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Review

Risk of Incidence of Hock Burn and Pododermatitis in Broilers Reared under Commercial Conditions

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ABSTRACT

The most common lesions observed in commercial broiler farms are hock burns and pododermatitis, defined as necrotic lesions on the plantar surface of the footpads and in the hock of growing broilers, causing pain and compromising broiler welfare. The present study aimed at identifying the risks of hock burns and pododermatitis in broilers reared under commercial conditions on new or reused litter. Twenty-four 40-d-old broilers reared in two houses in a commercial broiler farm. The plantar surface of the footpads and the hocks of broiler were recorded using infrared thermal images. The incidence of hock burns in broilers reared on new litter was 0.72 times lower than those on reused litter. Broilers reared on new litter presented lower risk (0.75, RR<1) of presenting pododermatitis when compared to those reared on reused litter. When simulating the risk using a larger sample, the simulated risk of broilers presenting footpad and hock lesions when reared on new litter was 38% higher those reared on reused litter.

INTRODUCTION

Brazil is an important exporter of chicken feet, especially to the Chinese market. Among the causes of carcass condemnation in Brazil, the most significant are dermatosis and keratosis of the feet, and are referred as pododermatitis and hock burns. The lesions are attributed to litter reutilization, inappropriate litter management (De Mello *et al.*, 2011; Gundim *et al.*, 2015), dietary imbalances (Delezie *et al.*, 2015), or incubation conditions (De Jong *et al.*, 2015). Dermatitis, often referred as ammonia burns, is caused by a combination of moist litter and irritation of the skin (Berg, 2004).

Both hock burns and footpad dermatitis are important welfare aspects in broiler production (Shepherd & Fairchild, 2010). The lesions may serve as a point of entry of pathogenic bacteria in the body (Kyvsgaard *et al.*, 2013) and may cause performance losses and carcass condemnations in processing plant. In most severe cases, the lesions become ulcerated, with inflammation of the subcutaneous tissue, leading to pain and compromised welfare (Bassler *et al.*, 2013).

Skin temperature increasesas a result of inflammatory processes due to vasodilatation. Abnormal thermal patterns are easily recognizable using thermal infrared technology, which may allow the early diagnosis of inflammation (Lahiri *et al.*, 2012). Thermal infrared images have been frequently used in veterinary medicine (Kastberger & Stachl, 2003; Bouzida *et al.*, 2009; Nääs *et al.*, 2014), and provides a non-invasive estimation of the lesion.

The present study aimed at identifying the risks of hock burns and pododermatitis in broilers reared under commercial conditions on new or reused litter.

MATERIAL AND METHODS

Data recording

Data were recorded in a commercial broiler farm (latitude 22°33′23′′ S, longitude 47° 10′21′′ W, and altitude of 650 m). The region's climate is characterized as tropical of altitude with rainy summers and dry winters, and average ambient temperatures during the hot months above 22 °C. Broilers reared in two different houses were evaluated in this experiment. House A1 had positive-pressure ventilation and new litter (rice husks), and house A2 had negative-pressure ventilation and reused litter from four previous flocks (rice husks).

Twenty-four 40-d-old broilers were randomly selected inside each house and evaluated. Both left and right hocks and footpads of individual birds were analyzed for pododermatitis severity and hock redness.

The severity of pododermatitis was scored in a 0-3 scale (0= no lesion; 1=lesion covering less than 50% of the footpad area; 2=lesion covering 50-100% of the footpad area; and 3=lesion covering 100% of the footpad area, including the digits), as proposed by Hashimoto *et al.* (2011). Hock lesion was determined as present (skin redness) or absent (skin with homogeneous color).

Thermal images of the whole leg of the birds were captured at a distance of 1m from the bird by athermal infrared camera (Testo 882, Testo Instruments, Lenzkirch, Germany). Mean surface temperature was determined using at 0.98 skin emissivity (Cangar *et al.*, 2008; Alves *et al.*, 2012).

Data analyses

The degree of association between the type of litter and the presence of lesions was evaluated by building a contingency table (2 x 2) that included the number of broilers analyzed (24 in each house). According to Hulley *et al.* (2013) and Fleiss *et al.* (1980), the size of the sample (n) is given by Equation 1 and Equation. 2.

$$n = \frac{\left[\left(Z_{\alpha}\sqrt{P(1-P)}\left(\frac{1}{q_1}+\frac{1}{q_0}\right)\right)+\left(Z_{\beta}\sqrt{P_1(1-P_1)}\left(\frac{1}{q_1}\right)+P_0(1-P_0)\left(\frac{1}{q_0}\right)\right)\right]^2}{(P_1-P_0)^2} \quad \text{Eq. 1}$$

and

$$P = (q_1P_1)+(q_0P_0) \quad \text{Eq. 2}$$

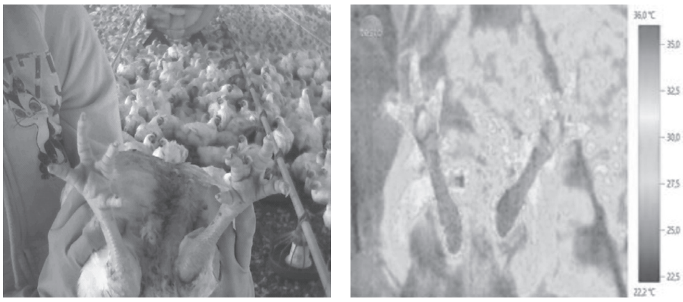
where: α = probability of rejecting the null hypothesis; β = probability of accepting the null hypothesis; Z_{α} = standard score for α(1.960); Z_{β} = standard score for β (0.842); q_1 = proportion of the sample of the group subjected to the highest risk; q_0 = proportion of the sample of the group subjected to the lowest risk; P_1 = estimated proportion of cases with lesions; P_0 = estimated proportion of cases with no lesions; and P = weighted average between P_1 and P_0 .

The contingency table using the number of birds (24) was set and odds ratio (OR) and relative risk (RR) values were calculated to estimate the risk of broilers to develop hock burn lesions and pododermatitis when reared on new and reused litter. A second contingency table was then built after a simulation, using the ideal number of samples, calculated as suggested by Hulley *et al.* (2013) and Fleiss *et al.* (1980).

Calculations were done using the online software Vassar Stats website for Statistical Computation,at95% confidence interval.

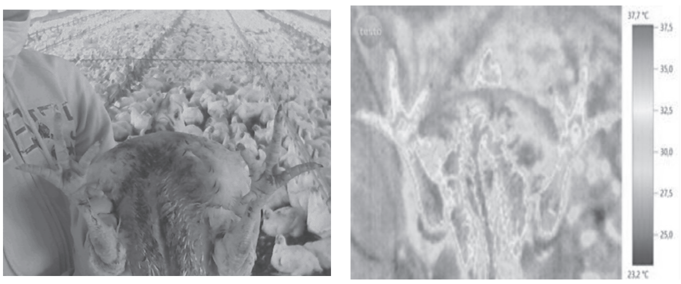
RESULTS AND DISCUSSION

Figure 1 shows the standard image and the infrared thermal image of a broiler with no lesions, and the same images of a broiler with lesions is shown in Figure 2.



A B

Figure 1 – Images of a sound broiler using a regular camera (A) and an infrared thermal camera (B).



A B

Figure 2 – Images of a broiler with lesions using a regular camera (A) and an infrared thermal camera (B).

In broilers, the limbs account for the thermoregulation mechanism of generating sensible heat exchange with the environment (Tessier *et al.*, 2003). When broilers present hock-burn lesions, the damaged skin exposes nocioreceptors, which are the sensorial receptors related to pain (Gentle *et al.*, 2001).

Figure 3 shows the mean surface temperature of the hocks and footpads of a broiler obtained by thermal infrared image. In both houses, mean hock and footpad surface temperature decreased with broiler age, in agreement with the findings of Nascimento *et al.* (2014). According to Richards (1970), broiler body temperature decreases with age because feather cover increases. The mean body surface temperature determined in the evaluated broilers at 40 days of age was 33.02°C.

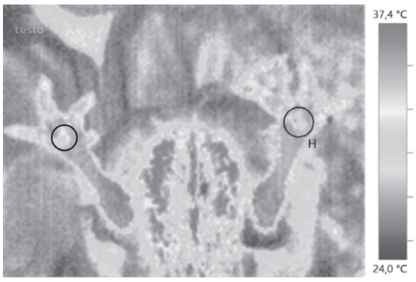


Figure 3 – Mean surface temperature of the footpads and hock burn (H) using an infrared thermal camera.

The incidence and severity of pododermatitis in broiler chickens is of great concern to the broiler industry, both from the product quality and animal welfare perspectives (Michel *et al.*, 2012). The welfare of broilers affected with those conditions is impaired (Martland, 1984, 1985) because their walking is compromised, hindering their feed and water intakes, as they are not able to reach the feeders and drinkers (Haslan *et al.*, 2007). The analyzed mean surface temperatures (Table 1) indicate a higher incidence of lesions in broilers reared on new litter, when compared with those on reused litter. Litter substrates with sharp particles, such as wood shavings and chopped straw, may increase the prevalence and severity of pododermatitis due to their abrasive action, and are directly associated with the capacity to protect the footpad from the continuous contact with moisture, minimizing its susceptibility to irritation and inflammation (Bilgili *et al.*, 2009).

Table 1 – Surface temperature of the hock burn and pododermatitis lesions of broilers reared on new or reused litter.

	Lesion	
Litter	Hock burns	Pododermatitis
New	35.50	33.61
Reused	34.30	32.49
mean	34.90	33.05
p-value	0.012	0.127

Table 2 presents the contingency values of the risk analysis, using a sample of 24 broilers, and includes the variables lesion (presence or absence) and the type of litter (new or reused). When lesions were analyzed, the odds ratio of occurring hock burns was 0.59 (p=0.377; IC 95% 0.183-1.900), with a relative risk of 0.72 (IC 95% 0.356-1.484). The incidence of hock burns in broilers reared on new litter was 0.72 times lower (RR<1) than those reared on reused litter. The odds ratio for the presence pododermatitis in new litter was 0.66 (p=0.527; IC 95% 0.190-2.337), with a relative risk of 0.75 (IC 95% 0.306-1.834), indicating that the incidence of pododermatitis was 0.75 times lower (RR<1) than in reused litter.

Some litter factors in the house with negative-pressure ventilation, such as litter depth and substrate, were similar those of the field study of Ekstrand *et al.* (1997), who found only 62% of broilers with sound feet in Swedish farms. In the present study, approximately 50% of the broilers at the slaughter age had some degree of footpad or hock lesions. Feed composition and flock density may negatively affect excreta degradation, increasing litter moisture and leading to the occurrence of lesions (McIlroy *et al.*, 1987; Delezie *et al.*, 2015). Although Delezie *et al.* (2015) did not determine any effect of feed on litter quality, the prevalence of footpad and hock burn lesions increased when broilers were fed imbalanced diets. Haslam *et al.* (2006) observed a high correlation between the percentage broilers with foot pad lesions and litter quality, but no correlation between flock density and footpad and hock lesions. High flock density usually increases litter moisture content, causing litter to stick to the feet, as well as ammonia production by the litter due to anaerobic conditions, predisposing to footpad lesions (Kyvsgaard *et al.*, 2015).

A second contingency table was built to estimate the risk of footpad and hock lesion on new or reused litter, using simulated sampling. The values of α=0.05 (probability of rejecting the null hypothesis) and β=0.20 (probability of accepting the null hypothesis) were designated. The calculated values of Z_α and Z_β are a consequence of the previous values (α and β). The estimation of the new values of the parameters resulted in new values calculated from the contingency Table 2.

Table 2 – Number of broilers presenting or not lesions according to litter type (n=48)

Litter	Lesion		
	Present	Absent	Total
New	11	13	24
Reused	08	16	24
Total	19	29	48

$$q_1 = \frac{24}{48} = 0.50\,;\; q_0 = \frac{24}{48} = 0.50\,;\; p_1 = \frac{11}{24} = 0.46\,;$$

$$p_0 = \frac{8}{24} = 0.33\,;\; P = 0.36$$

Correcting the sampling allowed simulating the risk. Using the new simulated sample n_{fc} = 472, it was possible to calculate the relative risk of the incidence of lesions of broilers reared on new litter (RR = 1.38). The application of the simulated sample values allowed estimating the risk of lesions in broilers reared on new litter (Table 3) as 38% higher compared with the broilers reared on reused litter.

Table 3 – Simulation of the number of broilers presenting or not lesions according to litter type (n=472)

Litter	Lesion		
	Present	Absent	Total
New	109	127	236
Reused	78	158	236
Total	187	285	472

Studying the factors that predispose broilers to foot lesions, Kyvsgaard *et al.* (2013) identified that lesion scores increased when the flock was reared on poor litter quality. Those authors also determined that the risks increased in the summer, when the environment was hotter and more humid, affecting litter quality, independently of litter substrate.

CONCLUSIONS

The incidence of hock burns was 0.72 higher in broilers reared on new litter (RR<1) compared with those reared on reused litter. The incidence of pododermatitis was 0.75 times lower in broilers reared on new litter (RR<1) compared with those reared on reused litter. The simulated risk of broilers presenting footpad and hock lesions when reared on new litter was 38% higher than those reared on reused litter. Choosing the right type of litter is essential because broilers remain during their entire life in direct contact with the litter, and substrates with small particle size may reduce locomotion problems caused by pododermatitis and hock burns.

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