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Optimizing performance of Hassan lambs: The role of coffee husk in nutrient utilization and growth

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Abstract

An experiment was conducted to optimize the performance of Hassan lambs by using locally available unconventional feed. Hence a study was designed to evaluate the nutritional value of coffee husk in terms of inclusion of coffee husk as roughage source replacing finger millet straw, maximum permissible limit, its effect on digestibility, efficiency of nutrient utilization and growth performance in the diet of Hassan lambs. Twenty healthy male lambs of comparable age (Hassan breed, 3-4 months old) and body weight (average 11.50 ± 0.5 kg) were randomly allotted in a completely randomized design (CRD) to four dietary groups T₁, T₂, T₃ and T₄ containing of five replicates in each group. The feeding cum growth trial was conducted for a period of 90 days. The control (T₁) group lambs were fed finger millet straw (FMS) and compounded feed mixture (CFM) at 50:50 ratio, on dry matter basis (DMB). Coffee husk replacing finger millet straw for T₂, T₃ and T₄ was 50, 75 and 100 percent, respectively on dry matter basis (DMB) which corresponds to 25, 37.5 and 50 percent of total diet. In all the group CFM was included at 50%. FMS, Coffee husk and CFM were blended according to the prescribed dietary treatments to form a total mixed ration (TMR) and offered to experimental animals *ad libitum*. There was a significantly ($p < 0.05$) higher DMI in coffee husk supplemented group. No difference was observed for ADG and feed efficiency in lambs fed coffee husk as source of fodder. Similarly, the percent digestibility of nutrients was not different among the treatment groups. It is concluded that coffee husk can replace finger millet straw up to 100 percent (50 percent of total diet) in the total mixed ration of lambs without affecting the growth performance and nutrient digestibility.

Keywords: Coffee husk, growth performance, Hassan Lambs and nutrient utilization

Introduction

The major constraint in sustainable livestock production in India is availability of quality feed and fodder throughout the year. Currently there is a deficit of green fodder (35.6%), dry roughages (10.5%) and concentrate feed ingredients (44.0%) (Dhamodharan *et al.*, 2024) [5]. Therefore, it is crucial to explore all avenues to address feed shortages for the sustainable growth of the livestock industry. Incorporating non-conventional feed resources (NCFR) emerges as a promising solution to bridge the gap between feed supply and demand. The chemical composition of the coffee husk is comparable with the conventional roughage source. If coffee husk is used as roughage source, partially feed shortage problem can be addressed thus, sustaining the growth in livestock industry. In India there are limited researches on inclusion of coffee husk as roughage source, maximum permissible limit, its effect on digestibility, efficiency of nutrient utilization and growth performance in the diet of Hassan lambs. Hence, this study has been conducted to assess the nutritive value of coffee husk in terms of nutrient utilization, growth performance in Hassan lambs.

Materials and Methods

Animal housing and feeding trial

The present study was aimed to evaluate the growth potential of lambs on feeding different levels of coffee husk replacing FMS as roughage source. The experiment was carried out at the Department of Animal Nutrition, Veterinary College Hassan, in collaboration with the Livestock Farm Complex, Veterinary College Hassan. The institutional animal ethical committee approval was taken (IAEC number: HVC/IAEC/01/2023) to carry out the above experiment.

Twenty healthy male lambs of comparable age (Hassan breed, 3-4 months old) and body weight (average 11.50 ± 0.5 kg) were randomly allotted in a completely randomized design (CRD) to four dietary groups T₁, T₂, T₃ and T₄ containing of five replicates in each group. The feeding cum growth trial was conducted for a period of 90 days. The control (T₁) group lambs were fed finger millet straw (FMS) and compounded feed mixture (CFM) at 50:50 ratio, on dry matter basis (DMB). Coffee husk replacing finger millet straw for T₂, T₃ and T₄ was 50, 75 and 100 percent, respectively on dry matter basis (DMB) which corresponds to 25, 37.5 and 50 percent of total diet. In the entire group CFM was included at 50%. Standard management practices such as deworming and vaccination were followed consistently under stall-fed conditions.

Procurement and processing of Coffee husk and FMS for TMR preparation

Adequate quantities of coffee husk necessary to feed twenty animals over a span of 90 days were procured from a commercial firm located in Hassan, Karnataka. The coffee husk was dried and provided to the growing lambs according to the specified dietary treatments throughout the experiment. An adequate quantity of FMS was obtained from a local farmer and shredded using a shredder machine for uniform mixing and preparation of TMR. FMS, Coffee husk and CFM were blended according to the prescribed dietary to form a total mixed ration (TMR) and offered to experimental animals *ad libitum*. The TMR offered was prepared daily and provided twice daily at 10:00 AM and 4:00 PM. Any feed leftover was noted the following day at 9:30 AM. Clean drinking water was provided free of choice to all the animals.

Chemical analysis

The proximate composition of the FMS, coffee husk and CFM were determined as per AOAC (2016) [1], fiber fractions as described by Van Soest *et al.* (1991) [18] and ME (MJ/kg DM) was predicted by using procedures of Menke and Steingass (1988) [8].

Metabolic trial, sample collection and analysis

A Metabolism trial of five days duration was conducted after tenth week of feeding trial using eight lambs (two lambs from each group) to estimate the nutrient utilization. Animals were acclimatized to metabolic cages for a period of 3 days. The feed offered and orts were weighed daily to determine the daily feed DM intake. Faeces and urine were collected quantitatively from the animals after 24 h of feeding daily and preserved appropriately for further analysis. The representative samples of the diets offered, ort, faeces (1/10th) and urine (1/20th) voided were taken and analyzed. Body weight of the experimental animals was recorded before and after the metabolic trial. During the growth period, individual data on quantities of feed and fodder offered daily, average daily dry matter intake (DMI), fortnightly body weights were recorded.

Statistical Analysis

The data obtained in the *in vivo* experiment were subjected to analysis of variance (ANOVA) to compare the means of each treatment by using the procedures described by Snedecor and Cochran (1989) [14] using Statistical Package for Social Sciences (SPSS, 2009, version 18.0 Chicago, USA).

Results and Discussion

Chemical composition

The chemical composition and ME (MJ/kg DM) of FMS, Coffee husk and CFM used to prepare TMR for feeding of experimental lambs during the growth trial is presented in Table 1. The results of proximate analysis of the coffee husk were comparable with the values reported by Teixeira *et al.* (2007) [17], Oliveira *et al.* (2007) [10] and Rios *et al.* (2015) [12]. Coffee husk with higher amount of NDF was reported by Rocha *et al.* (2006) [13] whereas Maxiselly *et al.* (2022) [7] reported coffee husk with lesser amount of ADF when compared to experimental coffee husk. Rego *et al.* (2019) [11] reported chemical composition of coffee husk with marginally higher EE, NDF, and ADF when compared to experimental coffee husk. Overall the coffee husk has higher CP, lignin and lower NDF compared to FMS. The variation in chemical composition by various researchers might be due to variation in geographical location, nutrient profile of soil and difference in varieties of coffee husk used. However, coffee husk has good nutrient profile with better CP and NDF. Hence can be a potential alternate feed for ruminants. The Nutrient composition of experimental diet (TMR) of different treatment groups used in growth trial (%DMB) is given in Table 2. The chemical composition of the feed and fodder offered to the lambs was similar throughout the experimental period. The nutrient content was within the reported range of values. There was a linear increase in CP, EE and lignin and decrease in NDF from T₁ to T₄.

Dry matter intake, nutrient digestibility and plane of nutrition

The DMI, percent digestibility of nutrients and plane of nutrition of the experimental lambs during the growth trial is given in Table 3. The DM intake was significantly ($p < 0.005$) higher in coffee husk supplemented groups T₂, T₃ & T₄ (650.88, 662.341 & 617.21 g/d/lamb) as compared to control T₁ (573.22g/d/lamb). Similar results were reported by Garcia *et al.* (2000) [6], Rios *et al.* (2015) [12], Bautista *et al.* (2018) [15] and Rego *et al.* (2019) [11]. Whereas Souza *et al.* (2006a) [13] and Rocha *et al.* (2006) [13] observed decrease in DMI in coffee husk supplemented group compared to control group which was attributed to antinutritional factors present in the coffee husk. The intake of DM when expressed as a percent of body weight and gram per Kg metabolic body weight there was no difference was observed. This indicates that coffee husk did not affect the palatability and since the feed was provided in the form of TMR and moisture was added for through mixing of TMR, which increased palatability.

The percent digestibility of DM, was varied non significantly between treatment groups and the highest DMD was observed in T₃ group followed by T₂, T₁ and T₄ group indicating coffee husk did not affect the digestibility of DM. Similar pattern was observed by Badarina *et al.* (2015) [3] and Rego *et al.* (2019) [11]. Ameca *et al.*, (2023) [2] observed higher DMD in coffee husk supplemented group. The percent digestibility of OM and CP in coffee husk fed group (T₂, T₃ & T₄) was comparable to control (T₁) group. The highest organic matter digestibility was observed in T₃ group followed by T₂, T₁ and T₄ indicating that coffee husk did not interfere with digestibility of OM. similar results were reported by Rios *et al.* (2015) [12] where he included coffee pulp up to 16% in the diet of sheep. Digestibility of CP varied non significantly between treatment groups and

the highest was seen in T₃ group and lowest CPD was observed in T₄ group. Similar results were reported by Badarina *et al.* (2015)^[3] and Rios *et al.* (2015)^[12] and they observed that there was no significant difference for CPD when coffee waste was included in the diet of sheep. Nunes *et al.* (2020)^[9] included coffee husk up to 24 percent in the diet of lambs and stated that the decrease in CPD is due to higher lignin content in coffee husk which was not observed in the present study. Also it was observed there was no significant difference in digestibility of EE, NDF and ADF between the control and treatment groups. The intake of DCP and TDN was similar between the control and treatment groups.

Weight gain and nitrogen balance

The average daily gain (g per day) during the experimental period was similar among the groups which may be attributed to similar TDN and DCP of the diets. Rios *et al.* (2015)^[12] and Sudita *et al.* (2023)^[16] observed increased ADG in coffee husk supplemented group. Similar results were also reported by Ameca *et al.* (2023)^[2]. Feed conversion ratio was also similar in all the groups however, higher FCR was noticed in coffee husk fed group (T₃) as compared to control due to higher DMI, higher intake of nutrient and higher intake of concentrate feed mixture with better digestibility and retention of nutrients resulting in improved gain. Ameca *et al.* (2023)^[2] observed similar FCR in coffee husk supplemented group. Garcia *et al.*, (2000)^[6] and Souza *et al.*, (2006a)^[13] reported increased FCR in coffee husk supplemented groups.

N intake of T₁ varied significantly with other treatment groups however; there was no significant difference among T₂, T₃, and T₄. N balance by T₁, T₂, T₃ and T₄ was 7.28, 8.78, 9.00 and 8.82 g/d, respectively. Positive N balance was observed in all the treatment groups and it increased linearly from T₁ to T₄. N balance among the treatment groups varied non significantly ($p>0.05$). Higher N intake in coffee husk supplemented group is due to higher N content in coffee husk compared to FMS and the higher N outgo in coffee husk supplemented group may be attributed to increased passage rate of digesta since the DMI was higher and higher lignin content in coffee husk which may be associated with nitrogen outgo. Higher N retained in coffee husk supplemented group may be attributed to higher intake of N. Oliveira *et al.* (2007)^[10] found decreased N balance in spite of increased CP in the supplemented diet due increased excretion of N was associated with lignin.

Table 1: Chemical composition of dietary ingredients and compounded feed mixture (% DM basis).

Particulars	Finger Millet STRAW	Coffee Husk	CFM
OM	89.41	91.52	93.59
CP	5.24	9.48	23.66
EE	0.72	1.44	2.18
CF	34.12	31.63	2.65
TA	10.59	8.48	6.41
NFE	49.33	48.97	65.1
NDF	70.72	60.84	18.86
ADF	44.73	43.08	7.87
Hemicellulose	25.99	17.76	10.99
Cellulose	37.3	24.58	9.58
Lignin	6.67	16.6	1.26

*Each value is the average of three observations.

**Composed of (g/kg): Yellow maize 584.8, Soybean meal 384.6, Di calcium phosphate 19.9, common salt 9.9, Vitamin mix 0.4 and Toxin binders 0.4.

Table 2: Nutrient composition of experimental diet (TMR) of different treatment groups used in growth trial (%DMB)

Particulars	T ₁	T ₂	T ₃	T ₄
OM	91.50	92.03	92.29	92.56
CP	14.45	15.51	16.04	16.57
EE	1.45	1.63	1.72	1.81
CF	18.39	17.76	17.45	17.14
TA	8.50	7.97	7.71	7.45
NFE	57.22	57.13	57.08	57.04
NDF	44.79	42.32	41.09	39.85
ADF	26.30	25.89	25.68	25.48
Hemicellulose	18.49	16.43	15.40	14.38
Cellulose	23.44	20.26	18.67	17.08
Lignin	3.97	6.45	7.69	8.93

DM was offered at 4.2% of body weight (ICAR 2013), 100 g ADG target.

Table 3: Nutrient digestibility, plane of nutrition and nutritive value of Coffee husk-based ration in experimental lambs during the feeding trial.

Atributes	T ₁	T ₂	T ₃	T ₄	SEM	P
Digestibility						
DM	52.50	53.34	55.71	52.61	2.01	0.670
OM	54.27	53.52	56.22	52.84	1.97	0.657
CP	62.22	63.15	64.35	60.30	1.61	0.368
EE	70.05	70.36	70.35	69.23	1.28	0.913
NDF	42.82	43.19	43.81	42.45	2.44	0.982
ADF	39.35	38.71	37.12	33.86	2.65	0.482
Plane of nutrition						
DM Intake g/d						
Total DMI g/d	573.22 ^a	650.88 ^b	662.34 ^{ab}	17.21 ^{ab}	19.19	0.020
% body weight	3.24	3.39	3.47	3.31	0.1	0.429
g/kg W ^{0.75}	66.43	70.91	72.55	68.77	2.12	0.235
Nutrient intake						
DCP intake (g/d)	26.61	34.47	37.00	32.64	2.6	0.067
TDN Intake (g/d)	294.56	348.32	357.90	325.18	18.90	0.125
Nutritive value of Total mixed ration						
DCP of diet (% DM)	8.99 ^c	9.79 ^b	10.32 ^a	9.99 ^b	0.25	0.010
TDN of diet (% DM)	51.48	53.13	53.98	52.55	1.79	0.793
ME (MJ/Kg)	7.79	8.03	8.16	7.94	0.27	0.797

^{abcd} mean values in a column bearing different superscripts differ significantly ($p<0.05$)

Table 4: Growth performance of lambs during feeding trial.

Particulars	T ₁	T ₂	T ₃	T ₄	SEM	p
Initial BW (kg)	11.93	11.54	11.82	11.52	0.63	0.956
Final BW (kg)	19.94	19.70	19.91	19.62	0.65	0.982
ADG (g)	89.03	90.64	89.91	90.01	1.17	0.81
FCR (g DMI/g wt. gain)	6.45	6.32	6.58	6.45	0.18	0.785
Mean FE	15.64	15.83	15.21	15.55	0.41	0.741

Table 5: Nitrogen balance in lambs during the metabolism trial.

Particulars	T ₁	T ₂	T ₃	T ₄	SEM	p
Nitrogen intake (g/d)	13.25 ^a	16.15 ^b	17.00 ^b	16.36 ^b	0.48	0.000
Nitrogen outgo (dung + urine) (g/d)	5.97 ^a	7.38 ^b	8.00 ^b	7.54 ^b	0.22	0.000
Nitrogen balance	7.28	8.78	9.00	8.82	0.50	0.096

^{ab} Mean values in a columns bearing different superscripts differ significantly ($p<0.05$)

Conclusion

Based on the results obtained from the present study, that replacement of finger millet straw with coffee husk did not adversely affect the growth performance in lambs. further, there was significant increase in DMI & CPI. Therefore, to optimize the performance of Hassan lambs by using locally

available unconventional feed, coffee husk can replace finger millet straw up to 100 percent (50 percent of total diet) in the total mixed ration of lambs without affecting the growth performance and nutrient digestibility.

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