for this study. The goats were randomly assigned to 5 treatments designated T_1-T_5 comprising of 3 replicates with 2 animals per replicate. The animals were kept in individual pens. The animals were treated against ectoparasites, dewormed against endoparasites and were administered with far-reaching antibiotics to ward off microbial infections. Afterward the animals were randomly assigned into 5 experimental groups and fed for 3 weeks for acclimatization to the experimental diets before data collection. Clean fresh water was offered daily throughout the duration of the trial. The feeding trial lasted for 90 days. The animals were raised in individual compartment under confinement.

Experimental feeds: Three experimental diets were used for the study, finger millet straw, green fodder as basal diets and supplementary diets. Five concentrate mixtures were used comprising dried poultry dropping at a rate of 10, 20, 40, 60 and 80% in addition to other feed ingredients of maize crumbs, rice bran, groundnut cake, mineral mixtures and salt. The proximate compositions of the experimental feeds, supplemental diets and ingredient compositions of the experimental diets are presented in Table 1, 2 and 3, respectively.

Feed preparation: Finger millet straw was chopped using chopping machine to 2-3 cm long before feeding as basal feed. The poultry manure was sun-dried for 3-5 days to minimize the level of microbes present. The product was thereafter milled using milling machine and was used for formulating the concentrate diet.

Experimental design: The experimental design used was the randomized block design (RBD). Thirty konkan kanyal goats aged above 12 months and with average weight of 14.38 kg were used for this study. The goats were randomly assigned to 5 treatments designated T_1-T_5 comprising of 3 replicates with 2 animals per replicate.

Feeding trial: The experimental goats were fed at 3% of their body weight. One-thirds were fed as green feed, two-thirds were fed as dry feeds while from this dry feed, two-thirds

Table 1: Chemical composition of experimental feeds (% DM basis)

	Proximate composition				
Parameters	Finger millet straw	Poultry droppings	Maize crumbs	Groundnut cake	Rice bran
OM	88.12	87.54	90.60	89.88	88.66
DM	98.55	98.25	90.15	92.24	91.82
CP	5.35	29.86	9.02	40.07	12.20
EE	0.86	1.34	3.95	5.61	1.38
CF	33.72	2.8	4.70	6.79	10.92
NFE	48.19	53.54	72.93	37.41	64.20
TA	11.88	12.46	9.40	10.12	11.34
Minerals					
Ca	0.10	2.19	0.24	0.56	0.54
P	0.08	0.16	0.15	0.20	0.18

OM: Organic matter, DM: Dry matter, CP: Crude protein, EE: Ether extract, CF: Crude fibre, NFE: Nitrogen free extract, TA: Total ash, Ca: Calcium, P: Phosphorus. Source: Proximate analysis result

Table 2: Chemical composition of supplemental feeds (% DM basis)

	Proximate composition				
Parameters	T_1	T_2	T_3	T_4	T_5
OM	89.32	89.50	89.11	89.20	89.33
DM	91.53	91.16	91.90	91.32	91.58
CP	13.34	14.05	14.25	13.71	14.39
EE	4.34	4.56	4.61	4.40	4.39
CF	3.30	3.50	3.23	3.40	3.31
NFE	68.34	67.39	67.02	67.69	67.24
TA	10.68	10.50	10.89	10.80	10.67
Minerals					
Ca	0.92	1.00	0.95	0.97	0.97
P	0.68	0.78	0.78	0.84	0.85

OM: Organic matter, DM: Dry matter, CP: Crude protein, EE: Ether extract, CF: Crude fibre, NFE: Nitrogen free extract, TA: Total ash, Ca: Calcium, P: Phosphorus. Source: Proximate analysis result

Table 3: Ingredients composition of experimental diets, dried poultry dropping (%) in the concentrate diet

Parameters	0	20	40	60	80
Diet composition (%)					
Maize crumbs	45.00	43.00	39.00	24.00	10.00
Rice bran	40.00	25.00	10.00	9.00	7.00
Groundnut cake	12.00	9.00	8.00	4.00	0.00
Dried poultry dropping	0.00	20	40.00	60.00	80.00
Mineral mixture	2.00	2.00	2.00	2.00	2.00
Salt	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

were fed as dry roughages and one-thirds were fed as concentrates. The level of inclusion of dried poultry dropping in the concentrate mixtures per treatments are T_1 0%, T_2 20%, T_3 40%, T_4 60% and T_5 80%. Chopped finger millet straw (2 cm long) was offered to the animals as basal diets. The goats were fed in individual pens.

All the animals were weighed at the start of the experiment, subsequently, weekly. An adaptation period of 21 days was allowed before data was collected for 90 days. The animals were dewormed, dipped against ectoparasites and dosed with antibiotics as prophylaxis prior to the commencement of the experiment. Fresh measured clean water was offered throughout the duration of the trial.

Digestibility trial: Three experimental goats were taken arbitrarily each from the experimental treatment group at the termination of the growth study. They were kept in personalised metabolic crate with provision for urine and faeces collection. Same experimental diets fed during growth study stage were equally fed during digestibility trial stage. Acclimatisation duration of 5 days was permitted before the urine and faecal outputs were collected for the successive 7 days. Urine output was collected on a daily into a graduated plastic container containing 100 mL of 50% hydrochloric acid (HCl). A 10% aliquot of total urine output per day was removed each day and stored until required for analysis. Faeces from experimental goats on each treatment group were completely mixed thoroughly and sub-sampled taken. Feed taken was determined by calculating the difference between the amount of feed given and the quantity refused. Samples of feed and faeces were dried at 65°C to constant weight, milled and preserved in air tight capped containers until needed for chemical analysis. Nitrogen values of feed, faeces and urine were analyzed by the Kjeldahl method AOAC[5]. Apparent digestibility of the experimental diets was determined as the difference between nutrient taken and excreted in the faeces depicted as a proportion of the nutrient intake[6-8]. Nitrogen retained by the animals was computed as the difference between nitrogen intake and nitrogen excreted, nitrogen retained = nitrogen intake - (faecal nitrogen+urinary nitrogen)[9,10].

Analysis of feeds and fodder: The samples of the experimental feed, feed ingredients and faeces were analyzed for the proximate principles *viz*., dry matter, crude protein, crude fibre, ether extract, nitrogen free extract, total ash and acid insoluble ash AOAC[5]. The nitrogen, calcium and phosphorus content in the urine were analyzed AOAC[5].

Statistical analysis: All data originating from the study were analysed with analysis of variance (ANOVA) using the general linear model (GLM) procedure of SAS[11]. Means were separated with the use of least significant difference (LSD) test of the same package. The experimental design used was the randomized block design.

Model:

$$y_{ij} = \mu+i\alpha+\varepsilon_{ij} \quad (i = 1, 2, \ldots \ldots . . r)$$

Where:

y_{ij} = jth replication of the ith treatment
μ = General mean effect
$i\alpha$ = Effect due to ith treatment= [-μ] i T
ε_{ij} = Error effect (ε_{ij}~ N (0. σ2))
CF = $(GT)^2$/N Tr.S.S

RESULTS AND DISCUSSION

Table 1 shows the chemical compositions of the experimental feeds. The dry matter content of the experimental feeds varies from 91.82% in rice bran to 98.55% in finger millet straw. The crude protein content of the feeds ranges from 5.35% in finger millet straw to 40.07% in groundnut cake. The lower value of crude protein of finger millet straw reported in this study (5.35%) justifies the important need for supplementation. This is in consonant with the earlier works reported by Alhassan[12], Abdul *et al.*[13]. The crude protein value for the poultry droppings used in this study was observed to be 29.86%. The present value was higher than the values reported by Bello and Tsado[14], Ukanwoko and Ibeawuchi[15], Owen *et al.*[16], Aro and Tewe[17] and Onimisiand Omage[18], respectively as 21.88, 26.60, 20.00, 21.67 and 20.30%. However, this value is lower than the value reported by Trevino *et al.*[19] as 31.6% and Ghaly and MacDonald[20] as 39-43%, respectively. The differences in the crude protein values of the poultry droppings could be attributed to the drying temperature used, was reported by Ghaly and MacDonald[20] as well as the type of bird, age of manure and level of feeding the birds. The crude fibre content of the experimental feeds varies from 2.80% in poultry droppings to 33.72% in finger millet straw. The high level of crude fibre reported for finger millet in this study may be attributed to the lignifications of the finger millet straw. Nitrogen free extract value in the present study varies from 37.41% in groundnut cake to 72.93%, respectively. Total ash content of the experimental feeds ranges from 9.40% in Maize crumbs to 12.46% in poultry droppings, respectively.

The daily feed intake (g/day) was not significantly different between treatment T_3 and T_4. The daily feed intake (g/day) was highest in values (780.75 g/day) in treatment T_3 compared to the other treatment groups. This was followed by treatment T_5 and T_2, respectively, while the lowest intake was observed in treatment T_1. From the results of the present study, treatment groups supplemented with poultry droppings had higher values for daily feed intake as compared to the control treatment group. This present findings is in agreement with Abdul *et al.*[13] in their study on the effects of supplementing sorghum stover with poultry litter on the performance of Wadara cattle where they reported that supplementation with poultry litter significantly ($p<0.05$) increased dry matter intake (DMI). Mubi *et al.*[21] studied the use of poultry litter as a replacement for cotton seed cake in feeding Yankasa sheep. The author reported that feed intake of the supplemental groups was highly (<0.05) significant compared to the treatment group not supplemented with poultry litter, Bello and Tsado[14] in their study on feed intake and nutrient digestibility of growing Yankasa rams fed sorghum stover supplemented with graded level of dried Poultry based diet, observed that the mean feed intake obtained from their study indicates that animals in T_1 had lower feed intake (808.80 g/day). Animals fed sorghum stover supplemented with dried poultry droppings had higher feed intake (1028.09-1661.12 g/day) compared to the control group (808.80 g/day). Similarly Mubi *et al.*[22] in their trial with

Table 4: Feed intake by experimental goats (% DM basis)

	DMI			
Treatments	Body weight (kg)	Feed intake (g)	Intake per 100 kg B.W (kg)	Intake per kg $W^{0.75}$ B.W (g)
T_1	14.00[a]	588.58[d]	4.19[e]	80.79[d]
T_2	14.45[a]	666.84[c]	4.51[d]	88.15[c]
T_3	14.53[a]	780.75[a]	5.11[b]	100.73[a]
T_4	14.23[a]	780.48[a]	5.28[a]	103.12[a]
T_5	14.67[a]	716.00[b]	4.93[c]	95.60[b]
SE	0.45	1.21	5.78	1.85
CD (5%)	2.25	2.38	15.97	3.19

Mean with the same superscript are not significantly different. Source: Field work

Table 5: Apparent nutrient digestibility coefficient of experimental animals (% DM basis)

Treatments	DM	CP	EE	CF	NFE	Total Ash	Ca	P
T_1	61.69[b]	58.98[b]	59.53[b]	56.08[b]	59.54[a]	55.80[c]	53.38[d]	62.04[b]
T_2	59.72[c]	58.64[b]	57.70[c]	54.41[d]	57.20[c]	54.81[d]	59.78[c]	60.42[d]
T_3	62.75[a]	61.56[a]	60.70[a]	57.23[a]	59.78[a]	57.50[a]	62.88[a]	63.92[a]
T_4	61.30[b]	61.15[a]	60.54[a]	56.15[b]	55.69[d]	56.13[b]	61.39[b]	61.40[c]
T_5	59.69[c]	58.74[b]	58.98[b]	55.93[c]	58.30[b]	56.07[b]	61.03[b]	61.08[c]
SE	3.79	1.79	0.66	0.71	0.58	1.61	0.16	0.13
CD (5%)	9.74	2.56	4.08	2.50	5.10	4.60	0.21	0.20

Means with the same superscript are not significantly different. Source: Field work

growing heifer fed sorghum Stover supplemented with poultry litter where they observed, there was significant increase in feed intake of the groups supplemented. The present value observed was lower than the values reported by Bello and Tsado[14] (1028.09-1661.12 g/day) and (808.80 g/day). However, higher than the values reported by Ukanwoko and Ibeawuchi[15] (310.03, 291.55, 305.89 and 313.42), Yousuf *et al.*[23] (351.17, 507.06, 536.88 and 356.72). In the study of Negesse *et al.*[24] inclusion of broiler litter at 40% in the diet increased total DM intake, while at higher doses, DM intake decreased.

This result on daily dry matter intake kg^{-1} metabolic body weight was higher than the findings of Ukanwoko and Ibeawuchi[15] in their study with West African Dwarf bucks fed poultry waste-cassava peel based diet and Yousuf *et al.*[23] in their study on the growth performance characteristics of goats fed varied levels of poultry manure in whole cassava plant based concentrate diet. The intake per 100 kg B.W. (kg) (4.19, 4.51, 5.11, 5.28 and 4.93) was higher than the findings of Jokthan *et al.*[25] in their study on effect of cottonseed replacement with broiler litter on performance of Yankasa rams fed maize husk basal diet (Table 4). The authors reported 3.07, 3.13, 3.17, 3.30 and 3.06 as the intake per 100 kg B.W. of the experimental animals studied.

The result of apparent nutrient digestibility coefficient is shown in Table 5. The digestibility coefficient of dry matter in treatment T_3 was significantly higher than all the treatment groups, closely followed by T_4 and T_1 and T_2 and T_5 and is all at par with each other, respectively. While T_5 has the least value. Gelaye *et al.*[26] reported similar results of DM digestibility coefficients as 63.6, 57.2 and 57.5% in T_1, T_2 and T_3, respectively in growing goats fed pearl millet straw and similarly Alem *et al.*[27] reported in their study with Ethiopian Island lamb fed *Eleusine coracana* straw supplemented with variously sourced protein mixed with wheat bran that supplementation improved ($p<0.01$) digestibility of DM, OM, CP and NDF of the total diet and Njidda[28], who studied the effect of cotton seed cake and dry poultry litter supplementation on performance of grazing sheep in the Sahelian zone of Nigeria, reported that dry matter digestibility were significantly ($p<0.05$) higher for the groups fed dry poultry litter.

While Bello and Tsado[15] reported higher values of DM digestibility coefficients than the present findings as 81.00, 86.70, 88.10, 89.30 and 91.40% in T_1, T_2, T_3, T_4 and T_5, respectively in Yankasa rams. The highest DM digestibility coefficient of T_3 closely followed by T_4 shows that treatment groups supplemented with dried poultry droppings can favourably replace ground nut cake (GNC) in goat diet with significant improvement. This could be due to the ability of the supplements to supply necessary nutrients especially fermentable N in ensuring optimum microbial biomass as reported by Abdul *et al.*[13].

Highest digestibility coefficients of CP was observed for T_3 (61.56) followed by T_4, however, there was no significant differences between T_3 and T_4. Similarly, there were no significant differences between T_1, T_2 and T_5 while T_2 has the least value for CP digestibility coefficients, this indicates that treatment groups supplemented with poultry droppings can compete favourably with the group fed convectional supplement. Furthermore, the higher digestibility values observed in the supplemented treatment groups could be attributed to the higher CP intake compared to the control treatment group. However, Bello and Tsado[14] reported higher values of CP digestibility coefficients than the present findings as 76.80, 81.00, 82.00, 83.40 and 86.60% in T_1, T_2, T_3, T_4 and T_5, respectively in Yankasa rams fed sorghum stover supplemented with dried poultry droppings.

The digestibility coefficients of ether extract were significantly higher in treatment T_3 and T_4 followed by T_1 and T_5, respectively. However, T_1, T_5 and T_3, T_4 were at par with each other and followed by T_2 with the lowest value. These values were at variance with the results reported by Bello and Tsado[14] in EE digestibility coefficients of sorghum stover supplemented with poultry droppings fed to Yankasa rams as 58.20, 87.20, 89.40, 91.90 and 92.10% in T_1, T_2, T_3, T_4 and T_5, respectively.

The digestibility coefficients of crude fibre in treatment T_3 was higher, closely followed by T_1, T_4 and T_5, T_2, however, there were no significant differences between T_1 and T_4 was lower than the values reported by Bello and Tsado[15] in CF digestibility coefficients of sorghum stover supplemented with poultry droppings fed to Yankasa rams as 70.80, 82.50, 84.70, 86.80 and 88.30% in T_1, T_2, T_3, T_4 and T_5, respectively. Significantly higher fibre digestibility was noted in the study of Negesse *et al.*[24] fed broiler litter to goats up to 60% level in millet hay-based diet.

Values of nitrogen free extract (NFE) digestibility coefficients were found to be as 59.54, 57.20, 59.78, 55.69 and 58.30% for treatment groups T_1, T_2, T_3, T_4 and T_5, respectively. The digestibility coefficients of NFE in treatment T_3 was higher, closely followed by T_1, T_5, T_2 and T_4, however, there were no significant differences between T_3 and T_1, respectively. The values in this present study were lower than the values reported by Bello and Tsado[14] in NFE digestibility coefficients of sorghum stover supplemented with poultry droppings fed to Yankasa rams as 95.30, 94.40, 94.70, 96.40 and 94.70% in T_1, T_2, T_3, T_4 and T_5, respectively.

CONCLUSION

Results of the present findings revealed that goats fed with dried poultry dropping based diets had significantly higher feed intake and superior apparent nutrient digestibility. From the results of the present study, it is recommended that dried poultry droppings based diets can be used satisfactorily to supplement finger millet straw up to 40% inclusion level for better improved performance.

SIGNIFICANCE STATEMENT

Poor performance of livestock in developing countries is characterized by seasonal shortages in both quality and quantity of feed. Consequently, proper uses of relatively cheap agricultural and agro-industrial by-products are significant to profitable livestock production.

During the dry season, ruminant animals depends largely on crop residues in most parts of Konkan region, especially Dapoli area which produces large amounts of finger millet straw as one of the main residues from cropping activities. However, crop residues are characterised by high fibre content and low protein, energy, mineral and vitamin contents.

Therefore, intake and digestibility of these feed resources are low. Poultry litter is an important protein source for ruminant animals because of its high nitrogen content hence its usage as protein supplement.

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