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Effects of Initial Body Weight and Litter Material on Broiler Production

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ABSTRACT

This experiment was carried out in a 104 m^2 poultry house located between the geographical coordinates 25°45'00" south latitude and 53°03'25" west longitude and an average altitude of 550 m, from September to November, 2008. The chickens were placed in 12 pens measuring 2 m^2 each at a stocking density of 12 chickens m^{-2}. This study aimed at evaluating the effect of two different initial weights (chick weight on first day of experiment) and two types of litter material on broiler production parameters, litter humidity, as well as on breast and footpad lesions. A total of 240 female Cobb® chickens, derived from the same flock of breeders, was distributed in a completely randomized experimental design with a 2 (initial weight) by 2 (litter material) factorial arrangement with three replicates per treatment. Initial weights were classified as light (34.40 – 35.22 g) or heavy (39.29 – 41.30 g), whereas wood shavings and sawdust were used as litter material. Data were analyzed by ANOVA and means were compared by Tukey's test at 95% confidence level. Initial weight significantly influenced bird performance, as chickens with heavy initial weight presented higher feed intake and body weight. Type of litter did not have any effect on breast injuries and litter humidity. However, the wood shavings litter significantly influenced footpad lesions.

INTRODUCTION

Chick quality has become an important factor in the broiler industry, as it is directly related to broiler performance (Decuypere *et al*., 2001). According to Cervantes (1994), flock uniformity, as well as bird size and weight on their first day of life are the most important factors of the broiler production process. Also, carcass lesions cause financial losses to the growers due to total or partial condemnation of carcasses, reduction in the price of the final product and reduction in the speed of processing (Oliveira *et al*., 2002).

Litter material determines chickens' skin condition, which may influence the incidence of injuries, as well as the conditions of the environment where birds are reared. Some litter materials reach high humidity levels and may also increase the occurrence of lesions, mainly on chicken breasts and footpads (Zavala, 1997; Willis *et al*., 1997; Godwin *et al*., 2000). The aim of using good litter material in broiler production is to prevent the direct contact of the bird with the floor and to promote the absorption of the fecal moisture (Garcia *et al*., 2010).

Wood shavings are commonly used as litter material in broiler production in Brazil. This material can be very expensive, depending on its availability in the different regions of the country. However, there has been an increasing demand for alternative materials capable

of providing the same technical efficiency as wood shavings has in the past few years. Many materials have been tested as alternatives to replace wood shavings as litter material, such as rice husks, corn cobs, Cameron grass, corn crop residues, sawdust, refined plaster, etc. (Reed & McCartney, 1970; Parsons & Baker, 1985; Santos *et al*., 2000).

Therefore, this study aimed at evaluating the influence of chick initial weight on broiler performance, as well as the influence of type of litter material on the occurrence of breast and footpad lesions.

MATERIAL AND METHODS

This experiment was carried out in a 104 m^2 poultry house located between the geographical coordinates 25°45'00" south latitude and 53°03'25" west longitude and at an average altitude of 550 m, from September to November, 2008. A total of 240 female Cobb® broiler chicks, derived from the same breeder flock and provided by a local hatchery, were used as experimental units. Chicks were distributed in a completely randomized experiment design in a 2 (initial weight) by 2 (type of litter) factorial arrangement. Initial weights were classified as light (34.40 – 35.22 g) or heavy (39.29 – 41.30 g), whereas the types of litter material used were wood shavings or sawdust.

Birds were raised for 42 days at a stocking density of 12 birds m^{-2}, and were offered water and feed *ad libitum*. Feed was supplied three times a day: at 07:00AM, at 01:00PM and at 06:00PM, when feed residues were also measured.

Birds were housed in a 104 m^2 masonry poultry house, with east-west longitudinal orientation, roof made of ceramic tiles, 0.40 m high concrete sidewalls protected by yellow plastic curtains equipped with movable wrenches to control the thermal environment. Birds were distributed in 12 pens measuring 2 m^2 each were equipped with tube chick feeders and drinkers, as well as brooders to provide heat to the birds. Brooder and curtain were controlled according to the environmental needs of the birds. The temperature was recorded using a digital thermometer located at the chickens' height. Chick tube feeders and drinkers were replaced by regular tube feeders and drinkers as the chickens grew, and brooders were removed. The lighting program adopted was 19 hours of light per day, during the entire experimental period.

Chicken weight, weight gain, feed intake, feed conversion and mortality were evaluated as performance parameters, whereas litter humidity and incidence of breast and footpad lesions were measured in relation to litter quality.

Footpad lesions were classified according to the following scores (Mc Ward & Taylor, 2000): 0 – normal (no burns, scab or lesion); 1 – pad burn (dermis only); 2 – pad scab (healing) on one or both feet; and 3 – pad lesion (open sore) on one or both feet. Breast lesions were classified on a scoring system reported by Angelo *et al*. (1997): 0 – No lesion; 1– presence of lesion without inflammation; and 2 – presence of lesion and inflammation.

Litter humidity was determined by the Method of Moisture Content Determination, reported by the Ministry of Agriculture (Brazil, 1992). The litter samples were weekly collected from two different spots of each pen, except for areas below feeders and drinkers.

All chickens were weighted weekly on a Toledo® platform scale.

ANOVA (SAS, 2003) was used to analyze the obtained data and means were compared by Tukey's test at 95% confidence level.

RESULTS AND DISCUSSION

Table 1 shows the average bird performance results for each treatment applied.

The results showed that heavy birds were 1.98% heavier than the light birds at 42 days and housed in pens with wood shavings as litter material. Also, heavy birds were 0.71% heavier than the light chicks on day 42 when sawdust was used as litter material. This result is consistent with those of Gomes *et al*. (2008), who found that heavy broilers presented better performance, being 1.8% heavier than the light broilers on day 49.

As shown in Table 1, initial weight significantly influenced, at 95% confidence level, broiler final weight on day 42, with heavy birds presenting higher average weight at slaughter as compared to the light birds. This indicates that the light chicks did not recover their weights during the six experimental weeks under the same production management as the heavy birds.

Moreover, there was no effect ($p > 0.05$) of litter material on final broiler weight. Also, there was no interaction between litter type of and initial bird weight. Therefore, birds with heavier initial weight presented heavier final weight, independently of the litter material. litter material had no effect on weight gain ($p > 0.05$). There was no significant effect of the treatments on mortality.

These results agree with those of Maiorka *et al*. (2003), who found that broilers with different weights presented distinct growth curves, which may result in performance differences, which are favorable for heavier chicks, as it is known that the bird weight on hatching day and on placement date are significantly related to bird weight during the growout.

Table 1 - Average bird performance results in each treatment.

Bird age (days)	H/WS	L/WS	H/S	L/S
Weight/bird (g)				
8	161.00	147.33	163.17	153.00
15	461.00	426.00	441.67	437.67
22	926.67	832.00	908.67	901.67
29	1429.67	1299.33	1401.00	1385.00
36	1970.00	1794.00	1934.00	1924.67
42	2372.67	2175.00	2355.00	2283.67
Weight Gain/bird (g)				
8	121.70	112.80	122.57	115.44
15	300.00	278.67	284.67	278.50
22	465.67	406.00	471.00	460.00
29	503.00	467.33	499.33	476.33
36	540.33	494.67	549.00	520.67
42	402.67	381.00	421.00	362.00
Feed Conversion (g/g)				
8	0.98	0.98	0.93	0.93
15	1.27	1.24	1.27	1.26
22	1.34	1.37	1.30	1.34
29	1.49	1.53	1.48	1.55
36	1.65	1.69	1.65	1.69
42	1.71	1.74	1.72	1.76
Feed Intake/bird (g)				
8	157.58	143.68	152.50	141.66
15	584.61	530.08	559.80	550.65
22	1242.12	1140.17	1173.09	1215.75
29	2135.18	1983.42	2072.12	2145.67
36	3250.37	3034.32	3162.67	3266.25
42	4053.07	3784.75	3935.93	4142.12
Mortality (%)				
8	0.00	1.67	0.00	1.67
15	1.67	0.00	0.00	3.33
22	0.00	1.67	1.67	0.00
29	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	1.67
42	0.00	0.00	0.00	0.00

(H/WS = Heavy birds/Wood Shavings; L/WS= Light birds/Wood Shavings; H/S = Heavy birds/Sawdust; L/S = Light birds/Sawdust).

According to Stringhini *et al*. (2003), bird weight on the first day of life significantly influenced body weight until 35 days of age. On day 42, those authors observed that the light broilers weighed 104 g less than the heavy ones chickens, despite the lack of significant relationship between initial and final weight on that day. Similar results were observed by Oliveira (1981) and Okada (1994), who found positive bird performance responses of related to bird initial weight.

The results obtained are consistent with the findings of Vieira & Moran (1998), Araújo *et al*. (1999) and Sklan *et al*. (2003). According to Vieira (2001), broiler weight at slaughter is positively related to the egg weight and to chick weight immediately after hatch. Okada (1994) also found that chicks weighing less than 40 g were more susceptible to health risks and, by the end of the growout, weighed less 10 to 15 g per gram of difference between initial and final weights as compared to heavier chicks.

Treatments did not influence feed conversion ($p > 0.05$). However, heavy birds presented better feed conversion after 36 days of age, independently of litter material. This result agrees with those found by Gomes *et al*. (2008), while Stringhini *et al*. (2003) found significant relationships only between bird initial weight and feed conversion during the first and last week of the growout.

Feed intake was significantly related to bird initial weight, with heavy chickens consuming more feed during the entire experimental period. Again, litter material did not affect feed intake ($p>0.05$). Pinchasov (1991) asserted that the better performance obtained by the heavy chicks may be related to their higher feed intake.

Vieira (2001) found conflicting information on the relationship of feed intake and feed conversion ratio with initial bird weight, but concluded that slaughter weight is positively related to egg weight and chick weight on its first day of life.

Bird initial performance is determined by many factors, such as fasting period, initial nutrition and environment temperature on the first days of life (Baião & Aguilar, 2001; Gonzales & Saldanha, 2001; Maiorka, 2001).

No relationship was determined between litter material and litter humidity ($p>0.05$). Conversely, Davassain & Boodoo (1998) verified that the water retention capacity of the wood shavings and its density were lower than the ones of the sawdust. Santos *et al*. (2000) found that litter materials with smaller particle size (milled material) presented higher density and lower humidity levels as compared to materials with larger particles. On the other hand, consistent with the results of the present study, Lien *et al*. (1998) did not find any significant differences in the humidity ratio (26%) of wood shavings and straw used as litter materials after seven weeks of use.

Regarding footpad lesions, litter material influenced footpad lesions ($p<0.05$), whereas initial weight did not have any effect on body lesions, as shown in Table 2.

Table 2 - Average breast and footpad lesion scores of broilers with different initial weights raised on different litter materials.

Variable	Litter Material	Initial Weight			CV (%)[1]
		Heavy (34.40 - 35.22 g)	Light (39.29 - 41.3 g)	Average	
Breast lesions	Wood Shavings	0	0	0	13.19
	Sawdust	0	0	0	
	Average	0	0	0	
Footpad lesions	Wood Shavings	1a[2]	0.97a	0.985a	12.67
	Sawdust	0.35b	0.27b	0.31b	
	Average	0.68	0.62	0.65	

1 - Coefficient of Variation, obtained by transformation of means ($\sqrt{x+1}$). 2 - Averages followed by distinct lower and upper case letters in the same row and column, respectively, are different by the test of Tukey ($p< 0.05$).

Table 2 shows that the incidence of breast lesions was low, *i.e.*, severity remained at the lowest degree. This result agrees with Smith (1956), who evaluated the effect of corn cobs as litter material on the incidence of breast lesions in broilers and observed that birds raised on this litter material presented the same degree of lesions as birds raised on wood shavings or sawdust. That author, therefore, suggested that the litter condition is more important than the type of material used as litter. Other authors also mentioned that breast and footpad lesions are mainly related to litter conditions (Harms & Simpson, 1977; Martland, 1984). However, Chen *et al*. (1991), in an experiment with turkeys, found higher incidence of breast lesions in birds raised on litter relative to those raised on slatted floor.

Consistent with the present study, Oliveira *et al*. (2002) did not find significant differences in the incidence of breast lesions in broilers raised on different litter materials with different densities. Willis *et al*. (1997) observed that broilers presented the same breast lesion score (approximately 1.4) when raised on different types of litter materials. Angelo *et al*. (1997) also did not find significant differences in the incidence of breast lesions, obtaining an average score of 0.54. Table 2 shows also that the incidence footpad lesions was higher birds raised on wood-shavings litter, indicating that sawdust litter was less harmful to footpads.

Relative to litter humidity, Wang *et al*. (1999) found that 38% of the birds raised on dry litter presented footpad lesions as compared to 92% of birds raised on humid litter.

Researchers found different incidences of bird footpad lesions with different litter materials, stocking densities, as well as interactions of both factors (Oliveira *et al*., 2002). The authors verified that footpad lesions were more severe in birds raised on the sawdust litter than in those raised on wood shavings litter (scores 1.05 and 1.20, respectively), differently from the findings of the present study. Su *et al*. (2000) evaluated different litter types and found that litter material influenced footpad lesions scores, which were lower in the birds raised on the wood shavings litter relative to those raised on straw litter.

Others authors observed higher incidence ($p<0.05$) of thin litter (depth < 5 cm) on broiler footpad lesions as compared to thick litter (depth > 5 cm), but no significant effect of litter type when using wood shavings or corn cobs (Ekstrand *et al*., 1997).

Figure 1 shows litter humidity and footpad lesion results during the experiment. Litter humidity increased along the days of experiment, independently of litter material, as expected due to the increase in the moisture produced by the birds and their manure. Although there was no significant relationship between litter moisture and litter material, wood shavings litter presented less moisture than the sawdust litter, similarly to Pearson *et al*. (2000), who verified that the smaller the material particles, the higher its water retention capacity.

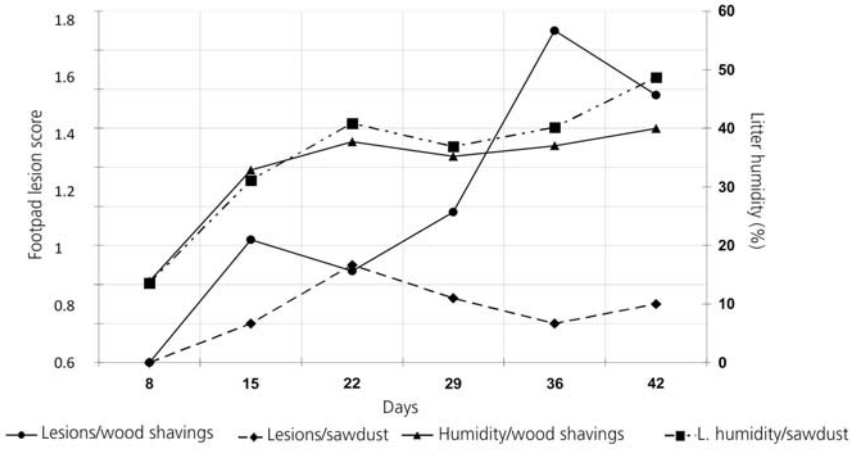

Figure 1 - Litter humidity and broiler footpad lesions during the experimental period.

CONCLUSIONS

Litter material did not affect bird performance, breast lesions or litter humidity. Nevertheless, the wood shavings litter significantly increased footpad lesions.

Initial chick weight was found to be a determinant factor in bird performance, as the heaviest broilers were those with the heaviest initial weights. Also, heavy broilers presented higher feed intake.

REFERENCES

Angelo JC, Gonzales E, Kondo N, Anzai N, Cabral MM. Material de cama: qualidade, quantidade e efeito sobre o desempenho de frangos de corte. Revista Brasileira de Zootecnia 1997; 26:121-130.

Araújo CSS, Stringhini JH, Araújo LF. Manejo nutricional de frangos de corte na fase pré-inicial. Archivos Latino-americanos de Producción Animal 1999; 7:77-84.

Baião NC, Aguilar CAL. Impacto do tempo de alojamento do pintinho de corte sobre a produção do frango. Anais da Conferência Apinco de Ciência e Tecnologia Avícolas; 2001; Campinas. São Paulo. Brasil. p.125-140.

Brasil. Ministério da Agricultura e Reforma Agrária. Regras para análise da qualidade e produtividade. Brasília; 1992.

Cervantes H. Una nueva fórmula para definir la calidad del pollito. Indústria Avícola 1994; 41:10-16.

Chen F, Noll SL, Clanton CJ, Janni KA, Halvorson DA. Market turkey performance affected by floor type and brooding method. Applied Engineering in Agriculture 1991; 7:606-612.

Davassain MM, Boodoo AA. Use of bagasse as a potential source of litter material for broiler production. Proceedings of the Annual Meeting of Agricultural Scientists 1998; Réduit. p.15-20.

Decuypere E, Tona K, Bruggeman F. The day-old chick: a crucial hinge between breeders and broilers. World's Poultry Science Journal 2001; 57: 127-138.

Ekstrand C, Algers B, Svedberg J. Rearing conditions and foot-pad dermatitis in Swedish broiler chickens. Preventive Veterinary Medicine 1997; 31:167-174.

Garcia RG, Almeida Paz ICL, Caldara FR, Nääs IA, Pereira DF, Freitas LW, Schwingel AW, Lima NDS, Graciano JD. Effect of the litter material on drinking water quality in broiler production. Brazilian Journal of Poultry Science 2010; 12(3):165-169.

Godwin JL, Carter TA, Grimes JL. The use of litter plus as a bedding material for broilers. National Poultry Waste Management Symposium; 2000; Auburn. Alabama; United State of America. p.344-351.

Gomes GA, Araújo LF, Prezzi JA, Savietto D, Júnior JRS, Valério J. Tempo de fornecimento da dieta pré-inicial para frangos de corte com diferentes pesos ao alojamento. Revista Brasileira Zootecnia 2008; 37:1802-1807.

Gonzales E, Saldaña ESPB. Os primeiros dias de vida do frango e a produtividade futura. Anais do Congresso Brasileiro de Zootecnia; 2001; Goiânia, Goiás. Brasil. p.310-327.

Harms RH, Simpson CF. Influence of wet litter and supplemental biotin on foot pad dermatitis in turkey poults. Poultry Science 1977; 56:2009-2012.

Lien RJ, Hess JB, Conner DE, Wood CW, Shelby RA. Peanut hulls as a litter source for broiler breeder replacement pullets. Poultry Science 1998; 77:41-46.

Maiorka A. Adaptações digestivas pós-eclosão. Anais da Conferência Apinco de Ciência e Tecnologia Avícolas; 2001; Campinas, São Paulo. Brasil. p.141-152.

Maiorka A, Luquetti BC, Almeida JG. Idade da matriz e qualidade do pintinho. In: Macari M, Gonzales E. editores. Manejo da incubação. Jaboticabal: FACTA; 2003. p. 361-377.

Martland MF. Wet litter as a cause of plantar pododermatitis, leading to foot ulceration and lameness in fattening turkeys. Avian Pathology 1984; 13:241-252.

Mc Ward GW, Taylor DR. Acidified claylitter amendment. Journal of Applied Poultry Research 2000; 9:518-529.

Okada TMA. Qualidade do pinto de um dia. In: Pinheiro MR, editor. Manejo de frangos. Campinas: Fundação Apinco de Ciência e Tecnologia Avícolas; 1994. p.41-46.

Oliveira MC, Gourlart RB, Silva JCN. Efeito de duas densidades e dois tipos de cama sobre a umidade da cama e a incidência de lesões na carcaça de frango de corte. Ciência Animal Brasileira 2002; 3:7-12.

Oliveira RL. Mortalidade inicial - causas e controle. In: Campos EJ, Lamas da Silva JM, Silva EM, editores. Produção e qualidade de pintos de um dia. Belo Horizonte: UFMG; 1981. p.229-236.

Parsons AH, Baker SL. Softwood chipping fines: Efficacy as poultry litter. Poultry Science 1985; 64:2292-2295.

Pearson EG, Leavengood S, Reeb JE. Comparison of the absorptive capacity of shavings of western juniper, western redcedar, and douglas-fir for animal bedding. Forest Products Journal 2000; 50:57-61.

Pinchasov Y. Relationship between the weight of hatching eggs and subsequent early performance of broiler chicks. British Poultry Science 1991; 32:109-115.

Reed MJ, Mccartney MG. Physical properties of selected litter materials and performance of broiler chickens. [research bulletin 75]. Georgia (FL): College of Agriculture Experiment Station; 1970.

Santos EC, Teixeira AS, Torres DM, Fonseca RA. Avaliação das propriedades de quatro materiais e duas granulometrias de cama sobre o desempenho de frangos de corte: Anais da Reunião Anual da Sociedade Brasileira de Zootecnia; 2000; Viçosa, Minas Gerais. Brasil. p.48-50.

SAS statistical analysis system user's guide: Stat. Version 8.2. Cary: SAS Institute; 2003.

Sklan D, Heifetz S, Halevy O. Heavier chicks at hatch improves marketing body weight by enhancing skeletal muscle growth. Poultry Science 2003; 82:1778-1786.

Smith RC. Kind of litter and breast blisters on broilers. Poultry Science 1956; 35:593-595.

Stringhini JH, Resende A, Café MB, Leandro NSM, Andrade MA. Efeito do peso inicial dos pintos e do período da dieta pré-inicial sobre o desempenho de frangos de corte. Revista Brasileira Zootecnia 2003; 32:353-360.

Su G, Sorensen P, Kestin SC. A note and the effects of perches and litter substrate on leg weakness in broiler chickens. Poultry Science 2000; 79:1259-1263.

Vieira SL. Idade da matriz, tamanho do ovo e desempenho do pintinho. Anais da Conferência Apinco de Ciência e Tecnologia Avícolas; 2001; Campinas, São Paulo. Brasil. p.117-123.

Vieira SL, Moran Jr ET. Broiler yields using chicks from egg weight extremes in breeder age and dietary propionate. Journal of Applied Poultry Research 1998; 7:320-327.

Wang G, Ekstrand C, Svedberg J. Wet litter and perches a risk factors for the development of foot pad dermatitis in floor-housed hens. British Poultry Science 1993; 39:191-197.

Willis WL, Murray C, Talbott C. Evaluation of leaves as litter material. Poultry Science 1997; 76:1138-1140.

Zavala G. Manejo de problemas locomotores en reproductoras pesadas. Avicultura Professional 1997; 15:26-28.