

Research Article



Effects of Litter Turning Frequency on Litter Moisture, Ammonia Concentration, and Footpad Dermatitis in H'Mong Chickens

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Abstract | Litter management plays an important role in maintaining environmental quality and animal welfare in poultry production, particularly in floor rearing systems where moisture and ammonia can accumulate rapidly. This study aimed to evaluate the effects of different litter turning frequencies on litter characteristics, ammonia concentration, and footpad dermatitis in H'Mong chickens. A total of 160 one-day-old H'Mong chickens were used in a completely randomized design with four litter turning treatments: LT0, no litter turning; LT1, litter turning once per week; LT2, litter turning twice per week with a three-day interval between turnings; and LT3, litter turning three times per week with a two-day interval between turnings. Each treatment consisted of two pens, with 20 chickens per pen, and rice husk litter was applied at an initial depth of 8 cm in all pens. Litter moisture, litter temperature, and ammonia concentration were measured during the experimental period, while footpad dermatitis was evaluated using a 0 to 3 scoring scale. Litter moisture and ammonia concentration decreased significantly with increasing litter turning frequency ($P < 0.05$). The highest values were observed in LT0, whereas the lowest values were recorded in LT3. Litter moisture and ammonia concentration increased over time in all treatments, but the rate of increase was slower in treatments with more frequent litter turning. Similarly, footpad dermatitis scores were significantly reduced as litter turning frequency increased, with the lowest lesion severity recorded in LT3. Increasing litter turning frequency effectively improved litter quality, reduced ammonia accumulation, and minimized footpad dermatitis in H'Mong chickens. Under the conditions of this study, turning litter three times per week was the most effective management strategy.

Keywords | Litter turning, Ammonia, Footpad dermatitis, Litter moisture, H'Mong chickens, Poultry welfare

Received | March 19, 2026; **Accepted** | June 17, 2026; **Published** | September 05, 2026

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Citation | Chuc NT, Mo TTH, Nhan P (2026). Effects of litter turning frequency on litter moisture, ammonia concentration, and footpad dermatitis in H'Mong chickens. J. Anim. Health Prod. 14(4): 1344-1351.

DOI | <https://dx.doi.org/10.17582/journal.jahp/2026/14.4.1344.1351>

ISSN (Online) | 2308-2801



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INTRODUCTION

Poultry production has become one of the fastest growing sectors in agriculture. In recent years, increasing consumer concern about animal welfare has led to greater emphasis on producing high quality meat under improved rearing conditions. At the same time, environmental changes, particularly those associated with

climate variability, are raising concerns about their potential negative effects on poultry health and productivity. These challenges make it increasingly difficult to define optimal environmental conditions for efficient poultry production (El-Shabrou *et al.*, 2022). Litter quality is considered a key factor in broiler production. It performs several essential functions, including absorbing moisture, providing thermal insulation, and enabling natural behaviors such

as scratching (Grimes *et al.*, 2002; Bilgili *et al.*, 2009; Shepherd and Fairchild, 2010). Excessive litter moisture is widely recognized as the main driver of poor litter conditions, leading to increased microbial activity, ammonia generation, and deterioration of house environment. Popoola *et al.* (2019) emphasized that overlooking the harmful effects of ammonia generated from poultry litter under conditions of high temperature and humidity can pose serious risks. Broiler chickens are particularly sensitive to elevated ammonia levels, which may lead to eye damage and a decline in overall productive performance. Elevated ammonia levels can impair respiratory health and reduce overall performance, while wet litter has been closely associated with the development of footpad dermatitis, a widely used indicator of animal welfare in poultry.

Among the various management practices, litter turning is considered a simple and practical approach to improve litter condition. By loosening compacted layers and enhancing aeration, turning facilitates moisture evaporation and may reduce ammonia release from the litter. However, the effectiveness of this practice largely depends on the frequency of turning, and limited information is available regarding the optimal turning frequency under practical rearing conditions. This is particularly relevant for local chicken breeds, which are often raised under less intensive management systems and for longer production cycles.

In Vietnam, H'Mong chickens are a native breed originally domesticated by the H'Mong ethnic community in Son La Province. They are currently reared mainly at the household level (Phuong *et al.*, 2017), yet studies evaluating litter management strategies in this breed remain scarce. Therefore, this study aimed to assess the effects of different litter turning frequencies on litter characteristics, ammonia concentration, and footpad dermatitis in H'Mong chickens. The findings are expected to provide practical insights into improving environmental conditions and animal welfare in small to medium scale poultry production systems.

MATERIALS AND METHODS

STUDY ANIMALS

A total of 160 one-day-old H'Mong chickens were raised at Dong Loi Farm, located in Dong Phuoc commune, Can Tho city, Vietnam. The chickens were reared under a deep litter housing system. All chickens were clinically healthy at the beginning of the experiment. The experiment was conducted from May to July 2025. Chickens were randomly allocated to eight pens, corresponding to four experimental treatments, with 20 chickens per pen. Each pen had a floor area of 2 m² (1.0 × 2.0 m), providing a stocking density of 10 chickens per m², which is appropriate for native chickens under deep litter conditions. All pens

were of equal size and managed under identical conditions, including feeding, drinking water, lighting, and ventilation.

FEED AND FEEDING

All chickens were provided with the same diet throughout the experimental period. From 1 to 28 days of age, chickens were fed a mash diet containing a minimum crude protein level of 21% and a metabolizable energy content of 3050 kcal/kg. The diet was formulated from common ingredients including rice bran, maize, broken rice, fish meal, and soybean meal, with calcium levels ranging from 0.9% to 1.1% and available phosphorus not less than 0.74%.

From 29 days of age onward, chickens were fed a pelleted diet containing a minimum crude protein level of 19% and a metabolizable energy content of 3100 kcal/kg. This diet was also formulated from similar ingredients, including rice bran, maize, broken rice, fish meal, and soybean meal, with calcium levels ranging from 0.92% to 1.1% and available phosphorus not less than 0.70%. Feed and clean drinking water were provided *ad libitum* throughout the experimental period.

EXPERIMENTAL DESIGN

The experiment was arranged in a completely randomized design with litter turning frequency as the main factor. Four treatments were applied: LT0 (no litter turning), LT1 (litter turning once per week), LT2 (litter turning twice per week with a three-day interval between turnings), and LT3 (litter turning three times per week with a two-day interval between turnings).

Each treatment consisted of two pens, with 20 one-day-old H'Mong chickens per pen. In total, 160 chickens were used in the experiment, distributed across eight pens. All pens had the same floor area of 2 m².

Rice husk litter was applied at an initial depth of 8 cm in all pens. Litter turning was carried out according to the assigned frequency for each treatment throughout the experimental period.

MEASUREMENTS

LITTER CHARACTERISTICS

Litter moisture content was measured using a moisture meter (TCVN GM01, Hong Kong), which is designed for materials such as rice husk and sawdust. Measurements were taken directly from the litter at three different locations within each pen and averaged to obtain a representative value.

Litter temperature was measured using a handheld digital thermometer (Model 6419, Traceable). The probe was inserted into the litter at a depth of approximately 3 to

5 cm. Measurements were conducted at three different locations within each pen and averaged. All measurements were taken at the same time of day to minimize variation.

Litter moisture and temperature were recorded twice per week throughout the experimental period.

AMMONIA CONCENTRATION

Ammonia concentration was measured using a portable gas detector Senko (Model SGT-P NH3) equipped with an electrochemical sensor and diffusion type sampling. Measurements were taken at a height of approximately 20 to 30 cm above the litter surface, corresponding to the breathing zone of the chickens.

At each measurement, ammonia concentration was recorded at three different locations within each pen and averaged to obtain a representative value. Measurements were conducted at the same time of day to minimize variation. Ammonia concentration was recorded twice per week throughout the experimental period.

FOOTPAD DERMATITIS

Footpad dermatitis was evaluated using a scoring system on a scale from 0 to 3, where 0 indicated no lesions, 1 indicated mild lesions, 2 indicated moderate lesions, and 3 indicated severe lesions with ulceration or necrosis. All chickens in each pen were examined. Both feet of each chicken were scored, and the average score was calculated to represent the footpad condition of the pen. Footpad dermatitis was assessed at weeks 4, 6, and 8, and the week 8 score was used as the final footpad dermatitis score.

STATISTICAL ANALYSIS

Data were analyzed using one-way analysis of variance to evaluate the effect of litter turning frequency on the measured variables. The experimental unit was the pen. For variables measured over time, treatment comparisons were performed separately at each sampling time. When significant differences among treatments were detected, means were compared using Tukey's test. In addition, linear and quadratic effects of litter turning frequency were evaluated using orthogonal polynomial contrasts. Differences were considered statistically significant at $P < 0.05$.

RESULTS AND DISCUSSION

LITTER CHARACTERISTICS

As shown in Table 1, litter turning frequency had a clear effect on litter moisture. The highest litter moisture was recorded in LT0 at $31.76 \pm 2.21\%$, followed by LT1 at $27.58 \pm 1.93\%$, LT2 at $23.42 \pm 1.66\%$, and LT3 at $20.63 \pm 1.52\%$. All treatments differed significantly

from one another ($P < 0.05$). This pattern indicates that increasing the turning frequency consistently reduced the amount of moisture retained in the rice husk litter. In practical terms, the difference between LT0 and LT3 was more than 11 percentage points, showing that litter turning was not a minor management adjustment but a factor with a substantial effect on litter condition. Previous studies have reported that moisture levels in poultry litter can fluctuate considerably, typically falling within a range of approximately 15 to 45% depending on housing conditions and management practices (Stephenson *et al.*, 1990; Edwards and Daniel, 1992; Groot Koerkamp, 1994; Hayes *et al.*, 2000; Miles *et al.*, 2011).

Table 1: Litter characteristics of H'Mong chickens under different litter turning frequencies (Mean $\pm$ SD).

Variable	LT0	LT1	LT2	LT3
Litter moisture (%)	31.76 $\pm$ 2.21 ^a	27.58 $\pm$ 1.93 ^b	23.42 $\pm$ 1.66 ^c	20.63 $\pm$ 1.52 ^d
Litter temperature (°C)	31.48 $\pm$ 0.73 ^a	31.07 $\pm$ 0.65 ^{ab}	30.61 $\pm$ 0.59 ^b	30.27 $\pm$ 0.54 ^b

Means with different superscripts in the same row differ significantly ($P < 0.05$). LT0: no litter turning; LT1: once per week; LT2: twice per week; LT3: three times per week.

Munir *et al.* (2019) highlighted that bedding material is an essential component of floor based poultry production systems, as it plays a key role in maintaining bird health and welfare. Various materials can be used as litter, including organic sources such as wood based or plant derived materials, as well as inorganic options like clay and sand. Regardless of the type, bedding materials should possess good absorbency, be readily available, comfortable for the birds, and non toxic. Wet litter is generally considered to occur when moisture content exceeds approximately 25 to 35%, depending on the criteria used (Collett, 2012; Ivoš *et al.*, 1966; Eichner *et al.*, 2007). Under practical conditions, the prevalence of wet litter in poultry houses can be quite high, with reports from the UK indicating levels of up to 75% (Hermans *et al.*, 2006). This problem is particularly common during the winter period, when ventilation rates are reduced to conserve heat, thereby limiting moisture removal from the litter (Tucker and Walker, 1992). The reduction in moisture observed in the turned litter can be explained by better aeration and a more uniform exposure of wet litter to the surrounding air. In pens where litter was not turned, moisture likely accumulated in the lower and compacted layers, resulting in a wetter bedding surface over time. By contrast, more frequent turning probably loosened the litter structure, improved evaporation, and prevented the formation of persistently wet spots. Under the conditions of this study, turning the litter three times per week appeared to be the most effective strategy for keeping litter moisture at a relatively low level. A similar

tendency was found for litter temperature, although the magnitude of the response was smaller than that of moisture (Table 1). The highest temperature was observed in LT0 ($31.48 \pm 0.73^\circ\text{C}$), while the lowest was found in LT3 ($30.27 \pm 0.54^\circ\text{C}$). Statistically, LT0 was higher than LT2 and LT3, whereas LT1 showed an intermediate value ($31.07 \pm 0.65^\circ\text{C}$) and did not differ from either LT0 or LT2. This suggests that litter temperature was less sensitive to turning frequency than litter moisture. Even so, the gradual decline in temperature from LT0 to LT3 is still meaningful because it reflects a less active fermentation process in drier litter. Wet litter generally promotes microbial activity and heat generation, so the slightly lower temperature in the frequently turned treatments is consistent with the lower moisture values recorded in those pens.

While Table 1 presents the overall treatment means, the temporal changes in litter moisture are shown in Table 2. Regardless of treatment, litter moisture increased from week 2 to week 8, indicating that moisture accumulation became more pronounced as the chickens grew older. In LT0, litter moisture increased from $27.64 \pm 1.81\%$ at week 2 to $36.31 \pm 2.38\%$ at week 8. A comparable increase was also observed in LT1, from $24.93 \pm 1.58\%$ to $30.02 \pm 2.11\%$. However, the increase was much less pronounced in LT2 and LT3. In LT2, moisture rose from $21.88 \pm 1.39\%$ to $24.85 \pm 1.76\%$, while in LT3 it changed only slightly, from $19.74 \pm 1.27\%$ to $21.02 \pm 1.55\%$. This result is important because it shows that litter turning did not simply lower moisture at a single time point, but also slowed down the rate of moisture accumulation over the rearing period. The separation among treatments became more evident in the later weeks. At week 2, the difference between LT0 and LT3 was about 7.90 percentage points, but by week 8 this difference had increased to 15.29 percentage points (Table 2). This widening gap suggests that the beneficial effect of litter turning becomes increasingly important as the production cycle progresses, when fecal output, water spillage, and litter compaction are generally greater. Deep litter systems play an important role in maintaining poultry health, comfort, welfare, and overall production efficiency (Marimuthu *et al.*, 2019). In practice, bedding materials such as sawdust, rice husk, peanut hulls, and other plant based residues are continuously mixed with spilled feed, feathers, and manure. This process helps create a dynamic litter environment that can limit the development of harmful pathogens within poultry houses (Stephenson *et al.*, 1990; Torok *et al.*, 2009).

Another notable point from Table 2 is that moisture in LT0 exceeded 30% from week 4 onward, whereas LT3 remained close to 20% throughout the entire study. This contrast has clear biological significance. Once litter moisture rises to a high level, the bedding tends to compact, ventilation within the litter mass becomes poorer, and the litter surface

remains damp for longer periods. Under such conditions, litter quality deteriorates rapidly. In contrast, maintaining moisture at around 20 to 21% suggests that the litter remained relatively friable and better aerated, which is generally considered favorable for chicken comfort and house hygiene.

Table 2: Changes in litter moisture over time under different litter turning frequencies (Mean $\pm$ SD).

Time	LT0	LT1	LT2	LT3
Week 2	27.64 ± 1.81^a	24.93 ± 1.58^b	21.88 ± 1.39^c	19.74 ± 1.27^d
Week 4	30.22 ± 2.06^a	26.91 ± 1.77^b	22.73 ± 1.54^c	20.36 ± 1.41^d
Week 6	32.87 ± 2.24^a	28.46 ± 1.92^b	24.18 ± 1.68^c	21.41 ± 1.49^d
Week 8	36.31 ± 2.38^a	30.02 ± 2.11^b	24.85 ± 1.76^c	21.02 ± 1.55^d

Means with different superscripts in the same row differ significantly ($P < 0.05$). LT0: no litter turning; LT1: once per week; LT2: twice per week; LT3: three times per week.

Taken together, the results from Tables 1 and 2 demonstrate that litter turning frequency played a decisive role in determining litter quality. Among the tested treatments, LT3 provided the driest litter condition, while LT0 consistently produced the wettest litter. LT1 and LT2 showed intermediate responses, but the data indicate that increasing the turning frequency beyond once per week produced additional improvements in litter moisture control. Therefore, under the present rearing conditions, litter turning two or three times per week was clearly more effective than either no turning or turning once weekly.

AMMONIA CONCENTRATION

The effect of litter turning frequency on ammonia concentration is presented in Table 3. A clear decreasing trend was observed as the turning frequency increased. The highest ammonia concentration was recorded in LT0 at 26.21 ± 2.27 ppm, followed by LT1 (21.36 ± 1.94 ppm), LT2 (15.74 ± 1.58 ppm), and the lowest value in LT3 (12.81 ± 1.33 ppm). All treatments differed significantly from each other ($P < 0.05$), indicating a strong and consistent effect of litter management on ammonia levels in the house.

Table 3: Ammonia concentration under different litter turning frequencies (Mean $\pm$ SD).

Variable	LT0	LT1	LT2	LT3
NH ₃ (ppm)	26.21 ± 2.27^a	21.36 ± 1.94^b	15.74 ± 1.58^c	12.81 ± 1.33^d

Means with different superscripts in the same row differ significantly ($P < 0.05$). LT0: no litter turning; LT1: once per week; LT2: twice per week; LT3: three times per week.

The magnitude of the reduction was substantial. Compared to LT0, ammonia concentration in LT3 was reduced by more than 50%. Even increasing the turning frequency from once to twice per week resulted in a notable decrease of approximately 5.6 ppm. This suggests that litter turning

is not only effective but also responsive, meaning that incremental increases in turning frequency can lead to measurable improvements in air quality. The reduction in ammonia concentration can be directly linked to the lower litter moisture observed in frequently turned treatments (Table 1). Ammonia is primarily produced through microbial degradation of uric acid in moist litter. Therefore, drier litter conditions in LT2 and LT3 likely limited microbial activity and reduced ammonia volatilization. In contrast, the higher moisture levels in LT0 created favorable conditions for ammonia formation and release.

While Table 3 shows the overall treatment effect, the temporal dynamics of ammonia concentration are presented in Table 4. In all treatments, ammonia levels increased steadily from week 2 to week 8, reflecting the progressive accumulation of excreta and the intensification of microbial activity as the chickens grew. In LT0, ammonia increased from 18.57±1.69 ppm at week 2 to 33.24±2.41 ppm at week 8. A similar upward trend was observed in LT1, rising from 15.42±1.44 ppm to 26.03±2.12 ppm over the same period. However, the rate of increase differed markedly among treatments. In LT2, ammonia rose from 11.36±1.19 ppm to 20.11±1.74 ppm, whereas in LT3, the increase was more moderate, from 9.28±1.05 ppm to 15.67±1.46 ppm. This indicates that higher turning frequencies not only reduced ammonia concentration at any given time but also slowed down its accumulation throughout the production cycle. The difference between treatments became more pronounced over time. At week 2, the gap between LT0 and LT3 was approximately 9.29 ppm, while by week 8 it had increased to 17.57 ppm (Table 4). This widening separation suggests that the benefits of litter turning become increasingly important as the rearing period progresses, particularly during the later stages when ammonia production tends to peak. Numerous studies have demonstrated a clear relationship between litter type and the occurrence of footpad dermatitis in broiler chickens (Berg, 2004; Bilgili *et al.*, 2009; Shepherd and Fairchild, 2010). Zikic *et al.* (2017) reported that broilers raised on chopped straw had a lower incidence of footpad dermatitis compared to those reared on unchopped straw. This difference was likely associated with improved litter condition and reduced ammonia emission in chopped straw systems. Supporting this, previous findings indicated that long straw tends to produce higher ammonia levels than chopped straw (Slobodzian-Ksenicz and Kuczyński, 2002). In addition, long straw was more prone to caking, eventually forming an almost impermeable layer covering most of the floor surface, which can further deteriorate litter quality. Therefore, the use of long straw is generally discouraged due to its negative environmental effects in broiler housing (Slobodzian-Ksenicz and Kuczyński, 2002).

Table 4: Changes in ammonia concentration over time under different litter turning frequencies (Mean±SD).

Time	LT0	LT1	LT2	LT3
Week 2	18.57±1.69 ^a	15.42±1.44 ^b	11.36±1.19 ^c	9.28±1.05 ^d
Week 4	23.68±2.06 ^a	19.72±1.76 ^b	14.51±1.43 ^c	11.84±1.21 ^d
Week 6	29.34±2.28 ^a	23.59±1.93 ^b	17.18±1.62 ^c	13.74±1.36 ^d
Week 8	33.24±2.41 ^a	26.03±2.12 ^b	20.11±1.74 ^c	15.67±1.46 ^d

Means with different superscripts in the same row differ significantly ($P < 0.05$). LT0: no litter turning; LT1: once per week; LT2: twice per week; LT3: three times per week.

From a practical standpoint, ammonia levels above 25 ppm are generally considered detrimental to poultry health and welfare. In this study, LT0 exceeded this threshold by week 6, while LT1 approached similar levels by week 8. In contrast, LT3 maintained ammonia concentrations below 16 ppm throughout the experiment (Table 4). This indicates that frequent litter turning can effectively maintain ammonia at levels that are less likely to impair bird performance or cause respiratory irritation. Overall, the results from Tables 3 and 4 confirm that litter turning frequency plays a critical role in controlling ammonia concentration in poultry houses. Increasing the turning frequency not only reduced the overall ammonia level but also mitigated its accumulation over time. Among the treatments, LT3 consistently provided the most favorable air quality, while LT0 resulted in the poorest conditions.

FOOTPAD DERMATITIS

The effects of litter turning frequency on footpad dermatitis are shown in Table 5. The occurrence and severity of footpad dermatitis (FPD) have become major concerns in the broiler industry, both in terms of product quality and animal welfare (Bilgili and Hess, 1997; Bilgili *et al.*, 2006, 2008; Bradshaw *et al.*, 2002). Previous studies have shown that excessively wet litter can negatively affect animal welfare and is commonly associated with production losses. Under such conditions, the incidence of diseases such as necrotic enteritis, footpad dermatitis, and coccidiosis tends to increase (Harms *et al.*, 1977; Tucker and Walker, 1992; Hermans and Morgan, 2007; Francesch and Brufau, 2004). In this study, the highest score was observed in LT0 (2.14±0.24), while the lowest was recorded in LT3 (0.78±0.17), with all treatments differing significantly ($P < 0.05$). The scores decreased consistently with increasing turning frequency, indicating a strong effect of litter management on foot health. The difference between LT0 and LT3 was substantial, suggesting that frequent litter turning markedly reduced lesion severity. This result is closely associated with the lower litter moisture and ammonia concentration observed in the more frequently turned treatments (Tables 1 and 3), as wet and contaminated litter is known to promote skin damage and inflammation.

Table 5: Footpad dermatitis score at the end of the experiment (Mean±SD)

Variable	LT0	LT1	LT2	LT3
Footpad dermatitis score	2.14±0.24 ^a	1.63±0.22 ^b	1.09±0.19 ^c	0.78±0.17 ^d

Means with different superscripts in the same row differ significantly ($P < 0.05$). LT0: no litter turning; LT1: once per week; LT2: twice per week; LT3: three times per week.

The progression of footpad dermatitis over time is presented in Table 6. In all treatments, the score increased from week 4 to week 8, reflecting the cumulative effect of prolonged exposure to the litter environment. In LT0, the score increased sharply from 0.82±0.13 to 2.14±0.24, while in LT3, the increase was more gradual, from 0.32±0.08 to 0.78±0.17. Although all treatments showed a rising trend, the rate of increase was clearly lower in LT2 and LT3, indicating that more frequent litter turning slowed down lesion development. Ekstrand *et al.* (1997) reported that thicker litter layers, irrespective of the material used, were associated with a significantly higher prevalence of footpad dermatitis compared to litter depths below 5 cm ($P < 0.05$). Based on the findings of Bilgili *et al.* (2009) and previous studies (Mayne *et al.*, 2007; Berk, 2008), the type of bedding material has been shown to influence both the prevalence and severity of footpad dermatitis in broiler chickens.

Table 6: Changes in footpad dermatitis score over time under different litter turning frequencies (Mean±SD).

Time	LT0	LT1	LT2	LT3
Week 4	0.82±0.13 ^a	0.65±0.12 ^b	0.43±0.10 ^c	0.32±0.08 ^d
Week 6	1.55±0.21 ^a	1.16±0.17 ^b	0.78±0.14 ^c	0.54±0.12 ^d
Week 8	2.14±0.24 ^a	1.63±0.22 ^b	1.09±0.19 ^c	0.78±0.17 ^d

Means with different superscripts in the same row differ significantly ($P < 0.05$). LT0: no litter turning; LT1: once per week; LT2: twice per week; LT3: three times per week.

The difference between treatments became more pronounced over time. At week 4, the gap between LT0 and LT3 was relatively small, but by week 8 it widened considerably, suggesting that the impact of litter conditions accumulates as the rearing period progresses. Notably, LT3 maintained scores below 1.0 throughout the experiment, indicating only mild lesions, whereas LT0 reached values above 2.0, corresponding to moderate to severe damage. Overall, these results confirm that increasing litter turning frequency not only reduces the final severity of footpad dermatitis but also delays its progression, with LT3 providing the most favorable condition for foot health.

CONCLUSIONS

Litter turning frequency had a significant effect on

litter quality and footpad health in H'Mong chickens. Increasing the turning frequency reduced litter moisture and ammonia concentration, while also limiting the development and severity of footpad dermatitis. Among the tested treatments, turning litter three times per week provided the most favorable conditions, maintaining lower moisture and ammonia levels and resulting in the lowest footpad lesion scores. These findings suggest that frequent litter turning is an effective and practical management strategy to improve both environmental conditions and animal welfare in poultry production systems.

ACKNOWLEDGEMENT

We acknowledge the support of time and facilities from Tay Do University (TDU) for this study.

NOVELTY STATEMENT

This study provides new insights into the effects of litter turning frequency on litter quality, ammonia concentration, and footpad health in H'Mong chickens under practical rearing conditions. Unlike previous studies that focused mainly on commercial broilers, this work evaluates a local breed and demonstrates that increasing litter turning frequency, particularly up to three times per week, can effectively improve both environmental conditions and animal welfare. The findings highlight a simple and applicable management strategy for small to medium scale poultry production systems.

AUTHORS' CONTRIBUTION

NTC: Conceptualization, methodology, data curation and writing original draft. TTHM: Conceptualization, resources and formal analysis. PN: Visualization, software and writing review and editing. All authors reviewed and approved the final manuscript.

GENERATIVE AI AND AI-ASSISTED TECHNOLOGY STATEMENT

Generative AI tools were not used to generate any scientific content. Any AI assistance was limited to minor language editing, and all ideas, interpretations, and conclusions are solely those of the authors.

ETHICAL APPROVAL

This study did not require formal ethical approval because no invasive procedures were performed on the animals. All animal care, handling, and sampling procedures were conducted in accordance with the Law on Animal Husbandry (No. 32/2018/QH14) issued by the National Assembly of the Socialist Republic of Vietnam, as well as standard husbandry practices. Animal welfare was carefully

monitored and maintained throughout the experimental period.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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