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The effect of paper substrate type used at the beginning of rearing on foot pad dermatitis (FPD) occurrence and production results of broiler chickens

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Abstract: *The effect of paper substrate type used at the beginning of rearing on foot pad dermatitis (FPD) occurrence and production results of broiler chickens*. The objective of the study was to estimate influence of different paper type as additional substrate in broiler chickens rearing on foot pad quality. Animals used in experiments were 320 Ross 308 chickens divided into groups according to substrate type: control group – chickens reared on litter with paper produced from paper pulp, and experimental group – chickens reared on litter with paper produced from paper pulp with cellulose addition. Production results were controlled during rearing period (in 21st, 35th, 42nd days). Foot pad quality was visually defined 5 days before slaughter. Effect of substrate type used during first days of life on occurrence of foot pad skin injuries and production results in chicken broilers was observed. Chickens from experimental group achieved higher production results (higher body weight, better herd health) and foot pad dermatitis appeared less frequently.

Key words: broiler chicken, type of substrate, foot pad dermatitis, production results

INTRODUCTION

Foot pad dermatitis (FPD) is a condition that causes necrotic lesions on the plantar surface of the footpads in growing broilers and turkeys. This condition not only causes downgrades and condemnations of saleable chicken paws, the portion of the leg below the spur, but is also an animal welfare concern in both the United States and in Europe (Shepard and Fairchild 2010). Frequency of foot pad dermatitis in broiler chickens, its reasons, consequences and possibility of reducing foot pad dermatitis are still subjects of surveys (Jankowski et al. 2012, Świątkiewicz et al. 2017). High quality of foot pad is important according to poultry welfare, production costs, food safety and quality (Shepherd and Fairchild 2010). Researchers described several factors influencing FPD formation, e.g. watering system, season time and humidity connected with it, stocking density, nutritional deficiencies and type, depth, humidity and pH of litter (Jones et al. 2005, Nagaraj et al. 2007, Meluzzi et al. 2008, Hashimoto et al. 2011, Michalczuk et al. 2014). Previous studies were focused on high quality of chicken paws. Therefore, avoiding FPD and high level

of birds welfare should be the main goal for breeders if they want to achieve satisfying production results. According to that fact, Polish export of chicken feet to Asian countries is rapidly increasing. Last year 30,000 t were sold (doubled amount according to data from 2009) and our main recipient is Hong Kong. Then chicken feet are sent to China, Vietnam, Thailand, Korea, Malaysia and Philippines.

Types of litter for growing broilers available in the market have different structure, absorbency and hygienic quality. In Poland straw, chips and sawdust are the most common litters. Paper addition at the beginning of rearing ensures extra feed source for chickens, but also stimulates faster feeding and shortens time from hatching to first feeding. This process is crucial for proper digestive system functioning and has significant effect for further production results.

Using paper substrate as additional litter in broiler chickens is a common practical solution, therefore the aim of the study was to evaluate effect of substrate composition on incidence of FPD and production results.

MATERIAL AND METHODS

Ross 308 chickens were used in conducted experiment. During the 1st rearing period (till 5th day) chickens were kept on paper substrate placed on wheat straw litter. Control group (C) was kept on paper pulp (grey paper) and experimental group (E) was reared on paper pulp with cellulose addition (green paper). Properties of green and grey paper are presented in Table 1. In both groups, stock density in a pen reached 11 birds per 1 m^2 of the experimental RZD – SGGW (Wilanów – Obory) farm. Starting from the first day, weekly measurements were made of microclimate conditions in the facility the birds were reared in, including: in-house temperature, air relative humidity and concentration of gases (CO_2, NH_3 and H_2S). The chickens were reared until the age of 42 days, and fed in a three-period according to recommendations of the Aviagen company (starter 1–21 day, grower 22–35 day, and finisher 36–42 day). Table 2 presents the nutritive value of feed used in the study. One day old chickens were individually weighted. Body weight, feed intake, mortality and culling level were provided in 21st, 35th, 42nd day. Obtained data was used to calculate feed conversion ratio (*FCR*, kg/kg), level of animal culling and mortality. Foot pad quality was visually defined 5 days before slaughter according to five-steps scale (Butterworth 2009). Foot pads were assigned, according to five-steps scale (0–4), where 0 is foot pad with no damage and 4 is foot pad with damages leading to deformations. Figure 1 presents characteristic stages of foot pad dermatitis.

Obtained results were analyzed statistically using Student's test distribution for independent samples by means of the SPSS 21 software.

TABLE 1. Comparison of grey and green paper properties

Specification	Green paper	Grey paper
Weight (g/m^2)	43.6	40
Humidity (%)	4.2	> 5
Water absorbance (%)	13.2	30
Stretching force (N/m)	343	200

TABLE 2. Composition and nutritional value of feeding by type of feed

Specification	Feed composition (%)		
	Starter	Grower	Finisher
Wheat	34	45	44
Maize	23	17.20	20
Soybean meal (46)	31	29	26.2
Wheat bran	1.0	–	–
Soybean oil	3.5	5.0	5.20
Limestone Ca39	1.4	0.60	0.2
Premix	6.0	4.0	4.0
Nutritional value			
ME (MJ/kg)	12.70	13.15	13.40
Crude protein (%)	22.00	19.50	18.40
Crude fiber (%)	3.10	3.90	3.80
Crude fat (%)	4.10	4.90	5.50
Crude ash (%)	5.20	5.00	4.30

FIGURE 1. Foot pad damages in chicken broilers ranked in five-steps scale (0–4) used in the experiment

RESULTS AND DISCUSSION

Obtained results suggest that paper used in experimental group had higher quality and was better additional feed source for chickens at the beginning of rearing and also influenced higher production results at the end of rearing. At the end of rearing period broiler chickens from experimental group achieved higher ($P < 0.001$) average body weight (2,670 g) than birds from control group (2,299 g) – Figure 2. Culling and mortality rates were lower in group that during 1st rearing period had green paper (with cellulose addition) on wheat straw litter.

Rearing environment (litter type in first days of rearing) did not influence value of *FCR*. However, quality of litter type had influence on broilers mortality and culling levels (Table 3).

Chickens from control group reared with grey paper on wheat straw litter had the worst condition of foot pad. Share of 25% of these chickens were ranked with 3 (23%) and 4 (2%). None of them was classified as 0 (Table 4). Almost half of chickens from experimental group (48%) were ranked with the lowest foot

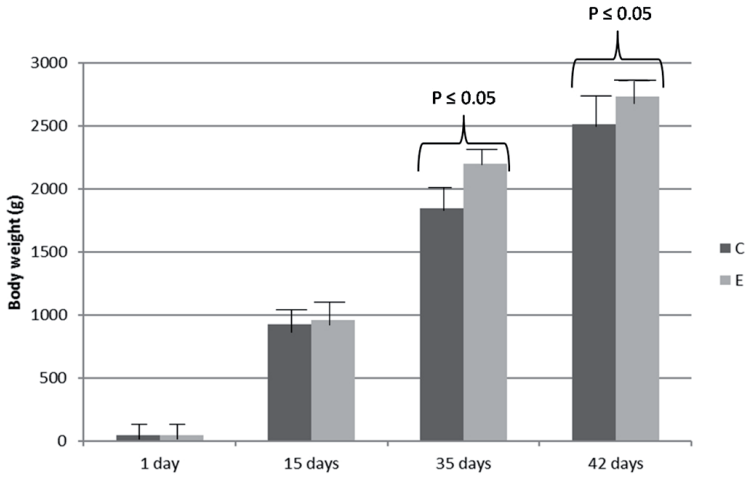

FIGURE 2. Effects of used different paper substrate on body weight of broiler chickens (g)

TABLE 3. Performance of broiler chickens

Group	*FCR* (kg/kg)	Mortality (%)	Culling (%)
C	1.74	1.87	3.75
E	1.73	1.25	2.50

TABLE 4. The incidence of foot pad damages in five-steps scale (%)

Group	Scoring				
	0	1	2	3	4
C	0	17	58	23	2
E	6	48	42	4	0

pad damage step and 6% did not struggle with FPD problem.

Deep litter is the most common maintenance system in Poland. Type and quality of used litter is an important issue. Paper can be used as additional substrate at the beginning of rearing because of its effects on production results and foot pad quality.

Bilgili et al. (2009) suggest that usage of different litter type does not influence production results. However, their analysis showed that litter type effects on foot pad quality. The best litter type, according to foot pad quality, was door filler and mortar sand, the worst were pine shavings, chipped pine and chopped straw. Higher quality of paper used in experimental group at the beginning of rearing influenced higher final body weight and better herd health. Feed placed on the better quality paper and improved locomotion of chickens from this group most likely had direct influence on easier access to feed and higher feed intake during the most important and crucial days for further growth.

Litter quality, including its temperature, effects on farm zoohygienic conditions during first days of life, Berg and Algers (2004) analysis points out that floor heating system positively influences foot pad quality. Stocking density is one of the most crucial rearing factors effecting production results and foot pad quality. Sirri et al. (2007) showed that decreased stocking density under 30 kg of live weight per 1 m^2 allowed

to achieve improvement in production results and foot pad dermatitis score. Foot pad dermatitis causes injuries in foot pad that results in inflammation in that area. This disease occurs in chicken broiler but also in turkeys. Studies carried out by Mayne et al. (2007) showed that turkeys maintained on wet litter had lower body weight and felt walking discomfort. After 15 days from transferring on dry litter symptoms of FPD almost disappeared. In addition to its type and quality, the height of litter layer is also very important. Shepherd et al. (2017) revealed in their research that using 7.6 cm height of fresh chips ensured the best litter humidity and allowed to decrease occurrence of FPD.

Due to the lower water absorption and higher stretching force of green paper (Table 1), it remains on litter for a longer period of time and improves quality of the substrate. Green paper influenced on faster access to the feed, which results in higher final body weight of the chickens and better health of the herd. Microclimate conditions were monitored during rearing period, however no statystical differences were observed in gases amounts in the building.

CONCLUSIONS

Effect of substrate type used during first days of life on production results and occurrence of FPD in chicken broilers was observed. Chickens from experimental group were reared on special paper with cellulose addition and achieved higher final body weight and better health, and foot pad dermatitis appeared less frequently. Foot pad damages ranked as rate 3 and 4 were less frequent in experimental group in which paper with cellulose was used.

It is important to consider further studies, because foot pads were assessed only during the last week of rearing. The positive effect of paper with cellulose addition should be verified also in combination with other litter types than wheat straw.

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Streszczenie: *Wpływ rodzaju papierowego podłoża użytego w pierwszych dniach życia na częstotliwość występowania schorzeń poduszki stopy (FPD) i wyniki produkcyjne kurcząt brojlerów.* Celem doświadczenia była ocena wpływu zastosowania różnego rodzaju papieru jako dodatkowego podłoża dla kurcząt brojlerów na jakość skóry podeszwy stopy. Badania przeprowadzono na 320 kurczętach Ross 308, podzielonych na grupy w zależności od użytego materiału: kontrolną – kurczęta odchowywano na ściółce wyścielonej papierem wytworzonym z pulpy makulaturowej, oraz doświadczalną – kurczęta utrzymywano na ściółce z papierem, którego składem była pulpa makulaturowa z dodatkiem celulozy. W czasie odchowu kontrolowano wyniki produkcyjne stad (w 21., 35., 42. dniu i na koniec odchowu). Na 5 dni przed ubojem u wszystkich ptaków przeprowadzono wizualną ocenę jakości skóry podeszwy stóp. Wykazano wpływ użytego materiału wyścielającego ściółkę w początkowym okresie życia na występowanie uszkodzeń skóry podeszwy stóp i wyniki produkcyjne kurcząt brojlerów. W grupie doświadczalnej uzyskano poprawę wyników produkcyjnych (większą masę ciała, lepszą zdrowotność stada) oraz rzadsze występowanie objawów zapalenia skóry poduszki stopy (ang. *foot pad dermatitis*).

Słowa kluczowe: brojlery kurze, rodzaj podłoża, zapalenie skóry podeszwy stopy, wyniki produkcyjne

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