Effect of Floor Litter Materials on Growth Performance and Skin Lesions of Arbor Acre Broiler Chickens

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ABSTRACT

This 8 week experiment was carried out evaluate the impact of bedding materials on growth performance and skin lesions of birds. A total of 120 Arbor Arces day-old broiler chicks of mean weight 40.00±0.50g fed commercial mash ad libitum were reared on concrete floor of well ventilated, deep litter poultry housing. The birds were assigned to one of five treatments at random. (spread height of 0.05m thick litter material) wood shavings (control), saw dust (T2), rice husk(T3), coconut husk(T4), and sun-dried chopped leaves of Tectona grandis (T5) respectively with 8 birds each replicated three times in an entirely random design. Results indicated that T. grandis litter was significant (P<0.05) when compared to parameter of skin lesion (breast blisters 0.25%,foot pad dermatitis 0.72%, hock burn 0.31%); with highest performance both for final live weight (1.76 kg); dressed weight (1.61kg) respectively at 8 week finishing stage. In addition, saw dust recorded depressed performance (weight gain 0.65kg) respectively at 4 week starter phase. According to the findings of this study, T. grandis litter material is associated with depression of skin lesions and better feed conversion leading to higher performance of final weight. T. grandis should be adopted as deep litter material for broiler farming by farmers and researchers.

***Keywords**: Litter materials, broiler chickens, foot pad dermatitis, hock burn, breast blisters, and growth performance*

INTRODUCTION

A careful choice of a bedding material is very essential especially for a farmer who intends rearing his broiler chickens on the deep litter system under the intensive system of broiler production (Sharma *et al*., 2015). This is required because the growth performance, health and welfare of broiler chickens depends largely on the surface they intend spending all their lives on (Lonkar *et al*., 2018; Kryeziu *et al*., 2018; Barbosa *et al*., 2022; Durmus *et al*., 2023). Factors such as nutrition, genetics, weather and climate also exert a considerable influence on the performance of chickens (Brake *et al*., 1992; Monira *et al*., 2003; Durmus *et al*., 2023).

A good litter material should serve as layer of rest, locomotion and feeding (Monira *et al*., 2003). It should also play another important function of maintaining the normal moisture levels, temperature and humidity in a poultry house (Grimes *et al*., 2002; Lacy, 2002; Bilgili *et al*., 2009; Shepherd and Fairchild 2010; Chakma *et al*., 2012). Factors to look into while choosing any litter material should include cost, availability and environment impact of these litter materials (Garcês

et al., 2013; Mahmoud *et al*., 2014; Kalu, 2015; Diarra *et al*., 2021). All these are important because there is a persistent increase in the prices of conventional litter materials like wood shavings and saw dust because of its alternative use in industries and as a source of fuel as cost and availability can impact on the profitability of the business (Mondal *et al*., 2020; Diarra *et al*., 2021). The type of litter material used can also lead to stress and some abnormal behavioral problems which can cause stress which decreases the immune system of the bird, affect performance and even expose the chickens to diseases (Lien *et al*., 1992; Garces *et al*., 2013; Boussaada and Ouachem, 2019). So the choice of any litter material should incorporate allowing a bird to express its natural instincts of dust-bathing and even pecking (Kuleile *et al*., 2019; Barbosa *et al*., 2022). Hence this study seeks to evaluate the effect of different litter materials on the growth performance and skin lesions in broiler chickens.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the poultry unit of the Teaching and Research Farm of the Department of Animal Science, University of Uyo, Akwa Ibom State, Nigeria. The Farm is located on (latitudes 4^0 59 and 5^0 04N and longitudes 7^0 53 and 8^0 00E) with a mean annual rainfall of 2,190mm and a relative humidity of 81% (University of Uyo Meteorological center).

Experimental Materials

Wood shavings, saw dust, Rice husk, coconut husk were sourced locally, from Timber market - Uyo, Rice mill in Ini and Ikot Abasi Local Government Areas of Akwa Ibom State, Nigeria respectively. Leaves of *T. grandis* were harvested in the university premises around the forestry aboretum. The wood shavings were thoroughly dried and packed into bags and stored. Coconut husks, leaves of *T. grandis* were further chopped and dried to reduce moisture content. All the litter materials were dried, packed in bags and stored at room temperature in air tight containers.

Experimental birds and Management

A total of 120 Arbor Arces unsexed day-old broiler chicks of mean weight 40.00 ± 0.50g were purchased from a reputable distributor in Uyo, fed commercial mash, clean water *ad libitum* and reared on concrete floor of well ventilated, deep litter poultry housing. The birds were randomly allotted to five treatments of (spread height of 0.05m thick litter material) wood shavings (control), saw dust (T2), rice husk (T3), coconut husk (T4), and sun-dried chopped leaves of *T. grandis* (T5), (spread to a depth of 0.01m) with 8 birds each replicated three times in a completely randomized design. Before the arrival of the broiler chicks, the poultry house was washed with disinfectants and allowed to dry before the experimental litter materials, feeders, drinkers were provided in each of the pen. When the birds arrived, the day old chicks were weighed using an electronic sensitive scale (5.0 kg scale -Mettler, ME204E model), to obtain the initial weight. Vitamins, minerals and antibiotics were added to their drinking water for (3-5) three to five days.

Chemical composition of diet

Diets offered to the broiler birds were starter and finisher commercial mash diets. The chemical composition for the commercial starter and finisher diets is as shown on the table below.

Table 1: Chemical composition of commercial diet for starter and finisher phase

Parameter	Starter	Finisher
Crude protein	21.00	18.00
Crude fat	4.00	6.00
Calcium	1.00	1.20
Av. Phosphorus	0.47	0.70
Lysine	1.15	1.00
Methionine	0.50	0.40
Metabolizable energy(Kcal/kg)	2900	3000

Experimental Design

The birds were randomly allotted to five (5) treatment groups (T) and each treatment was replicated three (3) times with eight (8) birds per replicate. The experiment was arranged in a completely randomized design of wood shavings (control), saw dust (T2), rice husk (T3), coconut husk (T4), and sun-dried chopped leaves of *T. grandis* (T5).

Data collection

Daily Feed Intake:

Feed intake/Bird/Day: This was calculated using the following formula below:

$$= \frac{Feed\ served - left\ over}{56\ days}$$

Weight gain/bird/day (Kg)

This was calculated at the end of the experiment using the formula below:

$$\frac{\text{Final live weight} - \text{initial live weight}}{56\ \text{days}}$$

Feed Conversion Ratio (FCR): It was calculated using the following formula below:

$$\text{FCR} = \frac{\text{Average daily feed intake(Kg)}}{\text{Average daily weight gain(Kg)}}$$

Mortality: Mortality was recorded daily. This was determined at the end of the experiment using the following formula:

$$\frac{\text{Number of dead birds during the experiment}}{\text{Total Number of birds stocked}} \text{ x } 100$$

Skin lesions

At the end of week 5 and 8 of the experiment, the broiler chickens were assessed on contact dermatitis including Foot pad dermatitis, hock burn and breast blisters. Foot pad dermatitis was carried out following the protocols of Michel *et al*., (2012) using a scores. Both feet of the chickens were evaluated. The procedure recorded by Bignon *et al*., (2008) was used to evaluate for hock burn with no lesions equal to score 1, less than 25% hock area represented score 2 and more than 50% of the hock area equaled score 3. Breast blisters were scored following the occurrence of blisters, scratches and lesion as explained and described in Welfare Quality Assessment (WQ) protocol for poultry (2009).

Carcass analysis

After 8 weeks of the feeding experiment, carcass analysis was done. Three birds were used, one from each replicate of a particular treatment. The broiler chickens were fasted for 18 hours clear the gastro-intestinal tract of feed and avoid contamination of the carcass. Each of the birds were weighed using an electronic scale (Mettler, ME204E model) and thereafter slaughtered using a sharp knife by cutting the jugular vein. The carcass were de-feathered by dipping them in hot water of temperature 60°C for 30 seconds, as instructed by Scott *et al*. (1969) and described by Ndelekwute *et al*. (2014). The loosened feathers were manually plucked and cleansed. The neck, breast cut, back cut, thighs, and drumstick were all precisely weighed using an automated weighing balance and recorded in kilograms.

Statistical Analysis

The data gotten from the experiment were subjected to one-way Analysis of Variance (ANOVA), using the statistical package for social science (SPSS) version 21. Significant means was separated using Duncan New Multiple Range Test (DNMRT) according to the outlined method of Steel and Torrie (1980).

Results and Discussion

Table 2 presents a summary of the growth performance of broiler starter chickens raised on different litter materials (0- 4 weeks).

Table 2: Growth Performance of Arbor Acre broiler chickens raised on Different Litter Materials (0-4 weeks, starter phase)

Parameters/Treatments	Wood shavings	Saw dust	Rice husk	Coconut husk	*T. grandis* leaves	SEM
Initial Body Weight (kg/bird)	0.04	0.04	0.04	0.04	0.04	0.01
Final Body Weight (kg/bird)	0.89^{b}	0.69^{d}	0.69^{d}	0.75^{c}	0.93^{a}	0.01
Total Weight Gain (kg/bird)	0.85	0.65	0.65	0.71	0.89	0.01
Daily Weight Gain (kg/bird)	0.03	0.02	0.02	0.02	0.03	0.01
Daily Feed Intake (kg/bird)	0.07	0.08	0.07	0.08	0.07	0.04
Total Feed Intake (kg/bird)	2.08	2.10	2.03	2.10	2.09	0.04
Feed Conversion Ratio	2.34^{c}	3.00^{a}	2.90^{ab}	2.79^{ab}	2.51^{bc}	0.13
Mortality (%)	0.00^{c}	0.33^{b}	0.33^{b}	0.00^{b}	0.67^{a}	0.25

a-d means on the same row with the same superscripts are not significantly different (P>0.05), SEM=Standard error of mean.

The growth performance of Arbor Acre broiler starter hens reared on different litter materials and fed commercial mash (0-4 weeks, starter phase) is shown in Table 2.

The broiler chicks' initial body weights ranged from 0.40 to 0.41 kg, and no significant differences were found on birds reared on the different litter materials studied (P>0.05). However, broiler starter chickens raised on sun-dried chopped leaves of *T. grandis* litter material had higher body weights compared to other treatment groups (Table 2). Abougabal *et al*., (2022) found that chickens raised on wood shavings litter material gained more body weight at 4 weeks than other treatment groups. The conclusions of this investigation contradict the results of current experiment. Yadav *et al*., (2017) reports in their experiment that birds on rice hull and saw dust litter material had a higher feed consumption at week 4. Regarding feed consumption, birds raised on sun-dried leaves of *T. grandis* litter material had the highest feed intake. The edible nature of sawdust and rice husk as litter materials likely led to reduced consumption of the provided feed. The feed consumption ratios were significantly higher in birds raised on dried leaves of *T. grandis* compared to wood shavings and coconut husk, but similar to rice husk and sawdust (Table 2). The increased feed consumption in birds raised on dried leaves of *T. grandis* can be attributed to their higher body weights, which is same with the results of experiment by of Gernat *et al*., (2009). In the current study, no considerable differences (P>0.05) in feed gain ratios between treatment groups. Birds fed on *T. grandis* litter material had the highest feed conversion ratio, indicating more efficient feed usage. Birds reared on rice husk and sawdust had equal feed conversion percentages. These findings contrast from prior research of (Monira *et al*., 2003; Yadav *et al*., 2017), but are consistent with findings from other studies (Skrbic *et al*., 2012; Thriumalesh *et al*., 2013). The poor feed gain ratio in the current study could be due to some factors including, the strain of broiler chicken, the commercial feed fed to the experimental birds, type of bedding material used in the study.

Table 3: Growth Performance of Arbor Acre broiler Chickens raised on Different Litter Materials (5-8weeks, Finisher phase)

The performance effects of various litter materials on broiler chickens fed commercial diets for 8 weeks are summarized in Table 3 below.

Parameters/Treatments	Wood shavings	Saw dust	Rice husk	Coconut husk	*T. grandis* leaves	SEM
Initial body weight (kg)	0.89^{b}	0.69^{d}	0.69^{d}	0.75^{c}	0.93^{a}	0.01
Final body weight (kg)	1.67^{b}	1.37^{d}	1.36^{d}	1.53^{c}	1.76^{a}	0.02
Total Weight gain (kg)	0.78	0.68	0.67	0.78	0.83	0.02
Daily Weight gain (kg)	0.01	0.01	0.01	0.01	0.01	0.02
Daily Feed Intake (kg)	0.10	0.09	0.09	0.09	0.10	0.01
Total feed intake (kg)	5.34^{b}	4.88^{e}	5.11^{d}	5.24^{c}	5.51^{a}	0.01
Feed Conversion Ratio	3.19^{c}	3.65^{a}	3.74^{a}	3.43^{b}	3.12^{c}	0.05
Mortality (%)	0.00^{b}	0.33^{a}	0.00^{b}	0.00^{b}	0.33^{a}	0.21

a- e means on the same row with the same superscripts are not significantly different (P>0.05). SEM=Standard error of mean.

Table 3 shows the data obtained on Arbor Acre broiler finisher chickens (5-8 weeks) reared on different litter materials and fed commercial mash. There were considerable variations for initial and final body weight between treatment groups (P<0.05). When compared to the control group, broilers reared on sun-dried leaves of *T. grandis* litter material had statistically greater body weights. The current findings contradict the findings of Durmus *et al*., (2023), who reported a non-significant difference in body weight of broiler chickens when saw dust and fine saw dust litter material were utilized, respectively. In the current study, birds on saw dust and rice husk litter material had a lower body weight. Costa *et al*., (2021) revealed a negligible change in live and slaughter weight in their investigation on the usage of thick saw dust and rice straw litter material respectively. According to Dhaliwal *et al*. (2018), chickens reared on rice hulls and thick saw dust litter material had identical body weights. The current study's findings are also in contrast to prior research such as those of (Davasaugum *et al*., 1997 and Monira *et al*., 2003) and consistent with the results of previous investigations of Shakila and Naidu (1998). The lower body weights obtained in chickens raised on sawdust and rice husk litter material could be attributed to their consumption of litter materials which is mainly fiber and fiber diets are usually associated with low weight gain in monogastrics. At week 6, highest mortality was reported in birds reared in rice hulls litter material (Abougabal *et al*., 2022). This report disagrees with the current study which showed that chickens reared on saw dust and sun-dried leaves of *T. grandis* had similar and highest mortality rate. However, birds raised on sun-dried leaves of *T. grandis* litter material had the highest feed intake than broiler chickens on other treatment groups. Toghyani *et al*. (2010) disagree with their findings, reporting that birds raised on rice hull litter material consumed less feed. Durmus *et al*. (2023) in their studies noted that consumption of bedding materials (saw dust) due to its dusty nature may be the possible reason behind low consumption of feed. Yadav *et al*. (2017) recorded higher feed intake for birds on saw dust and rice husk litter materials during 6 weeks of investigation, in contrast to the current study.

Broilers reared on various litter materials had feed gain ratios ranging from 3.12 to 3.74 kg. Broiler chickens reared on sun-dried leaves of *T. grandis* litter material outperformed the other treatment groups in the current investigation. Petek *et al*. (2014) reports that using rice hulls as litter material in broiler production led to having a better feed gain ratio than wood shavings litter material in their study. The quality of the commercial feed used in the current study could be a culprit in this.

Table 4: Carcass characteristics (%) of broiler chickens raised on different litter materials. The effect of different litter materials on the carcass quality of Arbor Acres broiler chickens fed commercial diets for 8 weeks is summarized in Table 4.

Parameters/Treatments	Wood shavings	Saw dust	Rice husk	Coconut husk	*T. grandis* leaves	SEM
Live body weight (Kg)	1.65^{b}	1.42^{d}	1.33^{e}	1.55^{c}	1.76^{a}	0.02
Dressed weight (Kg)	1.52^{b}	1.32^{c}	1.21^{d}	1.47^{b}	1.61^{a}	0.58
Dressing %	92.55	93.22	91.03	95.06	91.69	12.21
Back cut (%)	15.52	14.99	15.42	16.65	15.01	0.01
Thigh (%)	11.52	11.39	11.37	12.12	11.99	0.45
Drum stick (%)	10.87	10.97	10.71	11.63	10.72	0.39
Breast cut (%)	21.44	15.76	18.19	23.10	21.43	3.13
Wing cut (%)	11.31^{a}	10.83^{ab}	10.22^{b}	10.51^{ab}	10.03	0.32
Shank (both) (%)	5.49^{b}	4.68^{d}	6.03^{a}	4.99^{cd}	5.33^{bc}	0.12
Neck cut (%)	5.32	5.64	5.20	5.58	4.92	0.27

a-d means on the same row with the same superscripts are not significantly different (P>0.05), SEM = Standard error of Mean.

Table 4 shows the impact of different litter materials on the carcass traits of Arbor Acres birds fed commercial mash diets for 8 weeks. Significant differences (P<0.05) were reported in the current study for live and dressed weight in kg. The live body weights of the broilers chickens used for carcass evaluation ranged from 1.33% to 1.76% for the different treatment groups. Broilers raised on sun-dried leaves of *T. grandis* litter material showed higher dressed weight than those in other treatment groups studied. The results for dressed weights of the broiler chickens showed significant results (P<0.05). The dressed weights in the current experiment showed a reflection of the values obtained from the live weights. The differences obtained for dressed weights can be attributed to differences in feed intake as noted by (Akpan, 2007). These findings reflect the results of the current experiment and are compatible with the reports of Willis *et al*. (1997). Data obtained for dressing percentage ranged from 91.03% to 95.06% for the various therapy groups tested. The current study's findings are consistent with those published by Mondal *et al*. (2020). In their studies they reported saw dust and rice hulls litter materials as having non-significant results for the

different treatment groups. Also the findings by Inthujaa *et al*. (2019) disagrees with the current study in terms of carcass weight and dressing percentage.

Table 5: Effect of Litter Materials on Arbor Acre Broiler birds Skin Lesions in (%)
The effect of different litter materials on the skin lesions of Arbor Acre broiler chicks is shown below on table 5.

Week/Skin Lesions/Treatments	Wood shavings	Saw dust	Rice husk	Coconut husk	*T. grandis* leaves	SEM
5 (Foot Pad Dermatitis)	1.51^{c}	2.39^{a}	1.83^{b}	0.33^{e}	0.52^{d}	0.01
5 (Breast Blisters)	0.28^{d}	0.74^{a}	0.42^{c}	0.51^{b}	0.13^{e}	0.01
5 (Hock burn)	0.71^{ab}	0.66^{b}	0.22^{c}	0.16^{d}	0.22^{c}	0.02
8 (Foot Pad Dermatitis)	1.75^{c}	2.52^{a}	2.16^{b}	0.92^{d}	0.72^{e}	0.03
8 (Breast Blisters)	0.55^{d}	0.92^{a}	0.82^{b}	0.72^{c}	0.25^{e}	0.20
8 (Hock burn)	0.82^{a}	0.85^{a}	0.74^{b}	0.55^{c}	0.31^{d}	0.02

a-e means on the same row with the same superscripts are not statistically different (P>0.05), SEM = Standard error of mean.

The effect of different litter materials on the skin lesions of Arbor Acre broiler chicks is shown on table 5. The treatment groups evaluated showed significant differences (P<0.05). The current study discovered that birds raised on saw dust and rice husk litter material had severe foot pad dermatitis, while birds reared on coconut husk at the eighth week and birds reared on sun-dried leaves of *T. grandis* litter material had the lowest prevalence of foot pad dermatitis. Durmus *et al*. (2023) discovered that birds raised on fine saw dust litter material had a higher rate of foot pad dermatitis. The findings of Durmus *et al*. (2023) are consistent with the current study. Taira *et al*. (2014) concluded his study's reports by emphasizing the need of keeping proper moisture levels in litter materials in limiting the occurrence of foot pad dermatitis. During weeks 5, 8 of the current study contact dermatitis were prevalent, with more birds on saw dust litter material. It should also be noted that the results of the present experiment are consistent with prior studies such as (Farghly *et al*., 2015 and Kuleile *et al*., 2019). Brinka *et al*. (2022) discovered a high prevalence of foot lesions in wood shavings litter material at 38 days of age in broiler chickens. This study contradicts the results of the current study.

Conclusion

From the present study, it can be deduced that *T. grandis* litter material is associated with inferior water holding capacity and water content that resulted in the depression of skin lesions and enhanced higher performance of final weight.

Recommendation

Farmers and researchers should adopt the use of dried leaves of *T. grandis* or wood shavings as deep litter material for broiler production.

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Conflicts of interest

None.

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