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Original article

Effect of supplementing graded level of poultry litter and wheat bran on performance of Abergelle bucks

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ABSTRACT

The objectives of the study were to evaluate the appropriate level of poultry litter and wheat bran ration supplementation on feed intake, body weight gain and cost benefit analysis of Abergelle bucks fed on a grass hay basal diet. A ration of 74% poultry litter, 25% wheat bran and 1% salt was thoroughly mixed and fed for 90 days. Four treatments were applied, namely grass hay as a control (T1), grass hay + 150 g/d-1ration (T2), grass hay + 300 g/d-1 ration (T3) and grass hay + 450 g/d-1 ration (T4). DMI of grass hay 453.27, 487.05, 524.48 and 480.70 g d-1 for T1, T2, T3 and T4, respectively, and DMI was not affected ($p>0.05$) by the supplemental ration. However, supplemental bucks total DMI was higher by 6%, 12% and 16% for T2, T3 and T4, respectively from T1. Bucks in T1 gained 12.22 g/day while rams placed under T2, T3 and T4 gained 15%, 20% and 27% higher than T1, respectively. Thus, supplementation of 300 g/day ration of poultry litter and wheat bran is biologically more efficient and 150 economically more profitable and thus T2 and T3 are recommended for Abergelle buck fattening based on the target of the producer.

1. Introduction

The practice of agriculture the world over, is presently in favor of mixed farming systems by which various aspects of livestock production are integrated with cultivation of arable crops (Yousuf et al., 2013). This lead the main feed resources of ruminants in these areas are predominantly crop residue. Those, feed resource is lacking to supply the required nutrient to ruminants further affects their performance. Supplementing the required nutrient from other sources is critical to generate the desirable product form the ruminants. However, feed stuffs for animals are getting progressively expensive, thus necessitating minimization of feed cost, which could be achieved through the incorporation of relatively cheap and non-conventional feed ingredients (Asrat et al., 2008). Use of byproducts in ruminant diets can decrease production costs, accessible and increase total production (Goetsch and Aiken, 2000). Poultry litter has been identified as one of the non-conventional feeds for ruminant production (Asrat et al., 2008).

Poultry litter such as that from broiler/layer production units or houses is abundant in many parts of the world (Goetsch and Aiken, 2000). Although the inclusion of poultry litter in the diets of animals may be aesthetically difficult to accept, coprophagy is a common behavior among animals (Asrat, et al., 2008). Production responses are satisfactory when poultry wastes replace portions of the concentrate (Roothaert and Matthewman, 1992). The primary factors restricting efficiency of use of broiler litter at high dietary levels and with animals having high nutrient requirements involve the lowest available energy and ruminally undegraded protein levels (Goetsch and Aiken, 2000). Poultry wastes can be mixed with other feed stuffs when it is either fresh or dried. The feed stuffs to mix the poultry wastes should be rich in energy as poultry wastes are deficient in energy (Roothaert and Matthewman, 1992). The milling process of wheat produces large amount of wheat bran as a byproduct (Hossain et al., 2013). Isolated proteins from wheat bran may be used as ingredients in food formulations or special feeds, and contain superior nutritional value (Hossain et al., 2013). Wheat bran is rich in energy which is 2.42 MJ kg-1 (NRC, 1998).

Different research studies were undertaken on poultry litter treatment, mixing and feeding different classes of ruminants and fish. However, the appropriate level of poultry litter supplementation was not addressed, especially in our country. This research was undertaken to study the impact of poultry litter and wheat bran supplementation on feed intake, body weight gain and cost benefit analysis of Abergelle bucks fed on a grass hay basal diet.

2. Materials and Methods

2.1. Study area

The study was conducted at the Abergelle Agricultural Research station, Abergelle, Ethiopia. Which is situated at 13o 14' 06" N latitude and 38o 58' 50" E longitude. The area is categorized as hot to warm sub-moist lowland (SM1-4) sub-agro ecological zone of the region with an altitude of 1300-1800 masl and the mean annual rainfall ranging from 299 to 650mm which is characterized by low, erratic and variable rainfall. The mean annual temperature ranges from 28 to 40oC.

2.2. Experimental design and treatments

16 Abergelle bucks with the an age of 8 – 12 months was purchased from the local market. The design for this experiment was randomized complete block design (RCBD), with four treatments and replicated four times. These 16 Abergelle goats were assigned to four blocks based on their initial weight after consecutive two days fasting and each block contained four Abergelle bucks. The experimental bucks were assigned to each treatment within the block randomly and each block contains all the four treatments.

2.3. Treatments

T1= Feeding with grass hay (control) or (no supplementation)
T2= Grass hay + supplementation of 150g of poultry litter based ration
T3= Grass hay + supplementation of 300g of poultry litter based ration
T4= Grass hay + supplementation of 450g of poultry litter based ration

2.4. Management of the experimental bucks

Experimental bucks were tagged for identification and treated against internal and external parasite using anti-helminthes (Albendazole) and acaricides (Steladon), respectively, as per the recommended dosage and vaccinated against common disease of the area. The housing for the Abergelle bucks was in the Abergelle BED site constructed barn. The barn was a concrete floor, aerated with mesh wire in the middle, roofed with corrugate sheet and good drainage for feces and urine. Water was provided on free choice base through the experiment period.

2.5. Preparation of poultry litter based ration

Poultry litter was collected from deep floor system of Mekelle Farms poultry production. The collected poultry litter was sun dried till the dry matter reaches 85%. Sun drying of poultry destroys the pathogenic bacteria (Nadeem, et al., 1993). The wheat bran and salt was purchased from Mekelle market. The ration was prepared on the ratio of 25% wheat bran, 74% poultry litter and 1% salt and thoroughly mixed.

2.6. Feeding of the experimental animals

First the experimental bucks were left to adapt for the mixed ration and grass hay for the fortnight. Then the experimental bucks were supplemented accordingly; these bucks assigned to treatment one (T1) were fed grass hay in free base (control), bucks assigned to treatment two (T2) was supplemented 150g of the mixed ration in addition to the control feed, bucks assigned to treatment three (T3) was supplemented 300g of the mixed ration in addition to the control feed and bucks assigned to treatment four (T4) was supplemented 450g of the mixed ration in addition to the control feed. The supplemental ration was provided at two equal proportion at 8:00 and 16:00 morning and evening, respectively.

2.7. Statistical model and data analysis

The following statistical model was used in analyzing the data.

$Yij = \mu + \tau i + \beta j + \epsilon ijk$

Where; Yij = the overall response; μ = overall mean; τi = ith treatment effect (i= 1,2,3,4); βj = jth block effect (j= 1,2,3,4); ϵijk = overall treatment and block effect Data on the nutrient and dry matter intake, and live weight change were subjected to analysis of variance (ANOVA) using JMP5 (SAS Institute Inc, 2002) and mean comparison was done using Tukey's HSD test at $P<0.05$ (Sokal & Rohlf, 1981).

3. Results and discussion

3.1. Chemical composition

Feeds chemical composition used in this study is presented in Table 1. The DM and OM content of poultry litter was relatively lower than the grass hay and wheat bran. Comparably poultry litter (17.78%) and wheat bran (16.20%) contained higher CP than and grass hay (6.55%).

Table 1
Chemical composition of experimental feeds.

Composition	Feeds		
	Grass hay	Wheat bran	Poultry litter
DM (%)	94.71	93.58	90.75
OM (%)	91.77	93.73	83.05
CP (%)	6.55	16.20	17.78
NDF (%)	76.15	48.01	55.91
ADF (%)	50.62	15.52	32.85
ADL (%)	10.43	3.52	7.23

DM= dry matter; OM= organic matter; CP= crude protein; NDF= neutral detergent fiber; ADF= acid detergent fiber; ADL= acid detergent lignin.

3.2. Dry matter and nutrient intake

Results showed that grass hay DMI was not affected by supplementation of poultry litter based ration, but supplementation of poultry based ration had higher (P<0.0001) total DMI, OMI, CPI, NDFI and ADLI than the control group.

Table 2
Daily dry matter and nutrient intake of Abergelle bucks.

Parameters (%)	Treatments				SEM	P Value
	T1	T2	T3	T4		
DMI (hay)	453.27	487.05	524.48	480.70	26.098	NS
DMI	453.27^{c}	622.86^{b}	796.15^{a}	888.18^{a}	26.19	0.0001
OMI	415.96^{c}	563.50^{b}	714.44^{a}	790.80^{a}	24.04	0.0001
CPI	29.70d	55.50^{c}	810.50^{b}	102.27^{a}	1.72	0.0001
NDFI	345.16^{c}	444.05^{b}	545.74^{a}	585.56^{a}	19.95	0.0001
ADFI	229.44^{b}	285.10^{b}	342.60^{a}	358.94^{a}	13.26	0.0001
ADL	47.28^{c}	59.32^{b}	71.74^{a}	75.70^{a}	2.73	0.0001

$^{a, b, c, d,}$ means within a row not bearing a common superscript letter significantly differ. ***= (p<0.0001) NS = not significant DMI= Dry matter intake SEM= Standard error of mean OMI=Organic matter intake CPI= Crude protein intake

3.3. Body weight change

The result suggested that final weight of the bucks in ration T4 had better performance compare to (T1) but, insignificant at the other bucks fed on T2 and T3 rations. Daily live weight gain (DLWG) was higher in the supplemented group compared to (T1). From the supplemented group (T4) exhibited high DLWG than (T2) and (T3).

Table 3
Body weight change of Abergelle bucks supplemented with poultry litter and wheat bran.

Parameters	Treatments				SEM	P value
	T1	T2	T3	T4		
Initial weight Kg	18.55	18.3	17.85	18.25	0.23	NS
Final weight Kg	19.65^{b}	21.25^{ab}	21.35^{ab}	22.63^{a}	0.43	0.0066
DLWG (g/d)	12.22^{c}	32.80^{b}	38.90^{ab}	48.61^{a}	3.46	0.0001
FCE (gain/DMI)	0.026^{b}	0.042^{ab}	0.062^{a}	0.055^{a}	0.005	0.011

$^{a, b, c,}$ Mean in the same row with different superscript differ significantly SEM = standard error of mean NS=not significance different FCE = feed conversion efficiency DLWG = daily live weight gain (g/d) = gram per day)

3.4. Cost benefit analysis

Partial budget analysis of this experiment is conducted to determine economic feasibility of supplementing Abergelle buck with ration made of poultry litter and wheat bran. The net return obtained from feeding T1, T2, T3 and T4 and T5 were 132, 332, 376 and 482 ETB per head, respectively Table 4. This result describes feeding of Abergelle bucks with grass hay T1 they show weight gain and produce benefit of 132 but not produced higher profit like the supplemented one. This might be due to low concentration of nutrient in the feed and this lead to lower feed conversion efficiency and low return. According to Owen et al., (2008) The cost return pattern is a reflection of the biological effect as expressed in the results obtained. Comparing all the treatments T2 show higher profit followed by T3 and T4.

MRR for T2, T3 and T4 were 909, 554 and 530 ETB per head, respectively. This means for every expenditure of 1 ETB for the treatments (T2, T3 and T4) we are expected to get 9.1, 5.5 and 5.3 ETB per head, respectively. From this result T2 had the highest return compare to supplement and control. T3 and T4 had higher variable cost (feed cost) incurred than T2 this makes T3 and T4 less NI and MRR than T2 this happened because of optimum concentration of nutrient and higher feed conversion efficiency in T2 than T3 and T4. From all this, Abergelle bucks fed on grass hay and supplemented with 135.8 g/d DM of ration made from poultry litter and wheat bran when they get optimal nutrient they can show higher weight gains and profit like that of feeding concentrate feeds.

Table 4
Cost benefit analysis. kg= kilogram; Δ NI= change in net income; Δ TVC= change in total variable cost; MRR=

	Treatments			
Description	**T1**	**T2**	**T3**	**T4**
Purchase price of Abergelle buck, ETB/head	550	550	550	550
Total poultry litter consumed (kg/head)	0	9.99	19.98	29.97
Total wheat bran consumed (kg/head)	0	3.38	6.75	10.13
Salt (kg/head)	0	0.14	0.27	0.41
Cost of poultry litter, ETB	0	9.99	19.98	29.97
Cost of wheat bran, ETB	0	11.81	23.63	35.44
Cost of salt	0	0.2	0.4	0.6
Total variable (feed) cost	0	22	44.01	66.01
Gross income, ETB/head	132	354	420	525.6
Total return, ETB/head	682	904	970	1075.6
Net return, ETB/head	132	332	375.99	481.59
Δ NI	132	200	243.99	349.59
Δ TVC	-	22	44.01	66.01
MRR(Ratio)	-	9.09	5.54	5.30

Marginal rate of return; ETB= Ethiopian Birr; 1 Ethiopian birr = 0.05 €.

4. Discussion

The CP content of poultry litter found in this study was similar to (16.5%) unfermented poultry litter Nwaigwe et al., (2011) but, lower than 26.5 % reported by Asrat, et al., (2008). The variation in CP may arise from the type of cage, feed provides to the birds, the type of the farm and processing method. According to Hadjipanayiotou (1994) variation in chemical composition may arise from the ratio of bedding to wasted feed or excreta. Similarly Rooehaert and Matthewman (1992) explained no of birds per m2 and time affected the composition of poultry litter. The NDF content of the poultry litter (55.91%) was similar to wheat bran (48.01%) but, lower than grass hay (76.15%).

The DMI of this result contradicted with Yousuf, et al., (2013) reported increased level poultry litter inoculation in the goat diet decreased the DMI of the goats. This may arise from the sources of the poultry litter and the feed ingredients incorporated in the litter. ADFI did not show any difference between T1 and T2. The DMI result of this study contradicted with (Naddem et al., 1992) reported a decrease in DMI as a proportion of broiler litter increase. This may arise from the type and source of the poultry litter and the type of mixture.

The DLWG found in supplemented bucks of this study was in agreement with the observation of Nadeem et al., (1992) who reported 41.67±3.56 g/d for Babari goats supplemented with a concentrate mix with poultry litter proportion was 30%. However, the DLWG of this study was smaller than 70±10 g/d gain of West African Dwarf goats in replacement of concentrate by 50% poultry litter (Nwaigwe et al., 2011). Feed conversion efficiency (FCE) of the rams was higher at (T3) and (T4) than the remaining treatments. The feed conversion efficiency (FCE) of this finding was similar to Nadeem et al., (1992) who reported there is a relationship between feed intake and body weight change.

5. Conclusions

The CP content of poultry litter was higher than grass hay and wheat bran this resulted, the performance of the bucks improved as supplementation increased. Supplementation of 300 g/day ration of poultry litter and wheat bran is biologically more efficient and 150 g/d economically profitable. Thus, T2 and T3 are recommended for Abergelle buck fattening based on the target of the producer.

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