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Litter Characteristics and Pododermatitis Incidence in Broilers Fed a Sorghum-Based Diet

ABSTRACT

The aim of this study was to evaluate the incidence of footpad dermatitis and quality of broilers litter fed with sorghum grain and diets based in corn. It was used 544 male and female chicks, distributed in a completely randomized design with two treatments and eight replications. The chicken feed was formulated and produced from corn, soybean meal and sorghum grain. In the formulation were kept constant levels of energy and protein in accordance with the following treatments: A. Control (diet based on corn and soybean meal); B. Grain sorghum (Whole Sorghum + soybean meal). At 35 and 42 days were evaluated mineral matter (A %), calcium (Ca%), phosphorus (P%), pH and dry matter (DM %) of the poultry litter. To evaluate the footpad dermatitis were evaluated eight feet per treatment by visual analysis. At 35 and 42 days of age DM % MM (%), Ca (%) P (%) and pH of poultry litter no difference ($p>0.05$) was found between the treatments and the type of ingredient in the birds' diet is not related ($p>0.05$) with the incidence of footpad dermatitis. The incidence of footpad dermatitis and the quality of the litter weren't influenced by the type of the ingredient used in diet.

INTRODUCTION

In the livestock industry, poultry production has made expressive progress. Nutrition has significantly contributed for that development searching to improve dietary nutrient utilization (Rodrigues, 2003).

Feed accounts for 75% of total broiler production costs. Therefore, once environmental comfort and health are ensured, it is the role of nutrition to feed birds sufficient nutrients to supply their maintenance and growth requirements. The diets must present good quality, low nutrient loss in the excreta, as well as low cost.

According to Garcia *et al.* (2005), sorghum grain is an alternative feedstuff to corn and may allow significant reduction in feed costs, particularly during times of the year when the cost of broilers fed corn-based diets is high.

Litter characteristics, such as pH, moisture, and mineral content, may change as a function of feed, management practices, and rearing environment. Environmental control has a strong impact on broiler quality and productivity, and it is essential for the management of broiler houses. The functions of the litter are to absorb humidity, dilute urates and feces, thermal insulation, as well as to provide soft bedding, thereby preventing breast blisters and footpad lesions (Hernandes & Cazetta, 2001). Footpad health has been proposed as one of the best indicators of broiler welfare.

Brazil has exported broiler feet to East Asia for at least 20 years. Feet represented the largest share (61.76%) of poultry imports by China in



2008. Feet trade is even more important to Brazil as it accounts for 82.57% of poultry products exported to China (Zhang, 2009), thereby highlighting the relevance of identifying feet lesions that could result in their downgrading (Santos *et al.*, 2002).

The objective of this study was to evaluate the incidence of pododermatitis and litter quality of broilers fed diets based on sorghum grain or corn.

MATERIALS AND METHODS

Birds and experimental design

The experiment was carried out on the poultry experimental farm of Faculdade Presidente Antônio Carlos-UNIPAC, Uberlândia, state of Minas Gerais, Brazil, between April and June of 2013. The experimental procedures were approved by the Committee of Ethics of that institution under protocol number CEUA/UNIPAC 019/13.

In the experiment, 544 male and female Cobb broilers were distributed according to a completely randomized experimental design into two treatments with eight replicates each. Birds were distributed into 16 pens, with 34 birds each at a density of 12 birds/m². New wood-shavings litter covered the floor pens.

Diets

Feed and water were supplied *ad libitum* during the entire experiment. The lighting program, using both natural and artificial light, was divided in three phases: 22 h of light between one and seven days of age, 10 h of light between eight and 21 days of age, and 23 h of light between 22 and 42 days of age. The average minimal and maximal house temperatures were daily recorded, and presented minimum and maximum values of 20 °C and 27.58 °C, respectively. Birds were submitted to the management practices that are typically applied in commercial farms of that region.

Feeds were composed of corn, whole sorghum, soybean meal, soybean oil, dicalcium phosphate, limestone, salt, vitamin-mineral premix, and supplemental amino acids (DL-methionine, L-lysine, and L-threonine). Feeds were formulated to supply the nutritional requirements proposed by Rostagno (2011). Table 1 shows the ingredients and nutritional compositions of the experimental diets. The following treatments were evaluated: treatment A (TA), diet based on corn and soybean meal, and treatment B (TB), diet based on whole grain sorghum and soybean meal.

Table 1 – Composition of the starter (1-28 days) and finisher (29-42 days) experimental diets.

Feedstuff	Starter (%)		Finisher (%)	
	TA	TB	TA	TB
Corn grain	52.31	-	60.81	-
Soybean meal	37.33	34.63	25.11	25.10
Whole-grain sorghum	-	53.94	-	58.24
Soybean oil	2.15	3.23	7.0	9.70
Premix ¹	5.0	5.0	5.0	5.0
Dicalcium phosphate	1.76	1.64	1.28	0.87
Limestone	1.03	1.15	0.37	0.63
Salt	0.38	0.38	0.40	0.42
Nutritional composition				
ME (Mcal/kg)	2.800	2.800	3.287	3.287
CP (%)	21.5	21.5	17.3	17.3
Calcium (%)	0.96	0.96	0.55	0.55
Available P (%)	0.43	0.43	0.34	0.26
Sodium (%)	0.17	0.17	0.18	0.18

¹Mix Frango engorda SAA 4kg - composition/kg feed – Vit-A 9,000IU; D3 1,600IU; E 14mg; folic acid 300mcg; calcium pantothenate 9mg; biotin 50mcg; niacin 30mg; pyridoxine 1.8mg; riboflavin 4mg; thiamin 1mg; B12 12mcg; K 1.5mg; Se 250mcg; choline 219mg; Cu 9mg; Zn 60mg; I 1mg; Fe 30mg; Mn 60mg; growth promoter 385mg; coccidiostat 550mg; antioxidant 120mg.

On days 35 and 42, litter samples were collected at three different points of each pen of each treatment, avoiding the areas close or below the feeder and drinker, and subsequently analyzed for dry matter (DM %), ash (A %), calcium (Ca %), and phosphorus (P %) content and pH (Silva & Queiroz, 2009).

Pododermatitis evaluation

Eight feet per treatment, totaling 16 feet, were assessed for pododermatitis lesions on days 35 and 42. Pododermatitis lesions were evaluated using the methodology proposed by Martrenchar (2001). Lesions were scored as: 1, lesion covers less than 25% of the footpad; 2, lesion covers 26-50% of the footpad; and 3, lesion covers more than 50% of the footpad (Figure 1).

STATISTICAL ANALYSIS

Data were submitted to analysis of variance and means were compared by the test of Tukey at 5% significance levels, using Assistat statistical package (Silva, 2009). Pododermatitis scores were evaluated by the Chi-square test of Action® statistical software program (R Development Core Team, 2008).

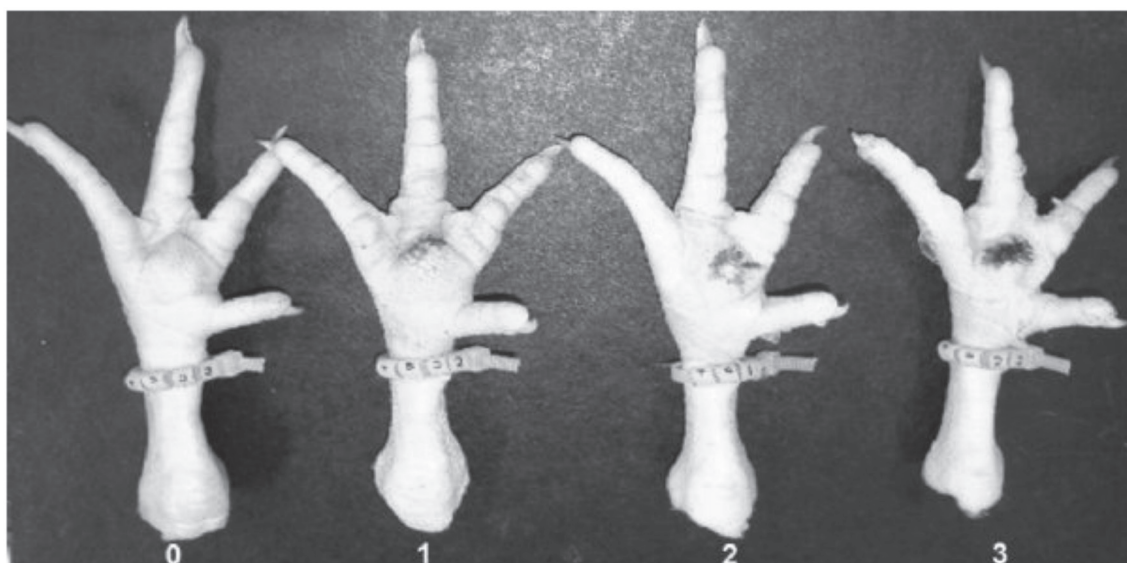


Figure 1 – Broilers feet classified according to footpad lesion score. Source: (Martrenchar, 2001)

RESULTS

Litter DM (%), A (%), Ca (%), P (%), and pH were not significantly influenced by the treatments on day 35 or 42 (Tables 2 and 3). These results showed that the litter of broilers fed the diet based on sorghum grain presented the same characteristic as that of broilers fed the corn-based diet. Dry matter, Ca, and P litter content were similar between treatments and were within acceptable levels, thereby ensuring less environmental pollution. Litter pH values were close to neutral pH, which prevent ammonia volatilization.

Table 2 – Litter dry matter (DM%), ash (A%), calcium (Ca%), phosphorus (P%) and pH evaluated when broilers were 35 days of age.

Treatments	DM%	A%	Ca%	P%	pH
Corn	53.04	20.24	2.65	0.5968	8.26
Sorghum	50.25	19.64	2.36	0.5023	8.45
CV (%)	3.15	13.05	12.17	20.00	3.70
P value	0.1141	0.1250	0.2271	0.2786	0.1152

Means followed by different letters in the same column are different by the test of Tukey at 5% significance level.

Table 3 – Litter dry matter (DM%), ash (A%), calcium (Ca%), phosphorus (P%) and pH evaluated when broilers were 42 days of age.

Treatments	DM%	A%	Ca%	P%	pH
Corn	43.24	22.14	2.62	0.67	8.07
Sorghum	42.93	22.27	2.71	0.53	7.87
CV (%)	6.11	16.91	10.14	18.35	4.66
P value	0.2013	0.2381	0.1771	0.1177	0.1430

Means followed by different letters in the same column are different by the test of Tukey at 5% significance level.

Pododermatitis scored on days 35 and 42 show that feedstuff is not related ($p > 0.05$) with the incidence of pododermatitis. The low litter DM content obtained in both treatments justifies the low incidence of pododermatitis observed. These results show that whole grain sorghum is a viable alternative to corn in the diet in terms of footpad lesions and litter quality.

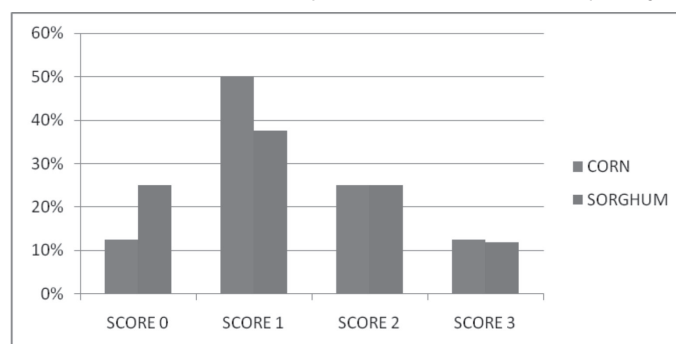


Figure 2 – Pododermatitis classification of 35-day-old broilers. p -value = 0.5

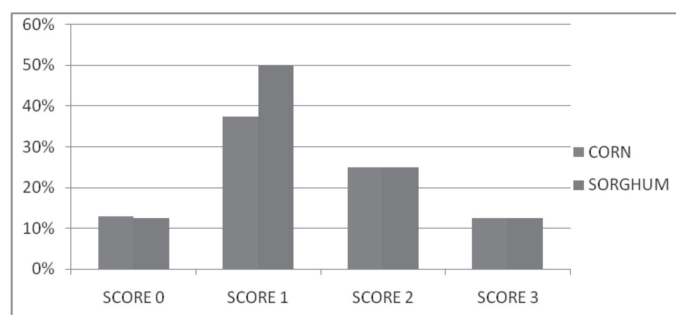


Figure 3 – Pododermatitis classification in 42-day-old broilers. p -value = 1

DISCUSSION

Litter quality and footpad lesions need to be evaluated when different types of diet are offered.



According to Garcia *et al.* (2011) several factors may affect litter quality in broilers houses, such as feed composition or type, litter material, time birds remain on the litter, bird density per area, and environmental temperature. Mayne *et al.* (2006) and Youssef *et al.* (2008) mention several studies that indicate that high litter humidity may induce pododermatitis, independently of other factors. The studies of Abd El-Wahab (2012) showed that broilers reared on litter with 65% humidity presented higher pododermatitis scores than those reared on litter with 35 and 50% humidity.

Oliveira *et al.* (2002) showed that litter DM content and footpad lesions were not influenced by bird density (10 or 14 birds/m²) when corn-based diets were offered. In that study, litter dry matter was 62%, differently from the results of the present study. However, the present results are consistent with the findings of Lopes *et al.* (2005), who obtained 42% litter DM, using corn-based diet.

Payne (1998) showed that calcium and phosphorus content in broiler wood-shavings litter may range between 0.6-3.9 and 0.8-6.1, respectively. The results of the present study are consistent with those findings. Silva (2006) determined 1.22% calcium and 1.76% phosphorus in wood-shavings litter of broiler fed corn diets.

Oliveira *et al.* (2003) observed that the pH of wood-shavings litter of 42-day-old broilers fed a corn-based diet was 8.04, which is close to the value obtained in the present study. Litter pH directly influences air ammonia levels. Ammonia volatilization is low when pH is lower than 7 and increases with pH (Reece *et al.*, 1979).

Litter quality has a strong influence on pododermatitis incidence. According to Jong & Hanr (2012), diet formulation based on digestible amino acids, the knowledge on the composition of the feedstuffs, and optimal sodium and potassium levels in the feed may reduce the incidence of that disease and improve broiler welfare. This should be taken into account as animal welfare legislation will become increasingly strict.

Conde *et al.* (2005) evaluates litter humidity and pododermatitis in broilers fed diets based on corn, soybean meal, poultry offal meal, or corn gluten meal. The results showed that birds fed diets containing corn gluten meal presented less pododermatitis lesions and the humidity of their litter was lower compared with those fed the other diets.

As there are few studies on these subjects, further research should be carried out to elucidate the influence

of diet on litter composition, and consequently, its effect on the incidence of pododermatitis and on animal welfare.

CONCLUSIONS

The evaluated feedstuffs did not influence pododermatitis or litter quality in this study.

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