INFLUENCE OF PROTEIN LEVEL ON FOOTPAD DERMATITIS

Constantin Sorin MIHAI[1], Ilie VAN[1], Georgeta CIURESCU[2]

E-mail: mihai_constantin_sorin@yahoo.co.uk

Abstract

The general objective of nutrition is to maximise the economic production performance of broilers but good nutrition is also important from a health point of view. Nutrition can indirectly impact bird welfare by acting on the environment. An excess of crude protein in the diet will increase the nitrogen emission along with wet droppings which will result in a high prevalence of contact dermatitis (Gordon et al., 2003). Footpad dermatitis (FPD) is a condition characterised by lesions on the ventral foot-pads of poultry. The aim of this study was to determine the influence of tree protein levels: high protein (HP), medium (MP) and low protein (LP). A total of 1272 as-hatched broiler chickens (Ross 308) were randomly allocated in 12 pens of 5.0 m x 1.4 m. From 7 days both foots were examined and scored for the incidence and development of FPD on a scale from 0 (no lesion) to 2 (very severe lesions). FPD occurred at as early as 7 days. FPD scores at 42 days were 51.16 (LP), 66.10 (HP), 76.56 (MP) exceeding the value of 50 points considered in the Directive proposal (European Commission, 2005). The protein level influences the FPD score of broiler chickens at slaughter.

Key words: Broilers, footpad dermatitis, protein level

FPD is a condition that causes necrotic lesions on the plantar surface of the footpads in broilers and turkeys. FPD was first reported as a skin condition in broilers in the 1980s (Greene et al., 1985). FPD is considered to be an indicator of animal welfare because the disease likely affects the health of the birds and inflicts suffering (Dawkins et al. 2004; Thomas et al., 2004). In an early stage, discoloration of the skin is seen. Hyperkeratosis and necrosis of the epidermis can be seen histological. In severe cases, the erosions develop into ulcerations with inflammatory reactions of the subcutaneous tissue (Greene et al., 1985). Often, the lesions become infected by a variety of bacteria and fungi, especially *Staphylococcus spp*. and *Escherichia coli* (Hester 1994).

Several experiments have shown that the incidence and severity of FPD is related to multiple factors such as: protein level and source (Nagaraj et al., 2007), diet density (Bilgili et al. 2006), litter material (Grimes et al. 2002), litter moisture (Martland 1985), litter deep (Ekstrand et al. 1997), litter amendments (Nagaraj et al. 2007), stoking density (Sørensen et al. 2000), seasonal effect (Ekstrand and Carpenter, 1998), nutritional deficiencies (Murillo and Jensen 1976; Kenny et al. 2010).

In this experiment we have investigated the influence of three protein levels on the incidence of footpad dermatitis in broiler chickens on farm.

MATERIAL AND METHOD

The experiment was carried out at the National Research & Development Institute for Animal Biology and Nutrition (INCDBNA) in Balotesti, Romania. A total of 1272 day-old broiler chickens (Ross 308) were randomly placed in 12 pens of 5 m x 1.4 m. Each treatment had four replicates of 106 birds each.

According to growth stage: starter, grower and finisher, the formulated diets contained 3 levels of protein: HP (24, 22 and 20%), MP (22, 20 and 18%) and LP (20, 18 and 16%). All diets were based on corn, wheat, soybean meal, rapeseed meal, corn gluten and synthetic methionine and lysine (without ingredients of animal origin). For each growth phase diets were calculated to be isocaloric and with similar content of total and digestible sulphur amino acids (Met + cys), lysine, calcium and available phosphorus and in accordance with the feeding recommendations for the intensive rearing of these strains (Ross Breeders, 2007).

During the study, the birds received a lighting regimen of 23 h light and 1 h darkness.
The initial temperature was 33°C and it was gradually reduced according to breeding standards. Control parameters, such as

[1] University of Agronomic Science and Veterinary Medicine, Faculty of Animal Sciences, Bucharest
[2] National Research & Development Institute for Animal Biology and Nutrition, Balotesti, Romania

temperature, humidity, light, ventilation and vaccination, were the same for all groups. Feed and water were provided *ad libitum*. Weekly all birds were examined for incidence and severity of footpad dermatitis, both feet were examined.

Footpad lesions were assessed according to the Swedish system, which is the generally accepted FPD scoring system used in Europe.

The footpad lesions were assigned to one of three classes:

Score 0 = no lesions, no or very small superficial lesions, slight discoloration on a limited area of the footpad, mild hyperkeratosis (thickening of the outer layer of the skin) or healed (Fig. 1);

Score 1 = mild lesion, discoloration of the footpad, superficial lesions, dark papillae and hyperkeratosis (Fig. 2);

Score 2 = severe lesions, epidermis is affected, ulcers and scabs, sign of haemorrhages or swollen footpads (Fig. 3)

To classify FPD lesion has been used a photo guide to broiler foot health classification developed by Wageningen UR.

The footpad score was calculated as follows:

FPD score = 100 * (0*no. score 0 + 0.5*no. score 1 + 2*no. score 2) / (total number of footpad scored).

Incidence of FPD % = (no. score 1 + no. score 2) (total number of footpad scored)

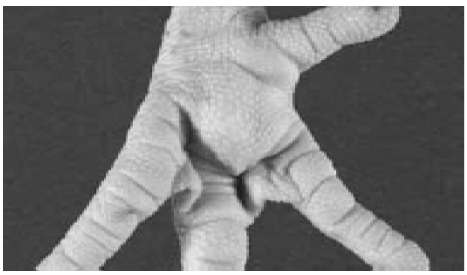

Figure 1 **FPD score 0**

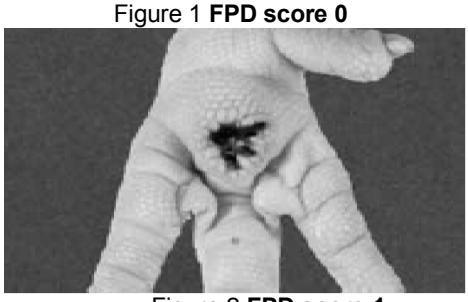

Figure 2 **FPD score 1**

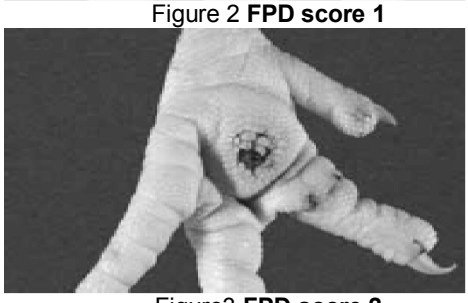

Figure3 **FPD score 2**

Statistical analysis

All data were analysed by the General Linear Models (GLM) procedure using the SPSS software version 17 (SPSS Inc, Chicago IL, USA). One-way analysis of variance (ANOVA) with the post hoc Tukey's multiple comparison tests was used to evaluate statistical significance of differences among the control and experimental groups. The results are given as means ± standard deviation and $P<0.05$ was considered as statistically significant difference.

RESULTS AND DISCUSSION

Footpad dermatitis was observed in all three types of protein levels. We observed that FPD occurred at as early as 7 days of age and the lesions became more severe according to age. Examples of foot pad lesions are presented in figure 4, 5, 6 and 7. The evolution of FPD score during the experiment is presented in Table 1.

According to Tukey test at age of 7 days significant differences were between HP and MP groups ($P < 0.05$) and no differences between the other groups.

According to Tukey test at age of 14 days very significant differences were between HP and LP groups ($P < 0.001$), significant differences were between HP and MP groups ($P < 0.05$) and distinguished significant differences were between MP and LP groups ($P < 0.01$) .

According to Tukey test at age of 21 days, were distinguished significant differences between HP and LP groups ($P < 0.01$), were very significant differences between HP and MP groups ($P < 0.001$) and very significant differences between MP and LP groups ($P < 0.001$) .

According to Tukey test at the age of 28 days there were no differences between groups.

According to Tukey test at age of 35 days were distinguished significant differences between groups HP and LP ($P < 0.01$) and significant differences between MP and LP groups ($P < .05$).

According to Tukey test at age of 42 days were distinguished significant differences between groups HP and MP ($P < 0.01$), very significant differences between HP and LP groups ($P < 0.001$) and very significant differences between MP and LP groups ($P < 0.001$).

Table 2 presents the evolution of incidence of FPD during the experimental period.

At the age of 7 days according to Tukey test were significant differences between HP and MP groups ($P < 0.05$). There were no differences between the other groups.

At the age of 14 days according to Tukey test were significant differences between HP and MP groups ($P < 0.05$), distinguished significant differences between HP and LP groups ($P < 0.001$) and very significant differences between MP and LP groups ($P < 0.001$).

Table 1

Evolution FPD score during the experimental period.

Week \ Diet	HP	MP	LP	Average
Week 1	0.44±0.81[b]	1.02±1.95[a]	0.72±1.35[a,b]	0.73±1.40
Week 2	7.80±12.14[a]	6.62±10.78[b]	4.61±4.60[c]	6.35±9.40
Week 3	32.18±20.69[b]	42.22±44.77[a]	24.40±25.73[c]	32.93±31.58
Week 4	59.49±50.73	47.82±58.91	31.42±33.58	46.24±48.18
Week 5	62.15±58.50[a]	61.20±66.82[a]	43.06±42.94[b]	55.47±55.16
Week 6	66.10±69.09[b]	76.56±68.45[a]	51.16±46.80[c]	64.60±60.49

[a-c]means in the same row with different letters differ significantly (*P < 0.05*)

Figure 4 **FPD score 1 at 7 days**

Figure 5 **Score 0 at 35 days**

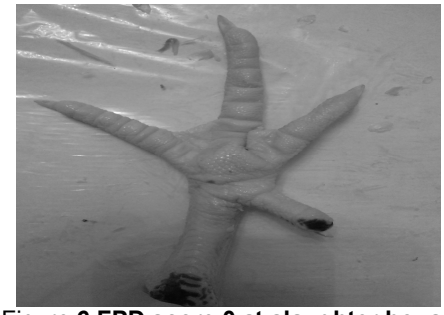

Figure **6 FPD score 0 at slaughter house**

Figure 7 **FPD score 1, 2, 2 and 2 at slaughter house**

Table 2

Evolution of FPD incidence during the experimental period.

Week \ Diet	HP	MP	LP	Average
Week 1	0.88±1.62[b]	2.05±3.9[a]	1.44±2.69[ab]	1.45±2.81
Week 2	15.61±24.27[a]	13.25±21.55[b]	8.86±8.9[c]	12.57±18.79
Week 3	46.8±31.77[a]	41.9±36.38[b]	27.38±27.09[c]	38.69±31.69
Week 4	55.49±23.81[a]	47.72±40.41[b]	36.51±34.11[c]	46.57±32.97
Week 5	48.9±27.38[a]	38.78±38.5[b]	29.34±27.24[c]	39.01±31.17
Week 6	42.89±31.69[b]	47.69±34.14[a]	30.97±25.39[c]	40.52±30.14

[a-c]means in the same row with different letters differ significantly (*P < 0.05*)

At the age of 21 days, according to Tukey test were very significant differences between HP and MP groups (P < 0.001),were very significant differences between HP and LP groups (P < 0.001) and very significant differences between MP and LP groups (P < 0.001). At the age of 28 days according to Tukey test were distinguished significant differences between groups HP and MP (P < 0.01) , were very significant differences between HP and LP groups (P < 0.001) and very significant differences between MP and LP groups (P < 0.001). At the age of 35 days according to Tukey test were very significant differences between HP and MP groups (P < 0.001), were very significant differences between HP and LP groups (P < 0.001) and very significant differences between MP and LP groups (P < 0.001). At the age of 42 days according to Tukey test were significant differences between HP and MP groups (P < 0.05), were very significant differences between HP and LP groups (P < 0.001) and very significant differences between MP and LP groups (P < 0.001). In terms of severity of FPD, as can be seen in fig. 8, FPD score had an ascending developed until the age of 21 days. The results obtained in this period contradict the conclusions of Nagaraj et al. (2007) that the most severe cases were associated with birds fed a high-protein diet,

between 28 and 35 days the results were consistent with the results of Nagaraj et al. (2007), but at the age of 42 days the results obtain in this study were again in contradiction with the results obtained by Nagaraj et al. (2007).

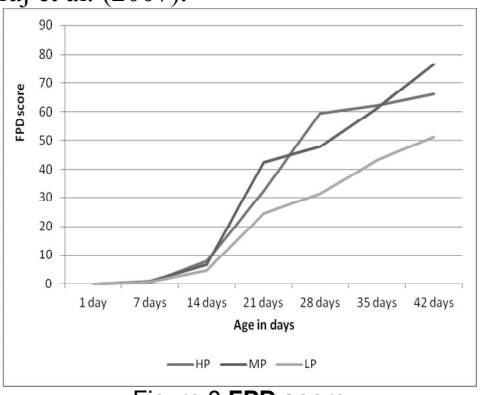

Figure 8 **FPD score**

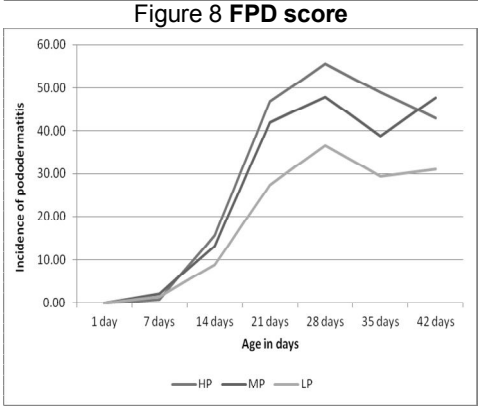

Figure 9 **Incidence of FPD score**

In terms of the incidence of FPD, as can be seen in fig. 9, the incidence FPD had an increasing trend until the age of 28 days when it has been noticed a reduction in the incidence of FPD because of the improvement of litter quality. At the age of 42 days the MP groups had a higher incidence of FPD, which contradicts the observations of Nagaraj et al. (2007).

CONCLUSION

The incidence and severity of FPD is significantly affected by protein level, which agrees with Nagaraj et al. (2007) conclusion, but we do not agree with Nagaraj et al. (2007) that the most severe cases were associated with birds fed a high-protein diet, because in our experiment the most severe cases where associated with birds fed a medium protein level diet which agrees with the second study by Nagaraj et al. (2007 a).

Studies on protein level have provided inconsistent results, and further research is needed.

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