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RESEARCH ARTICLE

Water consumption rate of konkan kanyal goats (*Capra hircus*) fed finger millet straw supplemented with varying levels of dried poultry dropping based diets

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ABSTRACT

This study was conducted to estimate the water intake of konkan kanyal goats fed finger millet straw supplemented with varying levels of dried poultry droppings based diet. 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 five treatments (T_I-T_5). T_1 were goats fed with 0% dried poultry droppings based diets (DPDBD), T_2 were fed with 20% dried poultry droppings based diets (DPDBD), T_3 were fed with 40% dried poultry droppings based diets (DPDBD), T_4 were fed with 60% dried poultry droppings based diets (DPDBD), T_5 were fed with 80% dried poultry droppings based diets (DPDBD. Water was offered at 5L goats^{-1} daily. Water and feed refusal were recorded on a daily basis before feeding in the morning. Feed and feaces samples were analyzed for proximate constituents. Live weight changes were also measured. The results revealed that treatment groups supplemented with dried poultry droppings based diets had superior water intake compared to the control group. Daily water intake of the experimental goats was 1.4, 2.2, 3.5, 2.7, and 1.7 L head^{-1}, respectively. Konkan kanyal goats fed finger millet straw supplemented with varying levels of dried poultry dropping based diets requires up to 3.5L of water head^{-1} day^{-1} for optimum utilization of the feed.
Keywords: Crop residue, Goats, Poultry litters, Water intake

INTRODUCTION

Ruminants consume fibrous and lower quality feedstuffs such as forages and by-products and convert these feeds into high-quality proteins, vitamins, fats and energy for humans. This unique capability of ruminants very much depends on sufficient quantities of water for maintenance, digestion, absorption and transport of nutrients and for milk secretion (NRC, 2005) and assimilation (Beede, 2012). The composition of water in the body of young growing ruminants is between 65-70%, while for the adult ruminants, it may be only 40-50%, depending on the degree of fatness because fat contains relatively little water (<10%) compared with lean (non-fat) soft body mass (Houpt, 1993). Additionally, water is about 90% blood plasma and 81% of whole blood (Beede, 2012)

Water is widely required for a number of bodily functions. Water is needed for physiological functions such as electrolyte balance, and nutrient transportation, osmotic regulation, metabolism, lubrication, thermoregulation, and excretion of faeces and urine, growth and development, pregnancy stages and as well as lactation stages (NRC, 2005). Water is a necessity for the digestion, absorption and for transportation of nutrients and for secretion of milk (NRC, 2005). The daily water requirement of livestock differs typically between animal breeds. The animal's size and growth stage will have a strong influence on daily water intake (Ward and McKague, 2007). Water consumption of animals also depends on several other factors, such as activity, environmental temperature, dryness of feed, type of production like lactation, which require much water, and relative humidity (Aduku, 2004; Ward and McKague, 2007).

Finger millet straws (FMS) are coarse, high-fibre, low-protein and low-digestible roughages, they play substantial role as filler and have some value as an energy source for feeding ruminant animals provided they are adequately supplemented (Heuze and Trans, 2013). Since FMS is of poor nutritive value it must therefore be supplemented with nitrogen and energy sources to meet maintenance and or production requirements (Heuze and Trans, 2015). Poultry litter is a significant by-product of poultry production, which is a mixture of poultry excreta, spilled feed, bedding material, feathers, etc. Poultry litter is high in crude protein, ranging from 15 to 35% of dry matter. Hence, poultry litter may be useful as a source of nitrogen in ruminant diets. Thus, poultry litter could play a significant role in replacing protein concentrates in goat feeding in areas where large-scale poultry production is practiced (Goetsch and Aiken, 2000).

Despite the great amount of attention paid to other essential nutrients by animal scientist and livestock rearers in the past, water intake and water quality have not been adequately examined. Currently, drinking water is scarcely considered a potentially limiting factor for the productivity and health of ruminants. Farmers hardly have information about the two major initial factors for assessing adequacy of water nutrition in farms, how much the animals are drinking and the quality of water drank. (Beede, 2012), However, intake of water and feed are the major determinants of productivity growth, gestation and milk production (Beede, 2012). Therefore, this study was conducted to estimate the water intake of Konkan Kanyal goats fed finger millet straw supplemented with varying levels of dried poultry droppings based diet.

MATERIALS AND METHODS

Experimental Site

The study was carried in the month of June, 2015-September, 2015, for 90 days 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 of Department of Animal Husbandry and Dairy Science farm, College of Agriculture, Dapoli is located at 280 meters above mean sea level (MSL) and in the subtropical region at $17^0 45'$ North latitude and $13^0 12'$ 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 33.4^0C in summer and 21.1^0C in winter while, relative humidity ranges from 55% to 96%.

Experimental Design

The experimental design used was the Randomized block design (RBD). Thirty Konkan Kanyal goats (*Capra hircus*) aged above 12 months and with average weight of 14.38 kg were used for this study. The goats were randomly assigned to five treatments designated T_1-T_5 comprising of three replicates with two animals per replicate

Experimental Animals

Thirty konkan kanyal goats (*Capra hircus*) aged above 12 months and with average weight of 14.38 kg were used for this study. The goats were randomly assigned to five treatments designated T_1-T_5 comprising of three replicates with two animals per replicate. The animals were kept in individual pens. The animals were treated against external parasites, given oral medication against internal parasites and were injected with broad-ranging antibiotic to prevent bacterial infections. Thereafter the animals were randomly assigned into five experimental groups and fed for three weeks for adjustment to the experimental diets prior to collection of data. Equal amount of clean fresh water was offered at 5L $goat^{-1}$ day^{-1} in individual feeding pen. The feeding trial lasted for 90 days. The animals were raised in individual compartment under confinement.

Experimental Feed Preparation

Three experimental diets were used for the study, Finger millet straw, green fodder as basal diets and supplementary diets. Five supplementary diets were prepared. The supplements consist of the following; 100% Concentrate, 20% dried poultry droppings concentrate based diet, 40% dried poultry droppings concentrate based diet, 60% dried poultry droppings concentrate based diet 80% dried poultry droppings concentrate based diet. The proximate constituents of the experimental diets are given in Table 2 and Table 3, respectively.

Finger millet straw was chopped using chopping machine to 2 cm – 3 cm long before feeding as basal feed. The poultry manure was sun-dried for 3-5 days to decrease the intensity of pathogens within to the tolerable level. The by-product was thereafter milled using milling machine and was used for formulating the concentrate diet.

Feeding Trial

The experimental animals were fed at 3% of their body weight (BW). One-thirds (1/3) were fed as green feed, two-thirds (2/3) were fed as dry feeds while at of out this dry feed two-thirds (2/3) were fed as dry roughages and one-thirds (1/3) were fed as concentrates. The level of inclusion of dried poultry dropping in the treatments are T_1 0%, T_2 20%, T_3 40%, T_4 60% and T_5 80%. Chopped finger millet straw (2 cm length) was offered to the animals as basal diets. The goats were fed in individual pens. Equal amount of clean water was offered at 5 litres per goat per day in individual feeding pen. Water and feed refusals were recorded each morning before feeding. While live weight changes were also recorded on a weekly basis. Weight gain was worked out as the difference between the initial and final live weight measurements.

Proximate Analysis of Feed Samples

The samples of the experimental feed, feed ingredients and faeces were analyzed for the proximate principles *viz*., Dry matter,(DM) Crude protein,(CP) Crude fibre,(CP) Ether extract,(EE) Nitrogen free extract,(NFE) and Total ash (TA) (AOAC, 1995). The Nitrogen, Calcium and Phosphorus content in the urine were analyzed (AOAC, 1995)

Statistical Analysis

All data generated were subjected to analysis of variance (ANOVA) employing the general linear model (GLM) procedure of SAS (2008). Means were separated with the use of least significant difference (LSD) test of the SAS software.

RESULTS AND DISCUSSION

Weekly Meteorological Data

Table 1 show the climatic condition under which the present experiment was carried out. The trial was conducted between the months of February to early May, 2016. These falls in the period when rainfall was absent and progressively high temperature, relative humidity and sunshine hour day^{-1} were observed.

Chemical Composition of Experimental Feeds (% DM basis)

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 (1985) and Abdul *et al.* (2008). 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 (2013), Ukanwoko and Ibeawuchi (2009), Owen *et al.* (2008), Aro and Tewe (2007) and Onimisi and Omage (2006) 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.* (2002) as 31.6% and Ghaly and MacDonald (2012) as 39-43%, respectively. The variations in the crude protein values of the poultry droppings could be attributed to the drying temperature used as was reported by Ghaly and MacDonald (2012) 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.

Table1. Weekly meteorological data of Ratnagiri District

Week	Date	Temperature (°C)		Humidity (%)		Sunshine (h/day)	Rainfall (mm)
		Max.	Min.	Max.	Min		
1	05.02.16-11.02.16	29.2	13.0	93	56	8.1	0.0
2	12.02.16-18.02.16	29.2	14.0	93	50	8.5	0.0
3	19.02.16-25.02.16	32.8	16.8	90	55	8.2	0.0
4	26.02.16-04.03.16	33.1	19.0	92	60	6.5	0.0
5	05.03.16-11.03.16	34.9	15.8	88	44	8.0	0.0
6	12.03.16-18.03.16	31.3	17.6	93	58	8.6	0.0
7	19.03.16-25.03.16	36.0	18.2	86	59	8.3	0.0
8	26.03.16-01.04.16	33.3	19.1	92	59	7.8	0.0
9	02.04.16-08.04.16	32.8	21.1	89	67	7.3	0.0
10	09.04.16-15.04.16	34.7	20.1	81	78	8.6	0.0
11	16.04.16-22.04.16	33.2	21.4	91	62	8.8	0.0
12	23.04.16-29.04.16	33.3	20.1	91	72	9.8	0.0
13	30.04.16-06.05.16	33.9	21.0	92	62	9.9	0.0
14	07.05.16-13.05.16	34.1	22.6	90	66	9.8	0.0

Source: Dr. BSKKV, Dapoli Weather Station Report (2016)

Chemical Composition of Supplemental Feeds (% DM basis)

The dry matter content in supplemental diets (Table 2) in the present study was 91.53%, 91.16%, 91.90%, 91.32% and 91.58%, respectively. The highest value was observed for T_3 as 91.90 per cent and the lowest as was recorded for T_2 as 91.16%. The present values reported were numerically and slightly higher than the values reported by Bello and Tsado (2013) as 84.20%, 88.60%, 85.80%, 92.80% and 92.80%. The crude protein content was 13.34%, 14.05%, 14.25%, 13.71% and 14.39%, respectively. The highest value was observed for T_5 as 14.39% and the lowest as was recorded for T_1 as 13.34%. The present values reported were comparable with the result reported by Bello and Tsado (2013) as 13.13%, 13.60%, 14.00%, and 15.40% except in T_1 which has the lowest value of 7.00%. The crude fibre content was 3.30%, 3.50%, 3.23%, 3.40% and 3.31%, respectively. The highest value was observed for T_2 as 3.50% and the lowest was recorded for T_3 as 3.23%. The present value was however lower than the values reported by Bello and Tsado (2013) as 6.70%, 9.30%, 12.50%, 8.00%. However, T_1 (3.20) value was lower than the present value reported. The nitrogen free extract content in supplemental diets in the present study was 68.34%, 67.39%, 67.02%, 67.69% and 67.24%, respectively. The highest value was observed for T_1 as 68.34% and the lowest was recorded for T_3 as 67.02%. However, the values reported in the present study were higher than the values reported by Bello and Tsado (2013) as 63.50%, 36.77%, 44.30%, 30.30% and 26.90%. The total ash content was 10.68%, 10.50%, 10.89%, 10.80% and 10.67%, respectively. The highest value was observed for T_3 as 10.89% and the lowest was recorded for T_2 as 10.50%. The present value was however lower than the values reported by Bello and Tsado (2013) as 12.00%, 12.50%, 16.50%, and 25.00%. However T_1 (5.50) value was lower than the present value reported.

Table 2. Chemical composition of experimental feeds (% DM basis)

Parameters	Proximate composition				
	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 and P= Phosphorus

Table 3. Chemical composition of supplemental feeds (%DM basis)

Parameters	Proximate composition				
	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 and P= Phosphorus. T1= 0% DPDBD, T2= 20% DPDBD, T3=40% DPDBD, T4= 60% DPDBD, T5=80% DPDBD. DPDBD= Dried Poultry Dropping Based Diet

Feed intake, water intake, live weight gain and feed conversion efficiency of the experimental goats

Results of the feed intake, water intake, and live weight gain and feed conversion efficiency of the experimental goats is presented in Table 4. The daily feed intake (g day^{-1}) was observed to be 588.58, 666.84, 780.75, 780.48, 716.00 g day^{-1}, for T_1, T_2, T_3, T_4 and T_5, respectively. Statistically, significant differences were not observed between T_3 and T_4. The daily feed intake (g day^{-1}) was highest in values (780.75 g day^{-1}) 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 Almaz *et al.* (2012) in their study with lambs fed finger millet straw supplemented with Atella, Noug seed cake and their mixtures, where they reported that supplementation of concentrate to finger millet straw increase the intake of DM and CP of the total feed. The highest intake was observed in supplemented treatment group (T_5), Gashu *et al.* (2014) in their study on effect of supplementation on feed intake and body weight changes of Washera sheep fed urea treated finger millet straw. The authors reported that supplementation of the basal diet increase significantly ($P<0.05$) the intake of total DM and CP when compared to control, Bello and Tsado (2013) 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^{-1}). Animals fed sorghum Stover supplemented with dried poultry droppings had higher feed intake (1028.09 to 1661.12 g day^{-1}) compared to the control group (808.80 g day^{-1}). Similarly Mubi *et al.* (2008) in their trial with 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 (2013) (1028.09 to 1661.12 g day^{-1}) and (808.80 g day^{-1}), However, higher than the values reported by Ukanwoko and Ibeawuchi (2009) and Yousuf *et al.* (2013).

The intake per 100 kg B.W^{-1} (4.19, 4.51, 5.11, 5.28 and 4.93 L) was higher than the findings of Pailan *et al.* (2008) in their study on evaluation of sorghum stover based diets in cattle, sheep and goats, where they reported 2.68, 3.59 and 3.44 L, respectively for the three different breed understudied and Jokthan *et al.* (2013) in their study on effect of cottonseed replacement with broiler litter on performance of Yankasa rams fed maize husk basal diet. The authors reported 3.07, 3.13, 3.17, 3.30 and 3.06 L as the intake per 100 kg B.W of the experimental animals studied.

Water intake in the present study was observed to be 1.4, 2.2, 3.5, 2.7 and 1.71 L day^{-1} in treatment T_1, T_2, T_3, T_4 and T_5, respectively as showed in Table 4. The intake was significantly ($P<0.05$) higher (3.5L) in goats fed 40% poultry dropping based diet (T_3) followed by goats fed 60% poultry dropping based diet (T_4)(2.7 L) and then T_2 and T_5 while T_1 had the least water intake in the present study. The superior average water intake in this present study (3.5 L) was observed to be slightly higher than the values reported by Osuhor *et al.* (2004) in their study on the water consumption of Yankasa rams fed a basal diet of maize stover-lablab mixture; where they reported they require about 3 litres of water day^{-1} per animal for optimum feed utilization, as well as the range reported by Aduku (2004) as 2.5 to 3 kg water kg^{-1} of dry feed consumed by sheep and lower than the value reported by Bello (2014) who studied the water intake of growing Yankasa rams fed sorghum stover supplemented with different levels of dried poultry droppings. The author reported that the animals will require about 4 litres of water head^{-1} day^{-1} for optimum utilization of the feed. However, the value reported in this present study is within the range reported by Markwick (2007) as 2 to 4 L day^{-1}.

The daily body weight gain of animals in each treatment groups were 23.97, 33.25, 63.46, 62.29 and 55.57 day^{-1} and the total body weight gain was 2.33, 3.23, 6.16, 6.04 and 5.39 kg in T_1, T_2, T_3, T_4 and T_5, respectively. The performance in body weight gain was highly significant ($P<0.05$) in T_3 (63.46 g day^{-1}) and T_4 (62.29 g day^{-1}) than other treatment groups. The B.W gain of the treatment groups supplemented with poultry dropping based diets were superior compared with the treatment group not fed poultry dropping based diets. This result concur with the earlier report by Njidda (2010) that investigated the effect of cotton seed cake and dry poultry litter supplementation on performance of grazing sheep in the Sahelian zone of Nigeria. The author reported that there was a significant difference between the supplemented group and control group. Animal fed with dry poultry litter showed significantly ($P<0.05$) higher daily live gain. Also, Gashu *et al.* (2014) studied the effect of supplementation on feed intake and body weight change of Washera sheep fed urea treated finger millet straw, reported that supplementation of Urea treated finger millet straw promoted higher daily weight gain. Highest daily weight gain was observed with T_4 and T_5. Furthermore, Bello and Tsado (2013) 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 reported superior weight gain by the treatment groups supplemented with poultry dropping based diet as against the control group.

Table 4. Feed intake, water intake, live weight gain and feed conversion efficiency of the experimental goats. Means with the same superscript in the same line are not significantly different.

Parameters	Treatments T_1	T_2	T_3	T_4	T_5	SE±	CD 5%
Feed intake (g)	588.58^d	666.84^c	780.75^a	780.48^a	716.00^b	42.60	138.74
Dry matter intake (100kg BW^{-1})	4.19^e	4.51^d	5.11^b	5.28^a	4.93^c	0.0012	0.0039
Water intake (L)	1.4^e	2.2^c	3.5^a	2.7^b	1.7^d	0.08	0.17
Live weight gain (kg)							
Initial weight (kg)	14.00^a	14.45^a	14.53^a	14.23^a	14.67^a	0.45	2.25
Final weight (kg)	16.32^c	17.66^b	20.69^b	20.27^b	20.27^b	0.20	0.99
Weight gain (kg)	2.33^d	3.23^c	6.16^a	6.04^a	5.39^b	0.47	2.36
Body weight gain (g day^{-1})	23.97^d	33.25^c	63.46^a	62.29^a	55.57^b	1.63	3.9
Feed conversion efficiency (%)	4.52^e	5.57^d	9.23^a	9.05^b	8.65^c	1.30	1.90

T1= 0% DPDBD, T2= 20% DPDBD, T3=40% DPDBD, T4= 60% DPDBD, T5=80% DPDBD. DPDBD= Dried Poultry Dropping Based Diet

The percentage of feed conversion efficiency (FCE) of the experimental goats were 4.52, 5.57, 9.23, 9.05 and 8.65 in T_1, T_2, T_3, T_4 and T_5 treatment group respectively. The FCE value of T_3 was significantly higher than all treatment groups and was closely followed by T_4, T_5, and T_2. The significant ($P<0.05$) differences existed between the treatment groups respectively. The feed conversion efficiency data showed that T_3 (9.23) is best converter of feed to flesh while T_1 (4.52) are the least converter of feed to flesh. The present findings agrees with the reports by Nadeem *et al.* (1993) in their study on the effect of feeding broiler litter on growth and nutrient utilization by Barbari goats where they documented the best FCE for treatment group fed the highest poultry litter (30%) as 12.45. Similarly, Yousuf *et al.* (2013) in their study on the growth performance characteristics of goats fed varied levels of poultry manure in whole cassava plant based concentrate diet reported 10.63 as the best FCE in the treatment group fed highest level of poultry manure (22%).

CONCLUSIONS

This present study revealed that goats fed with dried poultry droppings based diets had better feed intake, live weight gain, feed conversion efficiency as well superior water intake. Based on the result of this present study, Konkan Kanyal goats fed finger millet straw supplemented with dried poultry droppings based diets requires up to 3.5 L of water head^{-1} day^{-1} for optimum utilization of the feed fed.

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