FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 10 No. 13, July, 2026, pp 83 – 87
DOI: https://doi.org/10.33003/fjs-2026-1013-5544

Feed Intake and Growth Performance of West African Dwarf Sheep Fed Graded Levels of Air-Dried Layers Litters and Brewers' Dried Grain

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ABSTRACT

The study evaluated the feed intake and growth performance of West African Dwarf (WAD) sheep fed graded levels of air-dried layer litter (ADLL) and brewers' dried grain (BDG). Thirty-two (32) growing West African Dwarf Sheep (WADS) weighing 15±0.5 kg were randomly assigned to four dietary treatments in a Completely Randomized Design, with eight animals per treatment. Experimental diets contained ADLL and BDG at inclusion levels of 20% (T1), 25% (T2), 30% (T3), and 35% (T4) with other ingredients kept constant. The study lasted 12 weeks. Data were collected on Dry Matter (DM), Crude protein (CP), Microbial Loads (ML), Feed Intake (FI) and growth performance. All Data were analyzed using one-way and treatment means were separated at 5% probability level. Dry matter content ranged from 91.20 to 93.10%, while crude protein was highest in T4 (23.65%) and lowest in T2 and T3 (19.26%). Microbial loads increased with higher ADLL inclusion, with T4 recording the highest total bacterial count (4.92×10^3 CFU/g) and total coliform count (2.99×10^2 CFU/g). Animals on T4 recorded the highest final weight (14.95 kg), weight change (3.94 kg), and best feed efficiency ratio (0.23), while T2 recorded the highest total feed intake (21.62 kg) and average daily feed intake (386.12 g/d). T4 had the best feed conversion ratio (4.59). It can be concluded from this study that Air-dried Layer Litter can be safely included in WAD sheep diets at up to 35% without adverse effects, improving nutritional profile, feed intake, and growth performance while reducing feed cost.

Received: 17 Jul. 2026

Accepted: 27 Jul. 2026

Published: 6 Aug. 2026

Keywords: Air-dried Layer Litter (ADLL), Brewers' Dried Grain (BDG), Feed Intake (FI), Microbial Loads (ML), Dry Matter (DM)

INTRODUCTION

Livestock play an integral role in the economic, social and food security of any given country, and FAO (2011) has predicted that based on 2010 statistics, the world would need 73% more of meat and 58% more of milk in 2050, perhaps these values for developing countries will be 109% and 116%, respectively. To meet this demand, huge quantity of feed resources will be required; challenging sustainability of the feed production systems. (Makkar, 2018). But poor nutrition has been challenging to sustainable animal production in developing countries (Adegbola *et al*., 2020). The use of roughages and concentrates has been identified as the major helping tool for dry season feeding (Raymond, 2008), but the persistent increase in the cost of those feeding materials and competition with other has necessitated the search for better alternatives (Ogunbosoye and Babayemi, 2010). The poultry industry has been established to be one of the largest and fast growing sectors of livestock production in the world (FAO, 2010). Poultry litter has traditionally been used efficiently as a fertilizer; but it is now also used as a cost-saving livestock feed supplement for ruminants especially cattle, goats and sheep (Alokan and Aderinola, 2000; Lanyasunya *et al*., 2006). Poultry litter has high crude protein of 20% with crude fibre of 10.40% (Owen *et al.,* 2008). Rotimi et al., (2013) reported that poultry litter has 26.8% crude ash content. Rankins (2000) reported that dried poultry litter has been used as a feed ingredient for more than 40 years without harmful effects to people who have consumed such animals or animal products. To develop a sustainable ruminant production system, efforts should be directed in making the best use of local resources by adjusting the production system according to local conditions (Nyako, 2015). The use of appropriate supplements coupled with basal diets is a fundamental component of the feeding strategy in order to balance nutrients and meet the rumen micro floral component of ruminant animals (Eric *et al*., 2025). The use of poultry manure as a substitute to reduce the costs of production and improved animal performance has, been demonstrated (Jokthan *et al*., 2013) although there are controversies over the inclusion levels of poultry litter in the diets of small ruminants. In a study by Alokan and Aderinola (2000) on the use of layer litter to feed sheep, the researchers concluded that dried layer litters could partially or totally on a weight to weight basis replace Brewers dried grain up to 50% in a concentrate diet offered to Yankasa without any deleterious effect on intake, digestibility and rate of growth. In another trial by Narasimha *et al*., (2013) on the use of poultry litter to feed sheep and goats, the researchers concluded its use up to 35% level in the diet of small ruminants as unconventional protein source without any adverse effect. Contrarily, Jokthan *et al*., (2013) recommended a lower level of 30% inclusion in the diet of Yankasa rams without any adverse effect on performance.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Department of Animal Production and Health, Small Ruminants Unit, Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State. (BATC, 2006).

Experimental Animals

Thirty-two (32) growing West African Dwarf sheep weighing 15±0.5kg were purchased from different local ruminant markets in Ogbomoso. On getting to the pen, the animals properly neck-tagged for identification and randomly assigned into four dietary treatments in a Completely Randomize Design. Prior to the arrival of the experimental animals, pens were thoroughly washed and disinfected. The sheep were made to acclimatize to the new environment for a period of three (3) weeks. During acclimation, the animals were given prophylactic treatment. The animals were fed wilted forages and cassava peel ad-libitum during acclimation.

Procurement of Air-Dried Layer Dropping and Other Feed Ingredients

Poultry layer litters was collected from the poultry layer pen of Lautech Teaching and Research farms Ogbomoso and thoroughly air-dried for seven (7) days to reduce moisture content, sieved and stored in a dried and cool place. The Brewers' Dried Grain was sourced from International brewery, Ilesha. Other feed ingredients including cassava peel, corn bran, rice bran and local potash were sourced from nearby feed mills within Ogbomoso.

Table 1: Composition of the Experimental Diets

Ingredients	T1	T2	T3	T4
Air-dried layers litter (%)	20.00	25.00	30.00	35.00
BDG	40.00	35.00	30.00	25.00
DCP	25.00	25.00	25.00	25.00
Corn bran	5.50	5.50	5.50	5.50
Rice bran	8.00	1.00	1.00	1.00
Local potash	1.00	1.00	1.00	1.00
Salt	0.50	0.05	0.05	0.05
Total	100	100	100	100
Calculated analysis				
Dry matter	91.80	91.50	91.20	90.89
Crude protein	15.00	15.03	15.07	15.10
Crude fibre	24.66	23.40	22.00	21.96
ME (MJ/kg/DM)	12.56	12.25	12.01	11.98
Ash (%)	5.00	7.20	9.65	10.56

Data Collection

Feed Intake

The feeding trial lasted for twelve (12) weeks, and these was determined by giving 3% body weight (DM) on daily basis to the experimental animals. The left ort in each trough was weighed between 07-08hrs the following day. The feed intake was determined by deducting the ort from the quantity of feed offered.

Feed intake =quantity of feed offered (g) –quantity of feed leftover (g)

Weight Change

The weight changes of the experimental animals were determined weekly by subtracting the final weight obtained from the initial weight.

Weight change= Final weight - Initial weight

Laboratory Analysis

Proximate and Fibre

The proximate compositions of the experimental diets were determined using the Procedure described by AOAC, (1990). Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) were determined by the Method of Van Soest (1994). Cellulose and hemicellulose were calculated as differences between ADF and ADL and NDF and ADF, respectively. Metabolisable energy of the diets was estimated using the Method of Alderman (1985) as follows: ME (MJ/kg DM) 11.78 + 0.00654CP + $(0.000665EE)^2$ – CF (0.00414EE) – 0.0118A

Microbial Load

Determination of total bacterial count (TBC), coliform count (TCC), fungal count (TFC) and total microbial count (TMC) were applied according to Kinley (2009).

Statistical Analysis

All data collected were subjected to one-way analyses of variance (ANOVA) using SAS (2000). Significant differences among means was separated using the Duncan's Multiple Range Test (5% probability) of the same package.

RESULTS AND DISCUSSION

Proximate and Chemical Compositions of the Experimental Diets made from Varying Brewer's Dried Grain and Layer Bird Litter Based Feed

The chemical compositions of the experimental diets differs significantly ($P<0.05$). The dry matters (93.10%) and Ash content (23.50%) were high for diet T3 while their lowest values were recorded for diets T4 (91.20% and diet T1 (10.80%). The highest crude protein (23.65%), Crude fibre (16.25%) and ether extract (7.55%) were recorded for diet T4 while their lowest values are scattered across T2 and T3. The highest NDF (46.60%), ADF (16.65%) and Cellulose (10.40%) were recorded for Diet T2 while their lowest values were recorded at diet T4 and T1, but the highest hemicellulose (31.40%) was recorded at diet T1 and low at diet T3.

Table 2: Chemical Composition of the Experimental Diets

Parameters	T1	T2	T3	T4	SEM
Dry Matter	91.40^{b}	92.40^{ab}	93.10^{a}	91.20^{b}	0.29
Crude Protein	22.07^{b}	19.26^{c}	19.26^{c}	23.65^{a}	0.60
Crude Fiber	15.80^{a}	15.10^{b}	15.85^{a}	16.25^{a}	0.14
Ether extract	4.90^{d}	6.90^{b}	6.65^{c}	7.55^{a}	0.30
Ash	10.80^{c}	24.05^{a}	23.50^{a}	12.27^{b}	1.84
Neutral detergent fibre	45.60^{b}	46.60^{a}	44.35^{c}	43.01^{d}	0.42
Acid Detergent Fibre	14.20^{c}	16.65^{a}	13.83^{c}	14.75^{b}	0.33

Parameters	T1	T2	T3	T4	SEM
Acid Detergent Lignin	4.95^{c}	6.25^{a}	5.15^{c}	5.85^{b}	0.16
Hemicellulos	31.40^{a}	29.95^{b}	30.52^{b}	28.26^{c}	0.38
Cellulose	9.25^{b}	10.40^{a}	8.68^{d}	8.90^{c}	0.20

^{abcd} Means with Different Superscripts Within a Row are Significantly Different (P<0.05). T1= 20% Air Dried Layer Litters +40% Brewer's Dried Grain; T2=25% Air Dried Layer Litters +35% Brewer's Dried Grain; T3=30% Air Dried Layer Litters +30% Brewer's Dried Grain; T4=35% Air Dried Layer Litters +25% Brewer's Dried Grain

Microbial Loads (CFU/g) Present in the Experimental Diets Made from Varying Brewer's Dried Grain and Layer Bird Litter Based Feed

The microbial loads of the experimental diets is presented in table 3 below. The microbial loads of the experimental diets differs significantly (P<0.05). The highest TBC ($4.92x10^3$) and TCC ($2.99x10^3$) were recorded for diet T4 while their corresponding lowest values were recorded at diet T1 ($3.03x10^3$, $1.67x10^3$) but TFC was highest at ($2.76x10^3$) and statistically similar for Diet T4 while T2 and T3 were similarly low.

Table 3: Microbial Loads (CFU/g) Present in the Experimental Diets Made from Varying Brewer's Dried Grain and Layer Bird Litter Based Feed

Parameters	T1	T2	T3	T4	SEM
Total Bacterial Count x 10^3	3.03^{d}	4.66^{b}	4.11^{c}	4.92^{a}	0.15
Total Fungal Count x 10^3	2.76^{a}	2.60^{b}	2.61^{b}	2.71^{ab}	0.02
Total Coliform Count x 10^2	1.67^{d}	2.86^{b}	2.74^{c}	2.99^{a}	0.11

^{abcd} Means with Different Superscripts Along the Row are Significantly Different (P<0.05). T1= 20% Air Dried Layer Litters +40% Brewer's Dried Grain; T2=25% Air Dried Layer Litters +35% Brewer's Dried Grain; T3=30% Air Dried Layer Litters +30% Brewer's Dried Grain; T4=35% Air Dried Layer Litters +25% Brewer's Dried Grain

Weight Change of WAD Sheep Fed Diets Made from Varying Brewer's Dried Grain and Layer Bird Litter-Based Feed

The growth response of the experimental animals is presented in Table 4. The initial weight of the experimental animals was not significantly affected (p>0.05) by the experimental diets. FW and WC were significantly high for animals on T4 (14.94 and 3.94 kg), while their least values were recorded at T1 (12.66 and 2.37) respectively. Animals on Treatment 2 recorded the highest TFI (21.62kg), ADFI (386.12g/d) and FCR (7.29) while their corresponding least values were observed at T1 (15.22kg and 271.83g/d) and T4 (4.59). The highest FER was recorded at Treatment 4(0.23) while treatment 2 and 1(0.14, 0.16) were similar low.

Table 4: Weight Change of WAD Sheep Fed Diets Made from Varying Brewer's Dried Grain and Layer Bird Litter Based Feed

Parameters	T1	T2	T3	T4	SEM
Initial Weight (kg)	10.28	11.37	10.42	10.98	1.18
Final Weight (kg)	12.66^{b}	14.33^{a}	13.16^{b}	14.95^{a}	0.56
Weight Change (kg)	2.37^{c}	2.95^{b}	2.74^{b}	3.94^{a}	0.61
Total Feed Intake (kg)	15.22^{d}	21.62^{a}	16.99^{c}	17.45^{b}	0.42
ADFI (g/d)	271.83^{c}	386.12^{a}	303.40^{b}	311.65^{b}	0.01
Feed Efficiency Ratio	0.16^{bc}	0.14^{c}	0.17^{b}	0.23^{a}	0.21
Feed Conversion Ratio	6.26^{b}	7.29^{a}	6.25^{ab}	4.59^{c}	3.18

^{abcd} Means with different superscripts along the row are significantly different (P<0.05). T1= 20% Air Dried Layer Litters +40% brewer's Dried Grain; T2=25% Air Dried Layer Litters +35% brewer's Dried Grain; T3=30% Air Dried Layer Litters +30% brewer's Dried Grain; T4=35% Air Dried Layer Litters +25% brewer's Dried Grain, SEM= Sum of error means, ADFI= /Average Daily Feed Intake

Discussion

The proximate analysis of any given diet reveals the nutritional constituent present therein. The high dry matter content ranging between 91.20-93.10% reported for the study were within the report of Ogunbosoye et al., (2018). The high dry matter obtained for this study can be linked to the inclusion of the BDG and the poultry layers droppings as the two ingredients has been reported to contained relatively high dry matter contents. (Rotimi *et al*., 2013). The crude protein are generally responsible for muscle development and most importantly for rumen environment welfare in ruminate animal (López-Herrera *et al*., 2026), crude protein content reported for this study were generally high across the treatments, this is traceable to the abundance of BDG and Layer's litter in the diets since both ingredients have been reported to contain high level of protein (Rotimi *et al*., 2013). The high CP content of BDG and Layer's litter is well documented making them an alternative feed ingredient (Ahemefule, 2015). Swain *et al*., (2012) reported a range of 17-18% CP contents for BDG and a minimum of 20% in Layer's litter was reported by Owen et al., (2008), thereby justifying the use of the Layer's litter as a protein source in ruminant diets also confirming the high Protein content obtained for all the experimental diet in this study. The high Ether extract (7.55%), and Ash (23.50%) reported for diets containing higher inclusion levels of Air-dried layers dropping is another indication that poultry dropping is a nutrient dense pack alternative feed ingredient thus supporting previous findings (Owen *et al*., 2008). The fibre contents obtained for this study were similar to the report of Etela et al., (2008) who formulated a diet from agricultural byproducts coupled with poultry layers droppings. All the experimental diets had high lignin content especially for Treatment 2 with 40% inclusion of BDG. Cellulose is closely associated with lignin thus the observed relatively high lignin content in the examined feed ingredients may have resulted in the high cellulose levels in this study. In other words, the concentration of cellulose provides an insight as to the level to which the diet has been lignified. Although the hemicelluloses gotten for this study is slightly high, but the inclusion of poultry layer litter was an advantage to aid the activities of the ruminal microbes.

The microbial load obtained for this present study were high compared to 1.5-1.7x10^3 reported by Oderinwale et al., (2021) who fed diet treated with urea. This indicated that inclusion of poultry litters in the diets improved bacteria, fungi and coliform populations by providing the required energy and protein for their growth. As the population of bacteria and fungi increase in the rumen, crude protein and fibre degradations will improve at reasonable rate and invariably microbial protein available for the animals will also increase. This is indicative of a normal rumen environment. Oni *et al.* (2017) reported that population density of microbes could be attributed to availability of nutrient in the rumen which triggers microbial proliferation. Rumen bacteria population is dependent on ammonia concentration and pH of rumen fluid, and both factors are dependent on type of diet(s) fed to animals. Rumen bacteria is the principal agent for fermenting plant cell wall carbohydrates hence they constitute the largest proportion of microorganisms in the rumen in relation to fungi (Oderinwale *et al*., 2021). The Total Bacteria Count were in the range of 3.03-4.92x10^3, Total Fungus Count within the range of 2.6-2.76x10^5 and Total Coliform Count, falls within the range 1.67-2.99x10^5 which is close to the reported values of Wojdat *et al*. (2005) who fed waste dried agro by products to growing WAD sheep but higher than the report of (Oderinwale *et al*., 2021).

The Feed intake of animal is a measure of diet appreciation, selection and consumption by an animal Masafu, (2006). And also regarded as one major factor that determines the potential of animal performance and acceptability to a given dietary treatments. The total feed intake in this study is between (15.22kg-21.62kg/Animal) is lower compared to the reported values of (68.25kg - 78.49kg/Animal) by Dikko *et al*. (2019) this could be as a result of the size, physiology and other factors that might be responsible for feed intake by the animals. The lower feed intake (15.22kg) recorded for animals on T1 can be attributed to the higher inclusion of levels of BDG in their diet which might have slow down the rate of digestion due to its higher fibre content. The final weight change of animal reported by Dikko *et al.* (2019) was between the range of (1.95kg - 4.75kg) and collaborate with report for the final weight change which ranges between (2.74kg - 3.37kg) and the average daily weight gain ranging from (48.88g/d -70.27g/d). Feed conversion ratio FCR which is the amount of feed eaten to gain 1kg of body weight (39-4.39g g/d) was found to be lower compared to reported values (22.08g/d-64.24g/d) of Dikko *et al*. (2019).

CONCLUSION

It could be concluded from this study that the inclusion of Air-dried Poultry layers dropping in ruminant diet improved the diets nutritional profile, feed intake in the weight change of the experimental animals thus, Air dried layers litter can safely be included in the diets of West African Dwarf sheep up to 35%, as it improved performance and lower the cost of feed production.

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