



Effect of wood shaving litter density on the growth, leg disorders and manurial value in broiler

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Abstract

The study was conducted with an aim to investigate the effect of litter density on growth, leg health and litter quality of broiler chickens from d1-42 days. Day-old male broiler chicks (n=400; Cobb 500) were distributed randomly into four litter densities [T₁, T₂, T₃ and T₄] treatments, each treatment had 5 replicates with 20 birds per replicate cage in a completely randomized design. Wood shaving was used as litter materials to a thickness of 5 cm, 8 cm, 11 cm and 14 cm on the floor of the pen. Birds were reared on the litter floor open-sided housing condition with *ad libitum* feed and water throughout the trail period. Data on feed intake (FI), body weight (BW), feed conversion ratio (FCR) and mortality were measured weekly. Litter sample was collected on day 42 to assess the nitrogen content (N₂ %), dry matter (DM%) and moisture level (%). Footpad dermatitis (FPD) and hock burn (HB) incidences were measured on day 42 to assess the leg quality of birds. Results demonstrated that litter thickness had no significant (P>0.05) effect on FI, BW, FCR and mortality of broilers from d1-42 days. The N₂, DM or moisture levels (%) of litter were also unaffected (P>0.05) between treatment. Leg disorders such as HB and FPD were influenced (P<0.01) by treatment. The incidences of HB and FPD were higher (P<0.01) in T₁ and T₂ than other treatments. It can be inferred from our current study that, leg health may be deteriorated by using low density wood shaving without affecting growth and litter quality of broiler chickens.

Key words: growth, footpad dermatitis, hock burn, litter thickness and composition, wood shaving, chicken

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Introduction

Litter or bedding material is used in the poultry house to provide comfortable environmental condition as well as to achieve optimum productive performances. It is clear that broiler performance depends on many factors such as chick quality, flock uniformity, bird size, nutrition and live weight on their first day of life including others (Cervantes, 1994; Decuypere *et al.*, 2001). Apart from these, litter material is another important factor, which can contribute better production potentiality for poultry (Hossain *et al.*, 20013). Birds can confront many challenges if they are raised on the litter floor. Litter material determines chickens' skin condition, which might influence the incidence of injuries as well as the conditions of the environment where birds are reared. Further, litter might cause carcass, breast, skin and leg lesions or injuries, as the birds are reared on the litter floor, and come

directly into the close contact of the litter materials. Besides, litter might harbour many infectious agents such as coccidia, which might affect the production performance of the broilers. Some litter materials can contain high moisture or humidity levels which might also aggravate the occurrence of lesions, mainly on chicken breasts and footpads (Zavala, 1997; Willis *et al.*, 1997; Godwin *et al.*, 2000). Apart from nutrition, the major factors leading to foot-pad dermatitis seem to be related to the litter moisture and excreta adherence to the skin. These challenges of using litter in poultry production can cause financial losses to the growers due to total or partial condemnation of carcasses, reduction in the price of the final product and reduction in the speed of processing (Oliveira *et al.*, 2002).

The prevalence of leg problems of broiler chickens could be affected by a numerous factors, including litter quality, feed sources, nutrient density, dietary protein levels,

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deficiency of specific nutrients, especially vitamins and minerals in broiler diets (Bilgili *et al.*, 2006; Brickett *et al.*, 2007). However, the incidence and severity of leg problems that is faced by the fast growing meat chickens is of great concern to the poultry enterprise, in terms of product quality and animal well-being viewpoint. Birds with increased number of leg problems are culled from the flock or downgraded at slaughter (Kestin *et al.*, 1999). Weak bones result in breaking during processing and lower meat grade. Also weak legs often result in reduced feed intake thus affecting weight gain as well as product quality (Orban *et al.*, 1999).

Wood shavings are a good litter, and are commonly used as bedding material in broiler production all over the world including Bangladesh. The aim of using good litter material in broiler production is, to prevent the direct contact of the bird with the floor and to promote the absorption of the faecal moisture (Garcia *et al.*, 2010). Many materials have been already examined as alternatives to replace wood shavings as litter materials (Reed & McCartney, 1970; Parsons & Baker, 1985; Santos *et al.*, 2000). However, various litter such as sawdust, sugarcane bagasse, rice husk, wheat straw, sand and ash are used as poultry bedding. It is reported that very few research work on the depth of litter material is done on the growth performance, leg health and litter quality of broilers. With those idea in view, the present study is undertaken to find out the suitable density of wood shaving as litter material for profitable broiler production.

Materials and Methods

Bird management and experimental design

A total of 400 (Cobb500) day-old male broiler chicks was procured from the local hatchery. The chicks were weighed on receipt and then assigned randomly in groups of 20 to 20 floor pens with wood-shavings as litter material. Birds were reared in a floored pen, open-

housing condition from d1 to 42 days on the different densities of wood shavings (5 cm, 8 cm, 11 cm and 14 cm). Each treatment had five replicate pens, 20 birds per replicate in a CRD design, as shown in Table 1. Chicks were brooded with a with a temperature of 33 °C for the first two days of rearing period. The temperature was then gradually reduced by 1 or 2 °C every 1 or 2 days until the chicks were 19 days old at which point the temperature was maintained at 24° C for the rest of the trial. Continuous lighting program was maintained entire the trial period. Feed was provided *ad libitum* in mash form and birds had a free access to water all the time until the last day of rearing birds. In the first 3 weeks, the birds were given starter diets followed by the finisher diets for the last 3 weeks. All the diets were iso-caloric and iso-nitrogenous, as shown below in Table 2.

Data collection

Prior to feeding, chicks were weighed at the first day of starting trial. Live weight, feed consumption and feed conversions ratios were calculated weekly. Mortality was recorded when it occurred. Litter samples from each replicate cage were collected on day 42 to measure out nitrogen (N₂), dry matter (DM) and moisture content. Hock burn and footpad dermatitis incidences of birds were also assessed on day 42 to assess the leg quality of broiler chickens.

Measuring of Hock burn (HB) and Foot pad dermatitis (FPD)

“Hock burn” (HB), is closely related to FPD, in which the skin of the hock becomes dark brown. In severe cases, scabs are observed. A total of 10 birds were randomly selected from each replicate cage, and observed the HB of each birds visually for any incidence of dermatitis or disorder, wound, lesions, and scored against a number of criteria. The hocks were given 1 (not affected), 2 (colour changes or minor lesions), or 3 points (severe lesions). Left and right hocks were scored separately.

Table 1. Experimental design

Replicates	Treatments				Total
	T ₁	T ₂	T ₃	T ₄	
R ₁	20	20	20	20	80
R ₂	20	20	20	20	80
R ₃	20	20	20	20	80
R ₄	20	20	20	20	80
R ₅	20	20	20	20	80
Total	100	100	100	100	400

T₁ refers to litter density of 5 cm, whereas T₂, T₃ and T₄ treatments indicate 8, 11 and 14 cm, respectively.

Table 2. Ingredient and nutrient composition of the basal diet

Ingredients (%)	Diets	
	Starter (d1-21)	Finisher (d22-42)
Corn	57.77	61.50
Soybean meal	34.58	30.00
Palm oil	3.60	5.20
DCP	1.68	1.35
Limestone	1.15	1.00
Table salt	0.40	0.38
Choline Cl-70%	0.05	0.08
Vita- premix	0.05	0.05
Min- premix	0.10	0.10
L-lysine	0.34	0.16
DL-methionine	0.19	0.15
L-Threonine	0.09	0.03
Total	100	100
Nutrient composition (%)		
ME (MJ/kg)	12.71	13.32
Crude protein	21.02	19.01
Calcium	0.91	0.76
Average Phosphate	0.45	0.38
Lysine	1.18	0.95
Methionine	0.45	0.40
Threonine	0.77	0.65

Method of scoring the incidence of FPD of broilers

FPD is a type of contact dermatitis affecting the plantar region of the feet in poultry and other birds. At an early stage, discoloration of the skin is seen. Hyperkeratosis and necrosis of the epidermis can develop, and in severe cases, these changes are followed by ulcerations with inflammatory reactions of the subcutaneous tissue (Ekstrand *et al.*, 1997). The severity and incidence of FPD of broilers are scored by visual ranking system on day 42. The FPD scoring test followed the 3-point scoring system developed by Nagaraj *et al.* (2007). To conduct the test, 10 birds were randomly selected from each replicate cage, and observed the foot-pad of each birds visually for any incidence of dermatitis or disorder, wound, lesions and scored against a number of criteria accordingly (Table 3).

Statistical analyses

Statistical analyses were performed using Minitab software (Minitab Version 16, 2000). The data were analyzed using a one-way ANOVA with litter density as independent factor. The significance of difference between means was determined by Fisher's least significant difference at $P \leq 0.05$.

Results

The gross responses of broilers in terms of feed intake, live weight gain, feed conversion ratio (FCR) and mortality on the different density of litter materials are shown in Table 4. It indicates that litter thickness had no significant ($P > 0.05$) effect on the gross responses of broiler chickens, as is shown in the Table 4.

Table 3. Three point scoring system of foot-pad dermatitis of broiler chickens

Scores	Degree of impairment	Criteria
1	Foot-paw with no lesion	Dermal ridges intact within central plantar footpad surface, with or without discoloration;
2	Footpads with mild lesions	Dermal ridges not intact within a central, round to oval ulcer on the central plantar footpad surface, roughened lesion surface with small tag of crust less than 1.5 cm in diameter;
3	Footpads with severe lesions	A brown crust more than 1.5 cm in diameter, adhered to the central plantar footpad, sometimes extending up to the hock joint

Litter composition (Nitrogen percentage, dry matter and moisture level) was also unaffected ($P>0.05$) between treatment (Table 5). Litter density had no impact ($P>0.05$) on the manurial value of wood shavings between treatment (Table 5). Only hock burn (HB) and foot pad dermatitis (FPD) scores were significantly ($P<0.01$) affected by treatment (Figure 1). Higher incidences ($P<0.01$) of HB and FPD were observed in the broiler chickens reared on lower density litter material (T_1 and T_2) than those reared on higher density (T_3 and T_4) litter materials (Figure 1). The higher scores of HB and FPD were found in T_1 and T_2 treatments whereas T_3 and T_4 treatment being the lowest scores in HB and FPD.

Discussion

From the current study it is clear that, the gross response of broiler chickens raised on the different density of litter material (wood shaving) was not affected. It implies that litter density had a similar impact on the growth performances of the broiler chickens. Our result could be in agreement with the previous investigators (Haque and Chowdhury, 1994; Mizuet *et al.*, 1998; Anisuzzaman and Chowdhury, 1996), who observed similar responses when different depths (2.0, 3.0, 4.0 and 5.0 cm) of rice husk were used for broiler production.

Broiler litter composition such as nitrogen content, dry matter and moisture levels also were not influenced by the different density of litter materials, as is evinced from our current study. It indicates that manurial value of the supplied litter was identical. The litter can be used in the land as organic manure for increasing soil fertility as well as to reduce the burden of excess application of chemical fertilizer on the crop fields. From this result, it can be postulated that litter composition could be similar, if different density of single litter matter is used for production of broiler chickens. However, many dietary factors such as protein level, electrolytic balance, ionophores, cereal contents, fibre content, legumes and NSPs etc., might regulate the excreta /litter moisture and quality (Fleet and Saylor, 1983; Smith *et al.*, 2000; Murakami *et al.*, 2001, Francesch and Brufau, 2004). The scores of foot health are being imposed to control the broiler health and welfare in the European countries such as Sweden and Denmark (Kjaer *et al.*, 2006). So the incidence

and severity of leg problems that is faced by the broilers is of great concern to the poultry enterprise, in terms of product quality and animal welfare (Hossain *et al.*, 2013a). Culling rate and downgrading carcasses during slaughter period are increased with the increase number of leg problems encountered in broilers (Kestin *et al.*, 1999).

Litter density influenced the leg health significantly as is observed from our current research findings. The results revealed that the incidence of leg disorders such as HB and FPD was found to be increased in the broilers raised on low density litter material (wood shavings) compared to high density litter matter (wood shavings). The reason behind this incidences could be the thickness, absorbability and moisture level of the supplied litter material *i.e.*, wood shaving supplied to the broiler chickens. As it is reported that, the excess moisture could affect the litter quality adversely and leads to an increased risk of development of footpad dermatitis and other disease incidences (Hossain *et al.*, 2013a).

Many previous investigators reported that some litter materials having increased moisture levels, could also enhance the occurrence of lesions, mainly on chicken breasts and footpads (Zavala, 1997; Willis *et al.*, 1997; Godwin *et al.*, 2000). Moreover, the incidence and severity of FPD and HB could be increased, if any factors that increase bird water excretion and excreta viscosity (Eichner *et al.*, 2007). Though the moisture level difference between treatment was insignificant in our present study, the high density litter had a comparatively lower moisture level than the low density litter. Further, wood shavings act as a good absorbent litter materials in poultry rearing. So it can be assumed that high density wood shavings could have more absorption capacity of moisture and reduced humidity than the low density litter matter, and this properties of the litter materials might influence the frequency of leg disorders (HB, FPD) or leg problem of the broiler chickens. Further, any dietary change that increases water intake of birds will lead to an increase in excreta moisture level. The NSP contents of plant diets arising from soybean and other meals could affect digestion of other nutrients by attracting water and contributing to higher litter moisture (Francesch and Brufau, 2004).

Litter density in broiler production

Table 4. Feed intake, live weight gain, feed conversion ratio (FCR) and mortality of birds raised on different densities of litter material (wood shaving) from d1-42 days

Parameters	Age (days)	Treatment				Pooled SEM	P-values
		T ₁	T ₂	T ₃	T ₄		
Feed intake (g/b)	1--7	120.30	117.81	123.96	123.20	2.350	0.782
	1-21	1172.80	1165.30	1169.10	1187.90	7.804	0.751
	1-35	3205.50	3237.50	3243.20	3256.00	16.547	0.741
	1-42	4434.30	4514.60	4548.90	4463.20	68.739	0.935
Live weight gain (g/b)	1--7	113.01	114.00	112.00	116.74	0.048	0.753
	1-21	878.20	883.83	889.50	891.66	7.580	0.922
	1-35	2053.80	2103.20	2120.20	2108.80	16.234	0.504
	1-42	2554.60	2662.40	2681.60	2537.60	37.567	0.438
FCR/ Feed: gain ratio	1--7	1.07	1.04	1.11	1.06	0.0343	0.912
	1-21	1.34	1.32	1.32	1.33	0.0098	0.843
	1-35	1.56	1.54	1.53	1.55	0.0096	0.697
	1-42	1.74	1.70	1.70	1.77	0.033	0.855
Mortality (%)	1-14	0.00	1.67	1.67	0.83	0.427	0.472
	1-21	0.83	1.67	1.67	0.83	0.475	0.560
	1-42	1.67	1.67	2.50	0.83	0.604	0.813

Each value represents the mean values of 5 replicates consisting of 20 birds in each replicate pen from day 1 to 42 days; SEM= standard error of mean.

Table 5. Nitrogen (N₂), dry matter (DM) and moisture level of litter matter on day 42

Parameter (%)	Treatment				Pooled SEM	P-values
	T ₁	T ₂	T ₃	T ₄		
N ₂	1.48	1.37	1.42	1.53	0.0368	0.429
DM	71.75	67.00	72.90	72.85	1.7086	0.439
Moisture	28.25	33.04	27.10	27.15	1.7086	0.439

Each value represents the mean values of 5 replicates consisting of 20 birds in each replicate pen from day 1 to 42 days.

However, sex and heavy weight of broiler chickens could also influence the FPD and HB incidences. Male birds are more susceptible to FPD than the females as reported by previous investigators (Harms and Simpson, 1975; Nagaraj *et al.*, 2007). There are contradicting results in the literature on this point, no difference between sexes, or more FPD in females reported by Berg (2004) and Harms *et*

al. (1977). The relatively high magnitude of the heritability of FPD and the low genetic correlation to body weight (BW) suggest that, it is possible to reduce susceptibility to FPD by genetic selection without negative effects on BW gain. This makes the trait more likely to be included in selection indices, which would be of benefit to broiler welfare worldwide (Kjaer *et al.*, 2006).

Litter density in broiler production

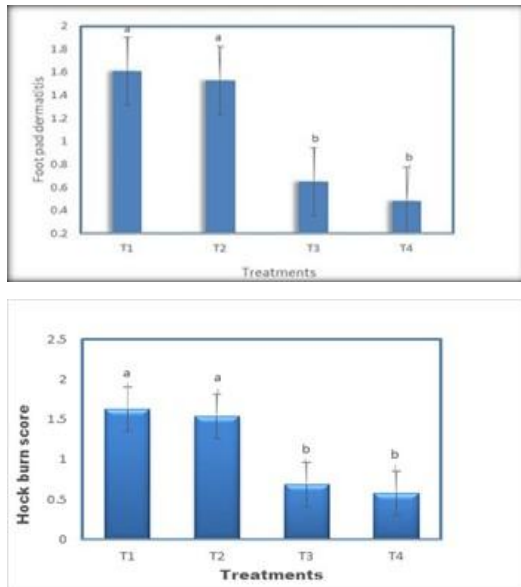


Figure 1. Foot pad dermatitis and hock burn scores of broilers of different treatments on day 42; Bars with different superscripts are significantly different at $**p < 0.01$.

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Conclusion

An overview of the results obtained in this current study revealed that, the growth performance of broilers and manurial value of litter materials were not affected by the litter density of wood shavings, but the incidences of leg disorders (HB and FPD) were found to reduce by using high density wood shaving in raising broiler chickens.

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