

Prevalence and factors affecting foot-pad dermatitis in broilers in Eastern Algeria

Prevalencia y factores que afectan la dermatitis plantar en pollos de engorde en el este de Argelia

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ABSTRACT

The prevalence and severity of pododermatitis can be used as indicators of the husbandry conditions and animal welfare that were present during the production cycle. The objective was to assess the frequency and extent of pododermatitis in broiler chickens in the wilaya of Batna and to study the risk factors associated with these lesions. This study focused on 30 broiler chicken flocks from different regions and slaughtered in two poultry slaughterhouses. Pododermatitis was measured in slaughterhouses according to the Welfare Quality[®] method (2009) on a sample of 100 chickens/flock. At the same time, a survey was conducted among poultry farmers to collect the necessary information on the farms concerned. The results showed very high variability in the distribution of the scores of pododermatitis according to the region of production. The results also revealed poor rearing conditions and a high prevalence of pododermatitis, which amounts to about 78%, ranged from mild skin inflammation (score 1) to severe ulcers (score 4), while 22% showed no lesion (score 0). In conclusion, in order to reduce the frequency of pododermatitis, it therefore seems necessary to control the breeding conditions, in particular the state of the moisture litter, the environmental parameters and the breeding density.

Key words: Broiler; pododermatitis; lesions; score; welfare

RESUMEN

La prevalencia y gravedad de la pododermatitis se pueden utilizar como indicadores de las condiciones de cría y bienestar animal presentes durante el ciclo de producción. El objetivo fue evaluar la frecuencia y extensión de la pododermatitis en pollos de engorde en la wilaya de Batna y estudiar los factores de riesgo asociados con estas lesiones. Este estudio se centró en 30 bandadas de pollos de engorde de diferentes regiones y sacrificados en dos mataderos de aves. La pododermatitis se midió en mataderos según el método Welfare Quality[®] (2009) en una muestra de 100 pollos/parvada. Al mismo tiempo, se llevó a cabo una encuesta entre los avicultores para recopilar la información necesaria sobre las granjas en cuestión. Los resultados mostraron una variabilidad muy alta en la distribución de las puntuaciones de pododermatitis según la región de producción. Los resultados también revelaron malas condiciones de crianza y una alta prevalencia de pododermatitis, que asciende a aproximadamente el 78%, desde una leve inflamación de la piel (puntuación 1) hasta úlceras graves (puntuación 4), mientras que el 22% no mostró ninguna lesión (puntuación 0). En conclusión, para reducir la frecuencia de la pododermatitis, parece necesario controlar las condiciones de cría, en particular el estado de la cama, los parámetros ambientales y la densidad de cría.

Palabras clave: Pollo de engorde; pododermatitis; lesiones; puntuación; bienestar

INTRODUCTION

Footpad dermatitis (FPD), also known as pododermatitis, foot burn or footpad lesions, is a contact dermatitis that causes necrotic lesions to form on the plantar surface [1]. FPD is becoming an increasingly significant issue in the poultry industry worldwide, affecting broilers, laying hens, and broiler breeders with an average annual rate of around 20%, and can reach up to 100% in severe cases [2].

In commercial broiler production, the prevalence and severity of contact dermatitis can be used as a welfare assessment measure. FPD is more prevalent than other types of contact dermatitis [3], suggesting that it plays an essential role in the welfare of broiler chickens. FPD can develop as a result of prolonged contact with poor litter quality. However, Meluzzi *et al.* [4] reported a high positive correlation between wet litter and FPD, which can lead to economic losses for affected broiler chicken flocks.

Factors influencing the prevalence and severity of FPD in chicken flocks have been reviewed by Shepherd and Fairchild [5] and by Amer [6]. These authors reported that FPD is primarily associated with various factors that influence the litter moisture content, such as drinking systems, feed composition, ambient conditions (e.g., temperature, ventilation, ammonia levels, relative humidity), litter type and material, health status, and stoking density. Therefore, broiler welfare can be improved by controlling rearing factors related to contact dermatitis, scratches, fractures and bruises [7].

Several studies have been conducted to assess the prevalence of FPD in broiler chickens and turkeys in many countries around the world. Ekstrand *et al.* [8] found a prevalence rate of 32% mild and 6% severe FPD in 101 flocks in Sweden. In France, Martrenchar *et al.* [9] reported a prevalence rate of 85% in broilers, while Allain *et al.* [7] found a lower prevalence rate of 56%. In the Netherlands, De Jong *et al.* [10] reported a prevalence rate of 25% mild and 38% severe FPD in 386 flocks. In Germany, Freihold *et al.* [11] reported a prevalence rate of 33% mild and 41% severe FPD in broilers. The differences in prevalence rates could be due to differences in management practices, breed, housing conditions, and other environmental factors.

In Algeria, few studies have been published on this issue [12], with most focusing solely on animal welfare assessment [13, 14]. However, none of these authors have investigated correlations between the welfare indicators and rearing factors.

The objective of our study is to assess the prevalence and severity of FPD in broilers at slaughter age in the wilaya of Batna and to study the risk factors associated with these lesions for future prevention.

MATERIAL AND METHODS

Data collection

This study was performed at two poultry slaughterhouses located in eastern Algeria (Batna) over the course of five months from December 2021 to April 2022. FPD among 30 broiler chicken flocks from 7 different regions was assessed among 100 birds per flock. The information about the broiler farms and management of the flocks were also collected and analyzed.

Assessment of the condition of Footpad dermatitis

To assess the condition of FPD, a sample of 100 birds chosen at random was examined from each flock. FPD was graded by direct

observation at the slaughterhouse using the Welfare Quality method guidelines [15], which allocate five scores based on the severity and the area affected as follows:

- » Score 0: absence of FPD
- » Score 1: presence of mild redness on one or both footpads
- » Score 2: presence of moderate redness on one or both footpads, or mild lesions affecting less than 50% of the footpad area
- » Score 3: presence of severe redness on one or both footpads, or moderate lesions affecting less than 50% of the footpad area
- » Score 4: presence of ulcers or severe lesions affecting more than 50% of the footpad area

The sampled broilers were all examined by the same observer, and the percentages of birds affected by these lesions were calculated by flock and by region.

Investigations

The investigations were carried out on 30 broiler farms located in seven different regions of the wilaya of Batna. A questionnaire was completed from information provided by broiler farmers and available documents. The data collected concerned characteristics of the poultry-houses (location, dimension, feeding and watering system, type of ventilation and heating), rearing practices, stocking density, feed origin, strain, breeder age, chick origin, mortality rate, slaughter age, threshing and dipping weigh, diseases, vaccinations, treatments and litter types.

Statistical analysis

The distribution of pododermatitis scores in broiler flocks at slaughter age was assessed using a radar chart, considering the production region as the variable of interest. Questionnaire results were analyzed using the ANOVA test at 5% level of significance, to determine the effect of rearing condition variables on the pododermatitis of broiler chickens. Pearson correlation was calculated to measure the strength of the relationship between rearing factors and the mean pododermatitis scores of broiler chickens observed at the slaughter age. Statistical testing was used with SPSS software (Statistical package for social science version 21, IBM/SPSS).

RESULTS AND DISCUSSION

Prevalence of pododermatitis in the wilaya of Batna

The distribution of FPD scores in broiler chickens in the wilaya of Batna are shown in the FIG. 1. The results presented demonstrate that the percentage of chickens with the most severe lesions (score 4) was relatively low, at 9%. The majority of chickens (38%) had moderately severe lesions (score 3), while 22% of chickens showed no lesions (score 0). Additionally, 22% of chickens had lesions that fell into the intermediate severity range (score 2), and 9% had only minor lesions (score 1).

In broiler production, FPD prevalence and severity are considered indicators of poor animal welfare and inappropriate rearing conditions. Our study, conducted in eastern Algeria, revealed that FPD prevalence varied depending on the production region and rearing factors in broiler houses. The distribution of FPD scores showed that, out of all the samples taken in the study region, 22% of broiler flocks had scores of 0 and 2. Conversely, the highest rate of broiler flocks

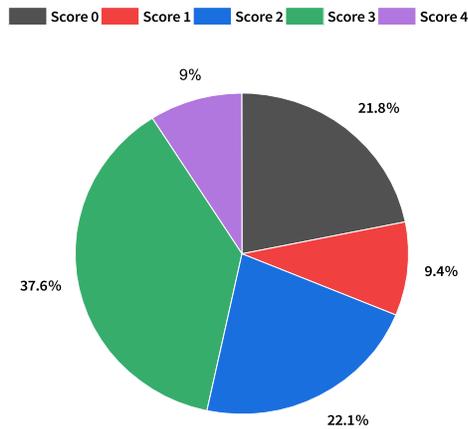


FIGURE 1. Graphical representation of FPD score prevalence in broiler chickens in the wilaya of Batna, Algeria (2021-2022)

(38%) exhibited severe lesions (score 3), while the lowest rates were associated with scores 1 and 4, with only 9% prevalence.

Our study's findings contrast with those reported by Ferhat *et al.* [12] in a study conducted in the same region, where a high prevalence of FPD was observed in the studied broiler flocks, with a prevalence of 80.5% (scored 2 to 5). The severity of FPD varied from mild skin inflammation to severe ulcers that covered more than half of the footpad surface. The study's results showed the presence of all five scores, with score 2 being the most common, occurring in 36% of the cases.

Prevalence of pododermatitis by production region

The distribution of FPD scores for the broiler flocks was highly variable across the studied regions. (FIG. 2). The highest percentage of broilers with no lesions (score 0) was observed in the Seggana (50%) and Tazoult (48.5%) regions. Broilers from Seggana and Taya had no serious or very severe lesions (score 4), while broilers from

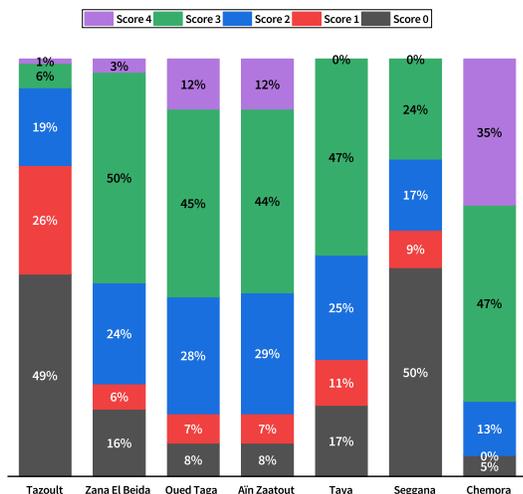


FIGURE 2. Graphical representation of FPD scores (%) by production region

Zana El Beida, Taya, and Chemora showed the highest percentage of severe lesions (score 3). The percentage of broilers with minimal (score 1) and intermediate (score 2) lesions varied heterogeneously across the regions, ranging from 6 to 26% and 17 to 29%, respectively.

Fig. 3 shows the mean FPD scores for each region. Broiler flocks from Tazoult had the lowest mean score (0.8), followed by Seggana (1.15). The highest mean score was observed in Chemora (3.07), while broiler flocks from other regions had mean scores ranging from 2.02 to 2.46.

Overall, the results demonstrate that there is a high degree of variability in the distribution of FPD scores across the studied regions, with some regions having significantly better or worse results than others.

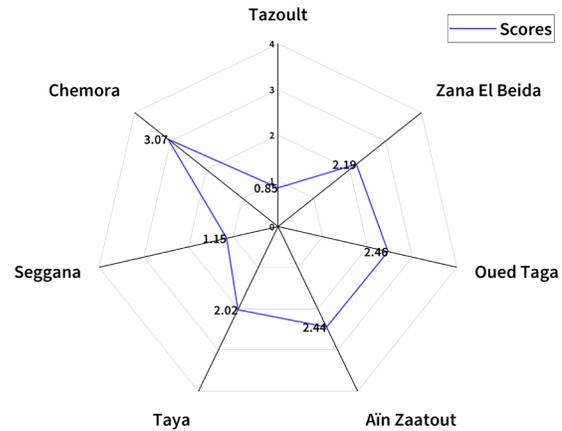


FIGURE 3. Mean of FPD scores by production region

The prevalence of FPD in broilers worldwide varies depending on the region, management practices, and production system. In Algeria, the rearing conditions differ from European countries in terms of poultry houses, stocking density, litter type, climate, and other factors. Additionally, the scoring systems of FPD vary widely between countries, making it difficult to compare study results. For example, a study conducted in French slaughterhouses showed that 70.80% of poultry footpads displayed severe lesions [7], while in the Netherlands, almost the same proportion of flocks had severe footpad lesions, and only 35.5% had no lesions [10]. However, Dinev *et al.* [3] reported a FPD prevalence of 21.87% in Bulgaria, while an average of 35% of poultry in Spain had FPD [16]. In the UK, a prevalence rate of 51.6 for FPD was reported [17].

Characterization of the broiler farms studied

The majority of broiler houses had uncontrolled ambiance (70%). A significant observation within poultry houses is the inadequate control of humidity. The visited poultry buildings, for the most part, lack dedicated humidity control facilities and essential sensors for optimal environmental management. Unregulated ventilation and humidity within these poultry houses result in damp litter, a factor strongly implicated in the development of footpad dermatitis in broiler chickens [18]. However, many houses were equipped with some essential features, such as radiant heating (63.33%), automatic feeding systems (56.67%), bell drinkers (66.67%), and dynamic

ventilation systems (93.33%). In terms of flooring, straw was used in 60% of the farms, while wood shavings were used in 40% of the farms. The stocking density during the rearing period was between 10 to 14 birds per square meter, with a mean flock age of 48.1 days at slaughter (see TABLE I).

TABLE I
Characterization of the broiler houses involved in the survey of pododermatitis

Variables	Description	Flocks (%)
Ambiance	Controlled	30.00
	Uncontrolled	70.00
Ventilation	Natural ventilation	6.67
	Dynamic ventilation	93.33
Heating	Radiant heater	63.33
	Forced-air space heater	36.67
Lighting	24 h	26.66
	22-23 h	73.33
Feeding system	Automatic	56.67
	Manual	10.00
	Auto and manual	33.33
Watering system	Nipples	33.33
	Bell drinkers	66.67
Litter types	Straw	60.00
	Wood shavings	40.00
Density	Low (≤ 10 birds·m ⁻²)	43.33
	Medium (11-13 birds·m ⁻²)	53.33
	High (≥ 14 birds·m ⁻²)	3.33

The results in TABLE II show that many of the studied rearing factors (ambiance, heating, lighting, feeding and water system, litter type and density) significantly affected the mean FPD scores of broilers at the slaughter age.

The analyses on effects of rearing conditions on the FPD showed that the ambiance in the poultry houses significantly ($P=0.001$) influenced the mean FPD scores at slaughter age (TABLE II). Flocks reared in controlled poultry houses had lower FPD scores than flocks reared in uncontrolled poultry houses. However, Heating systems significantly ($P=0.001$) affected the mean FPD scores. Birds reared in poultry houses equipped with forced-air space heater had significantly lower FPD scores. While, ventilation did not significantly affect the mean FPD scores of broiler chickens at the slaughter age.

The effect of lighting program on mean FPD scores was also observed. Flocks exposed to 22-23 h hours of light showed lower FPD scores. There was a significant ($P=0.001$) effect of feed and water equipment. Flocks reared in houses equipped with bell drinkers and manual feeding system had higher FPD scores than flocks reared with nipples and automatic feeding system.

Litter material significantly ($P=0.001$) influenced the mean FPD scores. Flocks reared on wood shavings had lower scores of FPD than

TABLE II
Effect of rearing condition variables on the mean FPD scores of broiler chickens observed at the slaughterhouse

Variables	Levels	Mean FPD scores	Significance (P)
Ambiance	Controlled	0.88	0.001
	Uncontrolled	2.42	
Ventilation	Natural ventilation	1.59	0.530
	Dynamic ventilation	1.98	
Heating	Radiant heater	2.44	0.001
	Forced-air space heater	1.13	
Lighting	24 h	2.27	0.001
	22-23 h	1.10	
Feeding system	Automatic	2.40	0.001
	Manual	2.66	
Watering system	Auto and manual	0.99	0.001
	Nipples	1.12	
Litter types	Bell drinkers	2.37	0.001
	Straw	2.38	
Density	Wood shavings	1.32	0.006
	Low (≤ 10 birds·m ⁻²)	1.42	
	Medium (11-13 birds·m ⁻²)	2.36	
	High (≥ 14 birds·m ⁻²)	2.46	

flocks reared on straw. There was also a significant ($P<0.006$) effect of density during the rearing period, as high density (≥ 14 birds·m⁻²) led to higher scores of FPD at slaughter age.

Several studies have investigated the relationship between the severity of FPD in broilers and various rearing factors, such as litter quality, management practices, stocking density and feed composition [9, 10, 19, 20]. Litter types is one of the most important factors affecting incidence and prevalence of FPD in broiler chickens. However, the development of FPD could be due to a prolonged contact with poor bedding materials [21, 22].

In the present study, broilers raised on straw had a 20% higher prevalence of FPD than those raised on wood shavings, which is consistent with the findings of Skrbic *et al.* [23] who reported a higher incidence of FPD in broilers raised on straw. Boussaada *et al.* [22] and Sirri *et al.* [24] also found that litter type significantly affected contact dermatitis development, with broiler flocks raised on wood shavings showing less dermatitis than those raised on straw.

Litter quality and various management factors were also found to be linked to contact dermatitis development, as reported by Allain *et al.* [7] and Kaukonen *et al.* [25]. According to Taira *et al.* [18], litter moisture is essential for the prevention of FPD. However, lowering litter moisture could stop FPD and prevent the spread of the disease.

The design of drinkers can significantly influence the overall moisture level of the litter, which in turn affects the occurrence of FPD [5]. According to Ekstrand *et al.* [8], flocks reared with small drinker cups had a higher FPD prevalence compared to those reared on nipple drinkers. However, nipple drinkers were found to result in

more scratches compared to other types of drinkers [7]. In turkeys, small water cups were observed to have a lower occurrence of FPD compared to bell drinkers [8]. This was confirmed by this study.

Correlation between FPD scores and rearing factors

As shown in TABLE III, the FPD scores showed a significant positive correlation with mortality ($r=0.451$; $P<0.05$) and stocking density during rearing period ($r=0.562$; $P<0.01$). There was also a correlation between slaughter age and mean FPD score ($r=0.637$; $P<0.01$). Moreover, a significant positive correlation was found between the severity of FPD and lighting program ($r=0.676$; $P<0.01$). However, no significant correlation was found between FPD and the other parameters studied.

TABLE III
Pearson correlations between rearing factors and the mean FPD scores of broiler chickens observed at the slaughterhouse

Rearing conditions	Density (birds·m ⁻²)	Slaughter age (days)	Body weight (g)	Mortality (%)	Lighting (hours·days ⁻¹)
Pearson correlation	0.562**	0.637**	-0.354	0.451*	0.676**

** $P\leq 0.01$; * $P\leq 0.05$

In the present study, we observed a positive correlation between the stocking density and the scores of FPD. This is supported by Haslam *et al.* [19] who reported that the severity of footpad lesions in broilers was positively correlated with stocking density, with birds reared at higher stocking densities exhibiting more severe lesions. However, some studies found that stocking density had no effect on contact dermatitis development [7].

Fast-growing broiler flocks and the slaughter age are among the typical risk factors that are often considered in the context of FPD. For this study, mean FPD scores were correlated with slaughter age of broilers. This is consistent with the results of previous studies that investigated the relationship between slaughter age and FPD, including De Jong *et al.* [10], Bassler *et al.* [26], and Tullo *et al.* [27].

With regard to other rearing factors, proper ventilation, heating systems, and lighting program in poultry houses have been linked to improved bird health and lower prevalence of FPD. Martrenchar *et al.* [9] reported that poor ventilation is associated with an increased risk of footpad lesions in broilers, and recommended improving ventilation in poultry houses. In addition, Tullo *et al.* [27] suggest maintaining appropriate temperature and humidity levels in poultry houses to prevent footpad lesions, while Kim *et al.* [28] found that broilers exposed to 24 hours of continuous light or intermittent lighting (4L:2D) had significantly higher footpad dermatitis scores compared those exposed to 18 hours of continuous light (18L:6D) or 8 hours of continuous light followed by 16 hours of darkness (8L:16D). This indicates that providing longer periods of darkness can reduce the prevalence and severity of footpad lesion in broilers.

CONCLUSIONS

The prevalence of FPD in the studied farms highlights the importance of controlling rearing conditions, particularly environmental parameters and breeding density. To mitigate the problem, modernizing production tools is necessary to better manage broiler farms and anticipate the occurrence and development of

FPD. Additionally, maintaining high-quality litter can help reduce footpad ulceration.

This study's results suggest the need for further research on a larger number of farms and chickens to improve animal welfare in Algeria and beyond. Expanding the scope to include a greater number of farms and chickens will enable a more comprehensive exploration of the factors influencing FPD. By doing so, it were can better understand the factors contributing to FPD and develop effective interventions to address the issue.

ACKNOWLEDGMENTS

The authors would like to thank the staff of the broiler farms and slaughterhouses for their willing support of the research.

Conflict of interests

The authors of this study wish to unequivocally state that no conflicts of interest exist concerning the publication of this manuscript.

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