Pathomorphological investigations on the prevalence of contact dermatitis lesions in broiler chickens

Ivan Dineva, Stefan Denev, Ivan Vashin, Dian Kanakov and Nikolina Rusenova

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1. Introduction

The aetiology of contact dermatitis is unclear. The condition is usually encountered in commercial broiler flocks and turkeys (Martland 1984; Allain et al. 2013). It was initially observed and described by McFerran et al. (1983); later, clinical and pathological findings were presented by Greene (Greene et al. 1985). The high prevalence of contact dermatitis among broiler chickens is associated with poor welfare and economic conditions. Losses are mainly attributed to slaughterhouse contamination of carcasses with contact dermatitis lesions (Pattison 1987). An examination of losses recorded between 1984 and 1987 revealed an average tarsometatarsal contact dermatitis prevalence of 21%; in some flocks, this reached 90% (McIlroy et al. 1987; Bruce et al. 1990). Furthermore, skin lesions are considered to be the main point of entry for pathogenic microorganisms, which can cause complications and new lesions of different types – cellulitis, gangrenous dermatitis, osteomyelitis (Dinev, 2009; Crespo and Shivaprasad, 2013; Gornatti-Churria et al. 2017).

Epidemiological surveys linked the increased prevalence of the condition to various production aspects, including increased population density, slaughter at a higher age and bigger male to female ratio in the flock (Bruce et al. 1990). The appearance of contact dermatitis lesions has also been linked to bad litter conditions, particularly when it occurred suddenly or within a short period of time (McIlroy et al. 1987; Bruce et al. 1990; Kaukonen et al. 2017). Lesions similar to those observed in broiler chickens were encountered in turkeys, housed on wet litter (Martland 1984). Recently, an examination of the pain caused by foot pad dermatitis, in the context of turkey poult, noted that the condition may have an adverse effect on mobility and linked it to weight loss (Da Costa et al. 2014; Wynenken et al. 2015). High humidity in poultry facilities was also highlighted as a predisposing factor (Bruce et al. 1990).

From an epidemiological perspective, the factors related to the incidence of contact dermatitis in broiler chickens in the 1980s and the 1990s were analysed and compared using data from large-scale field surveys (McIlroy et al. 1987; Menzies et al. 1998). In a number of studies, contact dermatitis lesions on the breast and tarsometatarsal joint area were suggested as economically relevant (Greene et al. 1985).

The purpose of the present study was to determine the prevalence and severity of contact dermatitis lesions in commercial broiler chicken flocks using pathomorphological research methods.

2. Material and methods

The cases of contact dermatitis in commercial broiler chickens were recorded over a period of one year. Chickens originated...
from one Ross 308 poultry farm located in Bulgaria. The annual production rate was 696,000 broilers. The observations focused on 36 broiler flocks; 24 flocks consisting of 20,000 chickens (during the winter-spring and autumn seasons), and 12 flocks consisting of 18,000 broilers (during the summer). Gender was not taken into account. The mean stocking density was 18.87/1 m² and 17.00/1 m² respectively, depending on the season, and the poultry house area was 1,060 m². During the experimental period, chickens received different rations depending on the fattening stage. The company’s aim was to produce broilers with an average live weight of 2.1–2.2 kg. The same immunophrophylaxis programme was used for broilers and original breeder flocks. The state of the litter, the relative air humidity and the age at which contact dermatitis lesions appeared were all recorded. Straw was used as litter in all cases.

The investigations were performed by a clinical examination (monitoring and registration) of chickens which showed obvious signs of contact dermatitis on their carcasses in the slaughterhouse. The number and the type of contact dermatitis lesions in the different flocks were both determined through meat inspection. All birds were slaughtered at the age of 36–42 days. The gender of chickens with clinical lesions was not recorded. In addition to the number of affected chickens, the localization and content of contact dermatitis was registered. An evaluation system focusing on the lesions’ area and depth after gross examination, similar to the model proposed by Michel et al. (2012), was used.

For the pathological study, 3 samples from the respective lesion type were obtained from each flock where they were observed. For this purpose, pieces of skin and subcutaneous tissue, including parts of the damaged and adjacent intact area, 1–2 cm in diameter, were fixed in 10% neutral formalin, routinely processed and embedded in paraffin. The cuts, approximately 5 μm, were stained with haematoxylin/eosin (H/E).

During the meat inspection of each flock with skin lesions, the results from routine bacteriological examinations for enterobacteria and Gram-positive cocci were taken into consideration, as required by the relevant meat inspection hygienic standards. Statistical analysis was performed using Statistica 6.1 (software). The significance level was set at \( P < 0.01 \).

### 3. Results

Varying levels of severity of the different types of contact dermatitis lesions were recorded in all broiler flocks in the farm during the study. The distribution of skin lesions, including their frequency and localization, is listed in Table 1. The total number of contact dermatitis lesions was 152,215 (21.87%), with seasonal prevalence during the winter-spring and autumn seasons: 88,932 (12.77%); this can be contrasted with the summer period: 63,283 (9.1%). Lesions on the plantar skin surface of the foot (plantar pododermatitis; PPD) were most frequently encountered – 109,272 (15.7%). The appearance of PPD was usually associated with a rapid or sudden dampening of the litter. Wet litter was found: when the ambient humidity on the premises exceeded 70% (in 8 facilities) as a result of the reduction of ventilation rates in order to save fuel for heating purposes (in 8 facilities); after flooding due to a watering system failure (1 premise); and after using a high-protein content ration (>22%) in the grower stage (6 premises). The incidence of lesions in different flocks ranged from 1% to 31%. In 78,648 (11.3%) of the cases, PPD was detected during the winter-spring and autumn. In 30,624 (4.4%) cases it was recorded during the summer of the one-year experimental period. PPD-specific lesions were detected clinically in broilers aged 21–30 days, regardless of the season.

Clinically, after an inspection of the affected chickens, lesions were noticed after the onset of lameness, impaired locomotion or after periods of lying down. The lesions’ surface was covered with brown-black crusts, which were removed along with profuse faecal mass stuck to them. The extent of the lesions varied from small erosions covered with a brown scab to deep ulcerations affecting the subcutis and underlying tissues. Frequently, erosions and ulcers were surrounded by perifocal inflammatory swelling (Figure 1). In more advanced stages, macerated lesions were detected, and birds were dehydrated.

![Figure 1. Moderate to strong swelling affecting the metatarsal region due to perifocal inflammatory oedema in plantar pododermatitis.](image1)

![Figure 2. Plantar pododermatitis lesions, having undergone maceration. Marked dehydration emerging on tarsometatarsal aspects of legs (arrows) likely to prolonged lying down and inability to reach food and water.](image2)
due to prolonged periods of lying down and the inability to eat or drink (Figure 2).

PPD lesions, detected in the slaughterhouse after the removal of litter and faecal mass tightly stuck to the foot pads, had a diameter of 1–1.5 cm. The depth of the ulcers varied between 1–2 and 5–6 mm; this was determined through transverse cuts. The lesions were distinctly separated from the intact tissue. Most frequently, they appeared as crater-like grooves surrounded by an indented haemorrhagic area (Figure 3).

Breast contact dermatitis lesions affecting the sternal bursa were next in prevalence – 36,888 (5.3%). Most of them – 30,624 (4.4%) – were observed during the summer, and the incidence during the other seasons was five times lower (6,264 or 0.9%). In all instances, the earliest appearance of lesions was in chickens older than 36 days of age in the slaughterhouse, when approximately 50% of the flocks with an average live weight >2 kg were slaughtered.

Breast skin lesions were of various shapes and sizes. In some cases, they were virtually round, 2–3–5–6 cm in diameter, whereas in other cases – strip-like and oblong, 3–4–7–8 cm in length (Figure 4). It should be noted that the breast plumage of these birds was in a poor condition or absent. The skin was covered with litter and faecal mass stuck to it. In cases of ulcerations, serous or haemorrhagic subcutaneous oedema was usually seen after the removal of the skin. Superficial breast muscles were affected only in the most severe cases.

The lowest prevalence of contact dermatitis lesions was observed on tarsometatarsal joints – 6,055 (0.87%). During the winter-spring and the autumn period, their frequency was almost twice higher than their frequency in the summer period: 4,020 (0.57%) vs 2,035 (0.3%). Lesions of this type could be observed in the farm, but in our study they were detected in the slaughterhouse. The lesions in initial stages were outlined on a hyperaemic surface, sometimes bleeding or eroded, with an area of 2–3 cm², and in their major part, in dorsal tarsometatarsal joint areas. In more advanced stages, the affected skin was necrotic, with dirty grey colour (Figure 5).

The extent to which contact dermatitis lesions are observed, as well as the area covered, is presented in Table 2. Superficial lesions (erosions) were predominant for all lesion types. Depending on the affected area, plantar lesions were mostly under 1 cm² (81.3%), whereas those larger than 1 cm² were most prevalent among breast (84.8%) and tarsometatarsal (75.15%) lesions.

During meat inspection in the slaughterhouse, 420 (~9%) out of the 4,685 chickens with deep breast lesions were regarded as inappropriate for human consumption and 1,670 (35.6%) were declared fit for processing after the removal of affected areas.

The routine bacteriological examinations which were performed, as per hygienic standards, did not show any differences between intact chickens and those with contact dermatitis lesions.

Histologically, the studied samples showed alterations depending on the stage of skin lesions development. In the early stage, subepidermal heterophilic infiltration was usually seen. For erosions, in addition to the inflammatory cell infiltration, typical degenerative necrobiotic changes of the superficial epidermal layers were observed. Deep ulcerations were characterized with the simultaneous occurrence of inflammatory degenerative and necrobiotic changes which affected all epidermal layers and penetrated deep into the dermis. In general, degenerative ulceration was differentiated from the adjacent intact tissue via a heterophilic zone (Figure 6).

| Seasonal prevalence | Plantar | Breast | Tarsometatarsal | Total number (%) |
|---------------------|---------|--------|-----------------|-----------------|
| Autumn-Winter-Spring| 78,648 (11.3%) | 6,264 (0.9%) | 4,020 (0.57%) | 88,932 (12.77%) |
| Summer              | 30,624 (4.4%)  | 30,624 (4.4%) | 2,035 (0.3%)   | 63,283 (9.1%)   |
| Total number (%)    | 109,272 (15.7%) | 36,888 (5.3%) | 6,055 (0.87%) | 152,215 (21.87%) |

Table 1. Localization and prevalence of lesions specific for contact dermatitis, *P < 0.01.*
Lesions

Tarsometatarsal 4,810 (79.42%) 1,245 (20.57%) 1,505 (24.85%) 4,550 (75.15) 6,055 (100%)

Breast 32,203 (87.3%) 4,685 (12.7%) 5,607 (15.2%) 31,281 (84.8%) 36,888 (100%)

Plantar 74,850 (68.5%) 34,422 (31.5%) 88,840 (81.3%) 20,432 (18.7%) 109,272 (100%)

Table 2. *Extent and area of observed contact dermatitis lesions, P < 0.01.*

| Lesions       | Extent       | Area            |
|---------------|--------------|-----------------|
|               | Superficial  | Deep            | Small (<1 cm²)  | Large (>1 cm²)  | Total number (%) |
| Plantar       | 74,850 (68.5%) | 34,422 (31.5%)  | 86,840 (81.3%)  | 20,432 (18.7%)  | 109,272 (100%)   |
| Breast        | 32,203 (87.3%) | 4,685 (12.7%)   | 5,607 (15.2%)   | 31,281 (84.8%)  | 36,888 (100%)    |
| Tarsometatarsal | 4,810 (79.42%) | 1,245 (20.57%)  | 1,505 (24.8%)   | 4,550 (75.15%)  | 6,055 (100%)     |

*The evaluation of lesions' extent and area was made on the basis of gross appearance and changes.*
et al. (2002), but the seasonal expression was different. It is acknowledged that the higher population density of birds impedes the locomotion and forces birds to lie down. As a result, the continuous contact with the litter predisposes them to dermatitis, affecting the skin of the breast region (Shanawany 1992). The appearance of breast skin lesions during the summer in our study was also associated with the prolonged period of extremely high ambient temperatures, when the thermal comfort of the birds was disturbed. The hot weather also results in certain factors responsible for dermatitis appearance, such as high air temperature and overheating of the litter in the building.

The results of the performed bacteriological tests allowed us to confirm that the microbial factor had no major role in the etiogenesis of contact dermatitis; rather, it had a complicating effect. The relevance of gender cannot be discussed as the chickens originated from mixed flocks (almost an equal number of male and female birds). Therefore, gender was not taken into account as a factor in our analysis on lesion occurrence.

5. Conclusions

In summary, the results allowed us to conclude that the prevailing type of contact dermatitis in broiler chickens was plantar pododermatitis, which, together with skin lesions in the tarsometatarsal joint region, was highly dependent on the poor state of the litter (increased humidity). Lesions on the breast skin were the least prevalent and mainly associated with population density in the building, particularly in the finisher stage of broiler chicken production.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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