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Effect of the Litter Material on Drinking Water Quality in Broiler Production

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ABSTRACT

Considering the importance of drinking water and its effect on broiler performance, drinking water quality was studied using six different litter materials. The presence of coliform bacteria and *Escherichia coli* was investigated. The following litter materials were used in the trial: wood shavings, rice husks, chopped Napier grass (*Pennisetum pupureum*), 50% sugarcane bagasse (*Saccharum* L.) + 50% wood shavings, 50% sugarcane bagasse (*Saccharum* L.) + 50% rice husks, and plain sugarcane bagasse (*Saccharum* L.). A number of 1620 Ross® one-day-old chicks were reared in 54 pens measuring 4.5 m^2 each, equipped with a bell drinker and a tube feeder. Water samples were collected in sterile tubes on days 28 and 42 of the rearing period, and submitted to the laboratory for analyses. Microbiological data were organized by classes expressed in a logarithm scale, where the lowest contamination corresponds to class 1 and the highest contamination to class 4. Results showed that total coliform contamination was higher on day 28 than in the end of the rearing period, and that E. coli presence was detected during both analyzed periods. The litter materials that presented lower degree of water contamination, predominantly class 1, were sugarcane bagasse and 50% of sugarcane bagasse and 50% of rice husks.

INTRODUCTION

Poultry production has grown in Brazil, and since 2007 an average of 10 million tons of chicken meat are annually produced per year, with approximately 70% sold in the domestic market and 30% as exports (UBA, 2008). Broiler production technology has improved during recent years, allowing production growth within the same built area (Proudfoot *et al*., 1979; Santos *et al*., 2000; Santos *et al*., 2005).

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. The use of appropriate litter also helps maintaining thermal environment balanced as it may reduce fermentation heat production in the rearing environment (Oliveira & Carvalho, 2002). Several materials have been used as litter, such as wood shavings and rice husks, and other materials, such as paper, peanut hulls, and sand have been studied as alternatives to reduce the use of wood and help preventing lumbering (Hernandes *et al*., 2002; Santos *et al*., 2000).

Animals need to consume sufficient water to satisfy their requirements. However, more important than water quantity is water quality, as the hygienic and physical-chemical quality of drinking water plays a key role in ensuring efficient animal production (Amaral *et al*., 1999; Li, 2009). Water is involved in every aspect of poultry metabolism and plays an important role in body temperature regulation, food digestion, and body waste excretion (Valias & Silva, 2001). Safe and

adequate water supply is essential for efficient poultry performance as the chick's body contains approximately 80% water at hatching. Previous studies have shown that pathogenic bacteria and excessive amounts of chemicals in water supplies can reduce animal production, impair fertility, and cause the bird mortality in extreme cases (Abbas *et al*., 2008; Li, 2009). Bacteria in drinking water may induce health problems, and consequent lack of welfare (Koelkebeck *et al*., 1999; Manning *et al*., 2007). Moreover, contaminants in drinking water can leave residues in animal products, i.e. meat, milk and eggs, which adversely affect product sales and may pose health risks to humans. In order to improve water quality a number of solutions, such as filtration, coagulation, solar radiation, chlorination, and acidification have been developed to improve farm water quality (Barton, 1996; Macari, 1996).

This study aimed at evaluating drinking water quality in bell drinkers used in broiler production as function of the litter material used in houses during the rearing period.

MATERIAL AND METHODS

Broiler housing and management

This study was conducted in an experimental broiler house located in the School of Agricultural Sciences of the Federal University of Grande Dourados, Brazil. The house was 50 m long, 10 m wide, and 3 m high. A total of 1620 Ross® broilers were distributed in 54 pens measuring 4.5 m^2 each, equipped with a bell drinker and a tube feeder. Side walls were covered with curtains and inside temperature was controlled by the use of fans and foggers. Chicks were brooded using 250W infrared lamps, one per pen. The lighting regime was 24 hours of light during the entire rearing period, using 40W lamps providing an average of 22 lx.

All birds were offered feed and water *ad libitum* during the entire experimental period. The feeding program included three phases: a starter diet (1 - 21 days), a grower diet (22 - 35 days), and a finisher diet (36 - 45 days). Birds were vaccinated against Marek's disease at the hatchery and were vaccinated against Newcastle disease in the drinking water at 10 days of age.

Broilers performance was evaluated in a weekly (feed intake, weight gain, feed conversion ratio, mortality, body weight and carcass yield).

Litter material

The following litter materials were tested: wood shavings, rice husks, chopped Napier grass (*Pennisetum pupureum*), 50% of sugarcane bagasse (*Saccharum* L.) + 50% wood shavings, 50% of sugarcane bagasse (*Saccharum* L.) + 50% rice husks, and only sugarcane bagasse (*Saccharum* L.). The sugarcane bagasse was obtained in the region of Dourados and Napier grass was bought in nearby farms. The grass was chopped in particles of approximately 2.0-3.0 cm and sun-dried to 15% final moisture. Wood shavings and rice husks were purchased from in companies that market those products. All tested materials were placed on the broiler house floor at a height of 10 - 8 cm.

Microbiological data of drinking water

Bell drinkers were daily cleaned and disinfected, and the drinking water was replaced twice daily. The drinking water in all treatments derived from the same water source, and free chlorine was used during the entire experimental period at 6 to 8 ppm in combination with acidification to a pH value of 5.0 (Macari, 1996), resulting in 5 ppm residual chlorine in the drinkers. Two samples per pen were collected in sterile tubes on days 28 and 42. After collection, samples were placed in thermally-insulated boxes containing ice, and immediately submitted to the laboratory for analyses. Determination of total bacteria and *Escherichia coli* counts were performed according to the Silva *et al*. (1997).

Microbiological data were organized by classes (Table 1) expressed in logarithmic scale, according to current literature (Ahmad *et al*., 2009; Carter *et al*., 2010; Souza *et al*., 1992). The lowest contamination corresponds to class 1, while the highest contamination to class 4.

Table 1 - Classes of the Most Probable Number (MPN) of micro-organisms (in logarithmic scale) used for the classification of drinking water quality.

MPN/mL	NPM Limit		Class
	Lower	Upper	
<3 - 15	3	44	1
20 - 460	7	89	2
461 - 1100	71	2400	3
>2400	50	4800	4

Experimental design

A completely randomized experimental design in a 6 x 2 factorial arrangement (six litter materials and two sexes), with five replicates per treatment was applied. Data were submitted to ANOVA using SAS (1998) software package, and means were compared using Tukey's test at 95% significance level.

RESULTS AND DISCUSSION

There was no significant effect of litter material on broiler performance ($p > 0.05$).

A high contamination of fecal coliforms was found in all collected water samples (Table 2). Using specific contamination classes, results showed that the predominant class was 1 (low contamination) in the water samples collected in pens with sugarcane bagasse, and 50% of sugarcane bagasse and 50% of rice husks litter,, while when rice husks and Napier grass were used as litter, the predominant class was 3 (high contamination). All other tested litter material could not be included in a specific class (Table 1).

Water is a critical nutrient that should be routinely analyzed to ensure that it complies with the accepted quality standards, thereby optimizing bird health and welfare. Koelkebeck *et al*. (1999) studied the effect of water quality using different water sources for layers, and the experimental results indicated that the quality of drinking water may greatly affect layer performance. Considering that water consumption (both daily and per cycle) is a key indicator of bird welfare, appropriate water supply and management is highly desirable (Manning *et al*., 2007). Total bacteria and coliform bacteria concentrations should not exceed 100 and 50 colony-forming units/100 ml, respectively, in the drinking water of broilers (Carter *et al*., 2010; Valias & Silva, 2001).

On day 42 of the experimental period, the drinking water in the pens using sugarcane bagasse, wood shavings, 50% sugarcane bagasse + 50% of rice hulls, and 50% of sugarcane bagasse + 50% of wood shaving as litter material presented lower

Table 2 - Microbiological analysis of the drinking water offered to 28- and 42-day-old broilers.

Litter material	Sample	28 days	Class	42 days	Class
Sugarcane bagasse	A	< 1.0E+01	1	< 1.0E+01	1
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
	A	> 1.1E+03	3	<1.00E+01	1
	B	> 1.0E+01	-	< 1.0E+01	-
	C	> 1.0E+01	Co	< 1.0E+01	Co
Wood shavings	A	9.20E+01	2	< 1.00E+01	1
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
	A	> 1.10E+03	3	< 1.0E+01	1
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
Rice husks	A	> 1.10E+03	3	> 1.1E+03	3
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
	A	3.6E+01	2	> 1.1E+03	3
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
Napier grass	A	> 1.10E+03	3	> 1.1E+03	3
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
	A	< 1.0E+01	1	> 1.1E+03	3
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
Sugarcane bagasse + Rice husks	A	1.5E+01	1	< 1.0E+01	1
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
	A	2.7E+01	2	< 1.0E+01	1
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
Sugarcane bagasse + Wood shavings	A	> 1.1E+03	3	< 1.00E+01	1
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co
	A	4.3E+01	2	< 1.0E+01	1
	B	< 1.0E+01	-	< 1.0E+01	-
	C	< 1.0E+01	Co	< 1.0E+01	Co

A: Total fecal coliforms, 36ºC (MPN/100ml); B: Coliforms, 45ºC (MPN/100ml); C: *Escherichia coli* 36ºC (/250ml); Microbiological pattern <3.00E+00 (Brasil, 2004). Co: Contaminated (Ahmad *et al*., 2009; Carter *et al.*, 2010)

contamination. Contamination levels were higher on day 28, when a predominance of the higher contamination classes.

All water samples presented *Escherichia coli* values higher the international standards (Amaral *et al*., 2001; Bettega *et al*., 2006; Carter *et al*., 2010). This contamination may be due to the use of bell drinkers. Studying the water quality in different types of drinkers, Barros *et al*. (2001) and Valias & Silva (2001) found that bell drinkers may reduce the biological quality of the water provided to broilers, posing a high risk of contamination (Amaral, 2004).

As the hygienic status of drinking water varies greatly among farms, methods and strategies to identify critical contamination points need to be identified and updated, and measured to control water-borne diseases at farm level need to be applied.

CONCLUSION

The type of litter material used during rearing slightly influenced the microbiological quality of the drinking water of broilers the beginning of the rearing period.

REFERENCES

Abbas TEE, Elzubeir EA, Arabbi OH. Drinking water quality and its effects on broiler chicks performance during winter season. International Journal of Poultry Science 2008; 7(5):433-436.

Ahmad MD, Hashmi RA, Anjum AA, Hanif A, Ratyal RH. Drinking water quality by the use of Congo Red medium to differentiate between pathogenic and non pathogenic *E. coli* at poultry farms. The Journal of Animal & Plant Sciences 2009; 19(2):108-110.

Amaral LA, Rossi Junior OD, Cardoso V. Qualidade higienicosanitária da água de bebedouros pendular e nipple utilizados na criação de frangos de corte. Revista Brasileira de Ciência Avícola 1999; 1(2):145-148.

Amaral LA, Nader Filho A, Isa H, Barros LSS. Qualidade higiênicosanitária e demanda de cloro da água de dessedentação de galinhas de postura coletadas em bebedouros tipo nipple e taça. Revista Brasileira de Ciência Avícola 2001; 3(3):249-255.

Amaral, LA do. Drinking water as a risk factor to poultry health. Revista Brasileira de Ciência Avícola 2004; 6(4):191-199.

Barros LSS, Amaral LA, Rossi Jr, OD. Microbiological aspects and chlorine demand in the drinking water of broiler chicken collected from bell shaped drinkers. Revista Brasileira de Ciência Avícola 2001; 3(2):193-198.

Barton TL. Relevance of water quality to broiler and turkey performance. Poultry Science 1996; 75:854-856.

Bettega JMPR, Machado RM, Presibella M, Baniski G, Almeida Barbosa CA. Analytical methods for water microbiological control for human consumption. Ciência Agrotecnica 2006; 30(5):950-954.

Brasil. Portaria n° 518MS de 25 de março de 2004.

Carter TA; Ronald E. Sneed RE. Drinking water quality for poultry [cited 2010 jan. 23]. Available from: http://www.ces.ncsu.edu/depts/poulsci/tech_manuals/drinking_water_quality.html. Hernandes R, Cazetta JO, Moraes VMB. Frações nitrogenadas, glicídicas e amônia liberada pela cama de frangos de corte em diferentes densidades e tempos de confinamento. Revista Brasileira de Zootecnia 2002; 31 (4):1795-1802.

Koelkebeck KW, McKee JS, Harrison PC, Parsons CM. Performance of laying hens provided water from two sources. Journal of Applied Poultry Research 1999; 8:374-379.

Li L. Clean drinking water is crucial in enhancing animal productivity. Proceedings of the 17th Annual ASAIM SEA Feed Technology and Nutrition Workshop; 2009; Vietnam. p.1-6.

Macari M. Água na avicultura industrial. Jaboticabal: Funep; 1996. 128 p.

Manning L, Chadd SA, Baines RN. Key health and welfare indicators for broiler production. World's Poultry Science Journal 2007; 63:46-62.

Oliveira MC, Carvalho ID. Rendimento e lesões em carcaças de frangos de corte criados em diferentes camas e densidades populacionais. Ciência Agrotécnica 2002; 26 (5):1076-1081.

Proudfoot FG, Hulan HW, Ramey DR. The effect of four stocking densities on broiler carcass grade, the incidence of breast blisters, and other performance traits. Poultry Science 1979; 58:791-3.

Santos EC, Cotta JTB, Muniz JA, Fonseca RA, Torres DM. Avaliação de alguns materiais usados como cama sobre o desempenho de frangos de corte. Ciência Agrotécnica 2000; 14 (4):1024-1030.

Santos TMB, Junior JL, Sakomura NK. Efeitos da densidade populacional e da reutilização da cama sobre o desempenho de frangos de corte e produção de cama. Revista Portuguesa de Ciências Veterinárias 2005; 100:45-52.

Silva N, Junqueira VCA, Silveira NFA. Contagem de coliformes totais, coliformes fecais e *Escherichia coli*. In: Silva N, Junqueira VCA, Silveira NFA. Manual de métodos de análise microbiológica de alimentos. São Paulo: Livraria Varela; 1997b. p.31-39.

SAS - Institute. User's guide: statistcs. Cary; 1998.

Souza LC, Iaria ST, Paim GV. Salmonellas e coliformes fecais em água de bebida para animais. Revista Saúda Pública 1992; 26(5): 321-327.

UBA - União Brasileira de Avicultura. Produção de pintos de corte. São Paulo; 2007 [cited 2008 jan 21]. Available from: www.uba.org.br.

Valias APGS, Silva EN. Comparative study of systems of drinkers in the microbiological quality of the water consumed by broiler chickens. Revista Brasileira de Ciência Avícola 2001; 3(1):83-89.