Vol 5 No 4 December 2024 Pages 1-4 e-ISSN 2708-5694

Journal of Agriculture, Food and Environment (JAFE)

Journal Homepage: https://journal.safebd.org/index.php/jafe

https://doi.org/10.47440/JAFE.2024.5401

Research Article

Management of broiler chickens using footpad and breast lesions, dustbathing behavior, and fecal microbial load as indicators

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Article history

Received: 20 August 2024

Revised: 04 October 2024

Accepted: 15 October 2024

Published online: 31 December 2024

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Keywords

litter management; dust-bathing; lesion; microbes

How to cite: Adedokun OO, Safiyu KK, Ekam IS, Ahamefule FO (2024). Management of broiler chickens using footpad and breast lesions, dustbathing behavior, and fecal microbial load as indicators. J. Agric. Food Environ. 5(4): 1-4.

ABSTRACT

This study was conducted on 180-day-old Ross 308 broiler chicks to investigate the effects of litter management strategies on footpad and breast lesions, dust-bathing and faecal microbial load. The chicks were divided into 3 groups: T1 = no-litter-change, T2 = litter changed at 7 days interval and T3 = litter changed at 14 days interval. Each treatment group had 60 birds, and this was replicated six times, with each replicate consisting of 10 birds, in a completely randomized experimental design. The study was conducted over a period of 8 weeks, and the resulting data were analyzed using a one-way Analysis of Variance (ANOVA) with a Generalized Linear Model (GLM) procedure to determine the effects of the different treatments. Results revealed birds in T1 recorded the highest frequency of dust-bathing than their counterparts in T2 and T3. Minor breast lesions were also observed in 13.33% and 16.67% of birds in T2 and T3, respectively. Birds in T1 showed a significant increase ($P<0.05$) in faecal bacteria isolates compared to treatment groups T2 and T3. The birds in treatment group T2 showed a significant decrease ($P<0.05$) in protozoa isolates compared to those in treatment groups T1 and T3**.** Therefore, no-litter-change improved welfare and comfort of broiler chickens with the expression of the highest frequency of dust-bathing without the presence of breast and foot pad lesions. However, litter change at 14 days interval reduced faecal bacterial contamination.

INTRODUCTION

In the commercial broiler industry, birds are raised on floors with various types of litter materials, which poses significant challenges in terms of management and disposal, particularly in relation to cost (Karamanlis *et al.*, 2008; Garcia *et al.*, 2010). Litter is a complex mixture of bedding materials, faeces, feed, feathers, and water, and its moisture and quality levels have a direct impact on the health, performance, and welfare of broiler chickens (Skrbic *et al.*, 2012). Good-quality litter is essential for maintaining a comfortable and healthy environment, as it helps to reduce floor humidity, allows for natural scratching behaviour, and provides thermal insulation, moisture absorption, and ammonia emission reduction (Bjedov *et al.*, 2013). Furthermore, litter serves as a protective barrier between the birds and the ground. However, if litter is not properly selected or managed, it can lead to environmental and management problems in the poultry industry, highlighting the need for careful consideration of litter quality and management practices (Karamanlis *et al.*, 2008; Garcia *et al.*, 2010).

Research has shown that poor litter conditions can have severe consequences on broiler chickens, including impaired growth, weakened immune systems, and increased incidence of health issues such as breast burns, leg abnormalities, and footpad dermatitis (Garcia *et al.*, 2010). To mitigate these issues, the ideal bedding material should be absorbent, dry reasonably quickly, and be safe for both poultry and farmers (Grimes *et al.*, 2007). Additionally, it must meet hygiene standards and maintain controlled ammonia levels throughout the production cycle (Villagra *et al.*, 2011). Effective litter management is crucial in chicken production, not only for maintaining flock health and productivity but also for preventing the spread of pathogens (Bjedov *et al*., 2013). The poultry industry is also driven to improve litter management to enhance consumer confidence in the food supply chain, with studies focusing on reducing pathogenic bacteria, improving broiler productivity, and boosting the immune system of the birds (Lee and Lillehoj 2016). The quality of litter management can significantly impact the efficiency of the broiler immune system, which in turn affects growth performance. This study aims to investigate the welfare indices and faecal microbial load of broiler chickens under different litter management conditions.

MATERIALS AND METHODS

Experimental location

This research was conducted at the Poultry Unit of the Teaching and Research Farm of the College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria. The farm is situated in a tropical rainforest region in southeastern Nigeria, with a specific geographic location of 5° 28' North latitude and 7° 32' East longitude, and an elevation of 122 meters above sea level. The area experiences a significant amount of rainfall, with an average annual total of 2,177mm spread over 148-155 days, and a relative humidity range of 57-91% during the rainy season. The environmental temperature in the area typically ranges from 22-30°C, according to data from the National Root Crops Research Institute (NRCRI, 2021).

Experimental birds and management

A total of 180 day-old Ross broiler chicks were procured from a reputable hatchery in South-western Nigeria for use in this experiment. Before their arrival, the experimental facilities were prepared by washing, disinfecting, and drying the pens and equipment, and covering the floor of the brooder house with a 4 cm layer of wood shavings as litter material. Upon arrival, the chicks were vaccinated and administered glucose and multivitamins to alleviate transportation stress. The birds were then randomly assigned to one of three management treatments (T1, T2, and T3), with each treatment being replicated six times with 10 birds per replicate. The birds were raised in a deep litter system, with feed (Table 1) and water provided *ad libitum* and routine management practices carried out as needed, over an 8-week period. The main difference between the treatments was the litter change frequency: T1 had no litter change throughout the experiment, while T2 and T3 had litter changes every 7 and 14 days, respectively. The birds were weighed at the beginning of the experiment and then weekly thereafter.

Table 1: Experimental Diets Composition

Ingredients	Starter	Finisher
Maize	48.00	59.20
Soyabean meal	27.20	23.00
Fishmeal	2.00	2.00
Wheat offal	14.00	7.00
GNC	5.00	5.00
Bonemeal	3.10	3.10
Lysine	0.10	0.10
Methionine	0.10	0.10
Salt	0.25	0.25
Premix	0.25	0.25
ME (kcal/g)	2833.72	2974.02
CP (%)	22.15	20.32

GNC-Groundnut cake, CP-Crude Protein, ME- Metabolizable Energy

Data collection

Welfare indicators

The dust-bathing behaviour of the experimental birds was monitored from week 3 to week 8, with observations taken three times a week. The data collected included the number of birds in each replicate that exhibited dust-bathing behaviour within a 5-minute period. Breast pad lesion and foot pad scores were also measured on weekly interval to see the number of birds with no, slightly and considerable pad lesion.

Breast pad lesion and foot pad score

0 – Indicate no lesion

1 – Indicate modest or slightly lesion

2 – Indicate considerable or pronounce lesion

Faecal Microbial Load

On the final day of the experiment, faecal samples were collected from two birds per replicate and subjected to microbiological analysis, using the methods described by Milanov *et al.* (2019).

Statistical analysis

The data collected from this experiment were analyzed using a one-way Analysis of Variance (ANOVA) with the General Linear Model (GLM) procedure in Minitab software (version 19.1.0). To determine significant differences between treatment means ($p<0.05$), the Tukey test was applied using the same software. The statistical model used for this study can be represented as:

$$Y_{ij} = \mu + T_i + E_{ijk}$$

Where;

Y_{ij} = Response variable

μ = Overall Mean

T_i = Effect of i^{th} (litter management)

E_{ijk} = Random error term

RESULT AND DISCUSSION

Welfare indicators

The relationship between litter management and dust-bathing frequency in broiler chickens is shown in Fig. 1. It was observed that expression of dust-bathing across treatments increased per week and peaked at week 6. However, birds in T1 where litter was not changed recorded the highest frequency of dust-bathing than their counterparts in T2 and T3. This result may imply that the continual presence of adequate bedding material for birds in the control group encouraged the expression of dust-bathing behaviour unlike their counterparts in other treatments who encountered some level of disturbance at every interval of litter change. This finding is consistent with previous research by Moesta *et al.* (2008), which showed that laying hens exhibit a preference for dust-bathing in used bedding over fresh wood shavings. Furthermore, studies by Škrbić *et al.* (2012) and Bjedov *et al.* (2013) highlight the importance of providing an adequate amount of litter in deep-litter houses, as it enables birds to engage in natural behaviours such as scratching and dust-bathing in a comfortable environment. Similarly, Schrader (2008) found that the availability of loose, friable litter encourages dust-bathing behaviour in various poultry species.

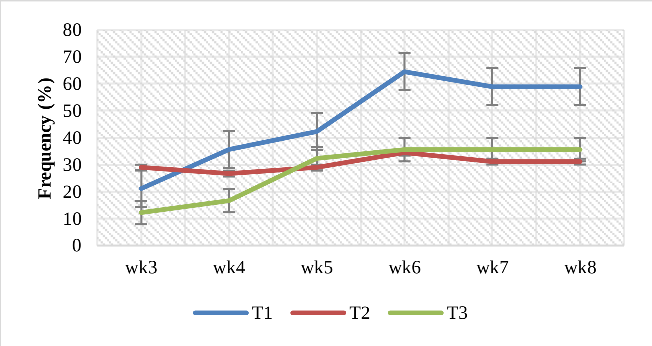

Figure 1: Effect of litter management on dust-bathing behaviour of broiler chickens
T1 = no litter change, T2 = litter changed at 7 days interval and T3 = litter changed at 14 days interval.

Fig. 2 illustrates the impact of litter management on the occurrence of breast lesions in broiler chickens. There are no visible breast lesions in all birds in T1, as well as 86.67% and 83.33% of birds in T2 and T3, respectively. However, 13.33% and 16.67% of birds in T2 and T3, respectively had minor breast lesions while severe lesions were not observed in any of the experimental birds across treatments. This result may imply litter management pose slight welfare concerns to broiler chickens as the birds experience temporary disturbance during the litter change intervals (i.e., 7- and 14-days) with some birds trying to dust-bathe on the bare floor. This study's findings are supported by earlier research on the causes of breast lesions in broiler chickens. Michel *et al.* (2012) reported that dry and friable litter can lead to smooth breast lesions without scales. Santos *et al.* (2002) also found that litter moisture was a major contributor to the incidence of breast lesions. Moreover, Mayne *et al.* (2007) showed that wet litter can cause more contact dermatitis in broilers than dry litter, emphasizing the need for proper litter management to prevent these lesions.

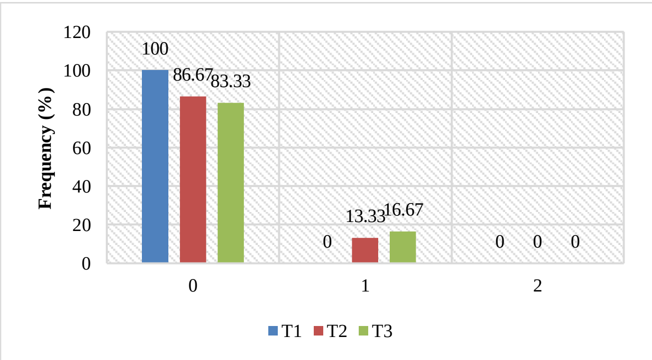

Figure 2: Effect of litter management on incidence of breast lesions in broiler chickens
T1 = no litter change, T2 = litter changed at 7 days interval, T3 = litter changed at 14 days interval, 0 – no lesion, 1 – minor lesion and 2 – severe lesion.

Fig. 3 illustrates the relationship between litter management and foot pad lesions in broiler chickens. The data show that treatment T1 was completely effective in preventing foot pad lesions, with no lesions observed in any of the birds, whereas treatment T2 resulted in foot pad lesions in 40% of the birds. Moreover, other birds in T2 showed the prevalence of minor (50%) and severe (10%) foot pad lesions while the highest incidence of minor (66.67%) and severe (33.33%) foot pad lesions were recorded in birds in T3. The brief distress experienced by broiler chickens during litter management operations may be responsible for triggering the incidence of foot injuries as density of litter was greatly reduced with birds having direct contact with the bare floor. The findings of this study are supported by previous research, including a study by Hossain *et al.* (2018) that found broiler chickens raised on low-density bedding material were more likely to develop leg disorders than those raised on high-density bedding material. Furthermore, studies by Karamanlis *et al.* (2008) and Garcia *et al.* (2010) have also demonstrated a relationship between litter condition and the incidence of foot pad lesions in poultry species, highlighting the importance of providing suitable litter conditions to prevent these lesions.

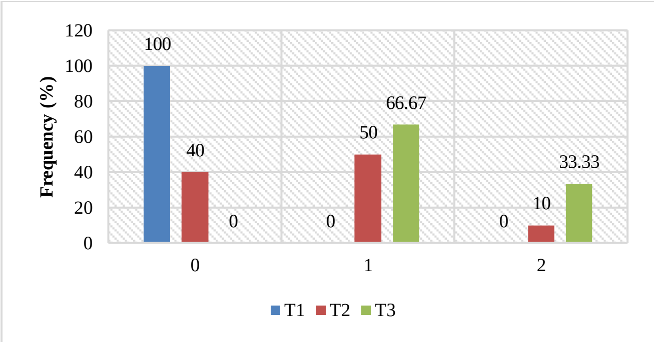

Figure 3: Effect of litter management on incidence of foot pad lesions in broiler chickens
T1 = no litter change, T2 = litter changed at 7 days interval, T3 = litter changed at 14 days interval, 0 – no lesion, 1 – minor lesion and 2 – severe lesion.

Faecal Microbial Load

Table 2 presents the impact of litter management on the faecal microbial load of broiler chickens. The results show that the bacterial isolates in the faecal samples of birds in treatment T1 were significantly ($P<0.05$) higher (20.70%) compared to those in treatments T2 (13.80%) and T3 (15.50%). It is expected that the consequences of not changing litter throughout the broiler production cycle are build-up of manure and other debris from poultry birds as well as increased bacteria proliferation. Therefore, birds reared using such litter may pick-up contaminated feed thereby influencing the gut bacterial population. Previous studies have shown that the continuous use of the same litter for poultry can influence the composition of their gut microbiome, as reported by Wang *et al.* (2016). Additionally, research by Chen and Jiang (2014) and Nandi *et al.* (2004) has highlighted the dominance of Gram-positive bacteria in chicken litter, which accounts for around 90% of the microbial diversity and is a major source of antibiotic resistance genes. The results of this study also revealed that the protozoa isolates in birds from T1 and T3 were statistically similar (21.30% and 21.40%, respectively), but significantly higher (P<0.05) than those in T2 (7.15%). This finding is consistent with the report by Viegas *et al.* (2012), who found that aged litter tends to harbour a greater variety of pathogenic protozoa than fresh litter.

Table 2: Effect of litter management on faecal microbial load of broiler chickens

Parameters	T1	T2	T3	SEM	P-VALUE
THPC ($\times 10^7$cfu/g)	6.75	7.68	7.52	0.87	0.731
TCPC ($\times 10^8$cfu/g)	4.15	6.70	6.30	0.81	0.109
TSSPC ($\times 10^8$cfu/g)	3.15	3.55	3.90	1.17	0.903
TSPC ($\times 10^7$cfu/g)	3.88	4.53	3.70	0.81	0.756
TFPC($\times 10^7$cfu/g)	4.07	1.95	3.10	0.92	0.309
Bacteria Isolates (%)	20.70[a]	13.80[b]	15.50[b]	0.57	0.000
Fungi Isolates (%)	18.60	12.50	18.80	2.95	0.274
Protozoa isolates (%)	21.30[a]	7.15[b]	21.40[a]	4.14	0.048

[a, b] Means within the same row with different superscripts differ significantly (P<0.05)
T1 = no litter change, T2 = litter changed at 7 days interval, T3 = litter changed at 14 days interval, THPC: Total heterotrophic plate counts, TCPC: Total coliform plate count, TSSPC: Total salmonella shigella plate counts, TSPC: Total staphylococcus plate counts, TFPC: Total fungal plate counts.

CONCLUSION

In summary, the results of this study demonstrate that not removing litter material (T1) has several benefits for broiler chicken welfare. Specifically, it promotes dust-bathing behaviour, decreases the incidence of breast lesions, and eliminates foot pad lesions. Although the microbial load was slightly higher in T1, it was still within acceptable limits. As a result, it is recommended that farmers consider adopting this litter management practice (T1) to enhance the overall health and welfare of their broiler chickens.

REFERENCES

Bjedov S, Žikić d, Perić l, Đukić stojčić M, Milošević N 2013: Effect of different litter treatments on production performance of broiler chickens. *Biotechnology in Animal Husbandry*, **29**, 4, 625-630

Chen Z, Jiang X 2014: Microbiological safety of chicken litter or chicken litter-based organic fertilizers: a review. *Agriculture*, **4**, 1-29

Garcia R, Almeida PI, Caldara FR, Näas IA, Pereira DF, Freitas LW, Graciano J 2010: Effect of the litter material on drinking water quality in broiler production. *Revista Brasileira de Ciência Avícola*, **12**, 165 - 169.

Grimes JL, Carter TA, Gernat AE, Godwin JL 2007: A novel bedding material made from cotton waste, gypsum, and old newsprint for rearing turkeys. *Journal of Applied Poultry Research*, **16**: 598 - 604.

Hossain MA, Zulkifili I, Islam S, Awad EA 2018: Effect of wood shaving litter density on the growth, leg disorders and manurial value in broiler. *Bangladash Journal of Animal Science*, **47**, 1, 21-27.

Karamanlis X, Fortomaris FP, Arsenos G, Dosis I, Papaioannou D, Batzios C, Kamarianos A 2008: The effect of a natural zeolite (clinoptilolite) on the performance of broiler chickens and the quality of their litter. *Asian-Australasian Journal of Animal Sciences*, **21**, 1642 - 1650.

Lee, KW and Lillehoj, HS 2016: An update on direct-fed microbials in broiler chickens in post- antibiotic era. *Animal Production Science*, 57, 8, 1575-1581.

Mayne RK, Else RW, Hocking PM 2007: High litter moisture alone is sufficient to cause footpad dermatitis in growing turkeys. *British Poultry Science*, **48**, 538 - 545.

Michel DRW, Prampart E, Mirabito L, Allain V, Arnould C, Huonnic DL 2012: Histologically- validated footpad dermatitis scoring system for use in chicken processing plants. *British Poultry Science*, **53**, 275 - 281.

Milanov D, Knežević S, Vidaković S, Pajić M, Živkov-baloš M, Aleksić N 2019: Microbial contamination of poultry litter during fattening period. *Biotechnology in Animal Husbandry*, **35**, 3, 253-265

Moesta A, Knierim U, Briese A, Hartung J 2008: The effect of litter condition and depth on the suitability of wood shavings for dustbathing behaviour. *Applied Animal Behaviour Sciences*, **115**, 160 - 170.

Nandi S, Mauurer JJ, Hofacre C, Summers AO 2004: gram-positive bacteria are a major reservoir of class 1 antibiotic resistance integrons in poultry litter. USA. pp. 7118 - 7122.

National Root Crops Research Institute (2021). National Root Crops Research Institute, Umudike, Nigeria. Agro-Metrologic Unit.

Santos FBO 2006: Impact of poultry age, season, litter quality, and nutritional intervention strategies on salmonella prevalence and populations, serotypes, genotypes, and antibiotic resistance profiles. PhD dissertation, in Poultry Science. Faculty of North Carolina State University, USA

Santos RL, Nunes VA, Baião NC 2002: Contact pododermatitis in broilers. *Brazilian Archive of Veterinary Medicine and Animal Science*, **6**, 655 - 658.

Schrader L 2008: Behavior and attitude. in: Brade, W. Flachowsky, G. Schrader, L. (eds). Layer hen breeding and egg production. Recommendations for practice. Johan Heinrich von thunen Institute (vti), Braunschweig: 93 - 117

Škrbić Z, Pavlovski Z, Lukić M, Petričević V, Milić D 2012: The effect of lighting program and type of litter on production and carcass performance of two broiler genotypes. *Biotechnology in Animal Husbandry*, **28**, 807 - 816.

Viegas C, Carolino E, Malta-vacas J, Sabino R, Viegas S, Verissimo C 2012: Fungal contamination of poultry litter: a public health problem. *Journal of Toxicology and Environmental Health*, 22-23, 1341-1350.

Villagrá A, Olivas I, Benitez V, Lainez M 2011: Evaluation of sludge from paper recycling as bedding material for broilers. *Poultry Science*, **90**: 953 - 957.

Wang L, Lilburn M, Yu Z 2016: Intestinal microbiota of broiler chickens as affected by litter management regimens. *Frontiers in microbiology*, **7**, 593 – 594.