

Performance of broiler chickens raised in boric acid amended chopped rice straw and paddy husk

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Abstract

A research study was carried out to evaluate the effects of boric acid amended chopped paddy straw and paddy husk on performance of broiler chickens. Total of 120, day-old, broiler chicks were randomly allocated into four treatment groups; CS= birds raised in chopped paddy straw, PH=birds raised in paddy husk, CS+H₃BO₃=birds raised in boric acid treated chopped paddy straw and PH+H₃BO₃=birds raised in boric acid treated paddy husk, with three replicates of ten birds each. The birds were fed with commercial diets. Boric acid was applied to the litter surface at the rate of 0.4 kg/9.3 m² in weekly basis. Body weight gain and feed consumption were recorded weekly and feed conversion ratio (FCR) was calculated. On day 42, the carcass characteristics and the relative organ weights were measured. The birds raised on boric acid amended chopped straw and paddy husk had significantly increased ($p<0.05$) overall body weight gains, feed consumption, live body weight and carcass weight over the untreated groups. The FCR of birds kept on boric acid treated chopped straw was significantly ($p<0.05$) lower than untreated chopped straw and paddy husk. The dressing percentage was lowest ($p<0.05$) in the birds kept on untreated chopped straw than others. The birds raised on untreated chopped straw had higher ($p<0.05$) spleen weight and lower gizzard weight than those of untreated paddy husk regardless of boric acid amendment. Therefore, the boric acid amendment to chopped straw and paddy husk increases the growth performance of broiler chickens.

Key words: Body weight, Boric acid, Broiler chickens, Paddy husk, Performance, Straw.

Introduction

Ammonia has been recognized as a problem in poultry houses for many years. Poorly managed or reused litter can result in elevated volatilization of ammonia in mainly broiler houses. Increased moisture level of litter may result an increase incidences of disease in broilers, the potential to increase numbers of total bacteria within the litter, and an increase of insects which enhances the volatilization of ammonia. High concentrations of ammonia in poultry houses reduce body weights of birds (Quarles and Kling, 1974; Reece *et al.*, 1979). Several studies documented that ammonia in the broiler house atmosphere reduces the feed efficiency of broilers (Quarles and Fagerberg, 1979; Quarks and Kling, 1974; Caveny *et al.*, 1981). Many studies have demonstrated that high

concentration of ammonia in poultry farms damages respiratory tract of chickens (Anderson *et al.*, 1964) and increases the mortality in chickens (Kristensen *et al.*, 2000). Many scientists have reported that the most efficient method to treat litter to reduce ammonia production by means of reducing pH, bacteria and mold counts, is use of various chemical products. These chemicals called chemical amendments such as Al₂(SO₄)₃.14H₂O (Moore, 1996), AlCl₃.6H₂O (Smith, 2004), paraformaldehyde (Seltzer *et al.*, 1969), zeolites like clinoptilolite (Nakaue *et al.*, 1981), superphosphate (Cotterill and Winter, 1953), phosphoric acid (Reece *et al.*, 1979), ferrous sulfate (Huff *et al.*, 1984), hydrated lime, limestone, gypsum (Cotterill and Winter, 1953), acetic acid, propionic acid

(Parkhurst *et al.*, 1974), and antibiotics (Kitai and Arakawa, 1979), and Poultry Guard (McWard, 2000). These chemical amendments act by inhibiting microbial growth and by combining with the released ammonia and neutralize it. Inhibiting ammonia volatilization from poultry litter with chemical amendments has been shown to increase productivity in broiler chickens (Moore *et al.*, 1995). Dufour *et al.* (1992) reported that livability, weight gain, and feed conversion were not adversely affected in broiler chickens as a result of exposure to litter treated with boric acid at recommended levels of 0.4-0.9 kg/9.3 m². In this context, a study was carried out to determine the effect of amending two different litter materials such as paddy straw and husk with boric acid on the performance of broiler chickens.

Materials and Methods

The study was carried out at the poultry unit of Livestock farm, Eastern University, Sri Lanka. One hundred and twenty, day old Indian River strain broiler chicks were obtained from a commercial hatchery and allocated to four treatment groups; birds raised in CS= non-treated chopped straw, PH= non-treated paddy husk, CS+H₃BO₃= boric acid treated chopped straw and PH+H₃BO₃= boric acid-treated paddy husk in a Completely Randomized Design (CRD). Each treatment was randomly replicated thrice and each replicate was consisted of 10 birds. A two phase feeding program was adopted, where the broiler chickens were fed broiler starter crumbles from day 1 to day 21 and broiler finisher pellets from day 22 to day 42 (Corn-soya based). Feeding and watering were provided *ad libitum* throughout the period. All pens were located in a single poultry house and the concrete floor of the house was divided into 12 pens (3 m × 3 m). The chicks were brooded for one week and thereafter randomly divided into treatments and replicates. Light was provided for 24 hours using four numbers of 40 W bulb for

the first week of rearing. The floor space per bird given from day 8 to day 28 and day 29 up to day 42 were 0.07 m² and 0.09 m², respectively. Deep litter system was practiced for which paddy husk and chopped straw were used. The boric acid was applied from third week to sixth week. The amount of boric acid used was 0.4 kg/9.3 m² as recommended by Dufour *et al.* (1992). Therefore, 40 g of boric acid was applied to the litter surface of the boric acid treated pen and then lightly mixed with a rake.

Performance of broiler chickens was determined by evaluating body weight gain, total feed consumption, livability, feed conversion ratio (FCR), dressing percentage and relative organ weights. The body weights and feed consumption of birds were recorded weekly. The FCR was calculated by dividing the total quantity of feed consumed by the total body weight gain. Mortality was recorded daily. At the end of the experiment, birds were kept fasting for 12 hours to keep the crop of the bird empty at slaughtering time. Thereafter, birds in each replicate were weighted and slaughtered. After removing feathers along with the skin, head, legs and all internal organs, the carcass weight was taken to determine the dressing percentage. The weights of organs such as heart, gizzard, spleen, liver, lungs and bursa of fabricus were measured and the relative organ weights were calculated as a percentage of organ weight to the live weight of birds. The data were statistically analyzed with the standard procedures of Analysis of Variance, using SAS statistical software, as described by Steel and Torrie (1981). The means were compared for significance of difference by Duncan's Multiple Range Test at 5% significant level.

Results and Discussion

Growth Performance and Livability

Table 1 shows the effect of litter amendment with boric acid on the growth performance

and livability of broiler chickens. The results of growth performances revealed a significant ($p < 0.05$) improvement in the birds raised on boric acid treated litters compared to that of untreated litters.

Table 1. Effect of litter amendment with boric acid on growth performance and livability of broiler chickens (Mean \pm SE)

Parameters	CS	PH	CS+ H ₃ BO ₃	PH+ H ₃ BO ₃
Body weight gain (g)				
0-21day	624 ^c \pm 14.40	649 ^{bc} \pm 0.00	714 ^a \pm 7.64	657 ^b \pm 8.33
22-42day	1475 ^b \pm 75.00	1450 ^b \pm 50.00	1735 ^a \pm 23.60	1692 ^a \pm 30.00
0-42day	2099 ^b \pm 76.40	2099 ^b \pm 50.00	2449 ^a \pm 28.90	2349 ^a \pm 28.90
Feed consumption (g)				
0-21day	724 ^b \pm 14.60	739 ^{ab} \pm 2.00	769 ^a \pm 15.20	739 ^{ab} \pm 5.81
22-42day	2663 ^b \pm 49.20	2577 ^b \pm 13.00	2850 ^a \pm 25.70	2813 ^a \pm 13.30
0-42day	3388 ^b \pm 49.50	3316 ^b \pm 11.40	3619 ^a \pm 31.60	3553 ^a \pm 18.80
FCR				
0-21day	1.16 ^a \pm 0.01	1.14 ^a \pm 0.00	1.08 ^b \pm 0.02	1.13 ^{ab} \pm 0.02
22-42day	1.81 ^a \pm 0.07	1.78 ^{ab} \pm 0.06	1.64 ^b \pm 0.01	1.66 ^{ab} \pm 0.02
0-42day	1.62 ^a \pm 0.04	1.58 ^{ab} \pm 0.04	1.48 ^c \pm 0.01	1.51 ^{bc} \pm 0.01
Livability (%)				
0-21	100 \pm 0.00	98.89 \pm 1.11	100 \pm 0.00	100 \pm 0.00
22-42	100 ^a \pm 0.00	97.78 ^b \pm 1.11	100 ^a \pm 0.00	100 ^a \pm 0.00
0-42	100 \pm 0.00	98.33 \pm 0.96	100 \pm 0.00	100 \pm 0.00

a, b, c : Means within the same row with different superscript are significantly different ($p < 0.05$).

Treatments: CS - Birds raised in Chopped Straw, PH- Birds raised in Paddy Husk, CS + H₃BO₃ - Birds raised in Boric acid treated Chopped Straw, PH + H₃BO₃ - Birds raised in Boric acid treated Paddy Husk.

Significantly higher ($p < 0.05$) body weight gains (WG) were observed in the birds raised on boric acid treated chopped straw (CS+ H₃BO₃) and paddy husk (PH+ H₃BO₃) when compared to those raised on untreated chopped straw (CS) and paddy husk (PH) during finisher period and overall period. The percentage increase in overall WGs when compared to the corresponding untreated litter materials were 14% and 11%, respectively for boric acid treated chopped straw and paddy husk. During early stages of life, the highest ($p < 0.05$) WG was observed in the birds raised in CS+ H₃BO₃ while the lowest was observed in the birds raised in CS (Table 1). Higher growth rates in the broilers from boric acid amended litter might be due

the reduced ammonia concentration in those pens. However, the results of this study are inconsistent with the findings of McWard and Taylor (2000) and Moore *et al.* (1999) who reported that there were no significant differences between the WGs of birds raised on the bedding materials; chopped straw and paddy husk. During the starter period, the recorded feed consumption was significantly differed ($P < 0.05$) among the treatments. Birds raised on boric acid treated both chopped straw and paddy husk recorded significantly higher ($p < 0.05$) feed consumption during finisher and overall periods than those on untreated litter materials. The percentage increase in overall feed consumptions when compared to the corresponding untreated

litter materials were 6% and 7%, respectively for boric acid treated chopped straw and paddy husk. These results are in contrast with the finding of Caveny *et al.* (1981) who indicated that there was no significant difference among the birds reared on boric acid treated and untreated groups for feed consumption.

Feed conversion ratio of birds was significantly different ($p < 0.05$) among treatments groups during starter, finisher diet and overall periods. During these three periods, the birds raised on boric acid treated chopped straw (CS+ H_3BO_3) showed the lowest ($p > 0.05$) FCR than others which was not different ($p > 0.05$) from those on boric acid treated paddy husk (PH+ H_3BO_3). It indicates that the boric acid amended chopped straw and paddy husk improve the FCR in broiler chickens. These results agree with findings reported by McWard and Taylor (2000), that boric acid application to poultry litter results the lower FCR in broiler chickens.

A significant difference was recorded for the livability of birds during the finisher diet period where the significantly lowest ($p < 0.05$) livability was recorded for the birds raised on untreated paddy husk than other treatment groups which were not significantly differed ($p > 0.05$) among themselves. These observations are similar to the findings of the Do *et al.* (2005).

Carcass Characteristics

Table 2 shows the effect of litter amendment with boric acid on carcass characteristics of broiler chickens. Significantly higher ($p < 0.05$) live and carcass weights were recorded for the birds raised on boric acid treated chopped straw and paddy husk when compared to those of untreated litter materials. In birds raised on boric acid treated chopped straw and paddy husk, the live body weight was increased by 14% and 10%, respectively while the carcass weight was increased by 21% and 14%, respectively compared to those raised on corresponding untreated litter materials. Lower concentration of ammonia level in the boric acid amended litter materials would have resulted this higher live weight and carcass weight in broiler chickens. The dressing percentages of birds were similar ($p > 0.05$) among the treatments, except those from untreated chopped straw which had the lowest ($p < 0.05$) dressing percentage. Thus, boric acid amended chopped straw increased the dressing percentage while boric acid amended paddy husk did not increase the same in broilers. These results are in agreement with report of Reece *et al.*, (1979) who stated that the lower body weight would be resulted the lower carcass weight when the birds were in high ammonia exposure levels.

Table 2. Effect of litter amendment with boric acid on carcass characteristics of broiler chickens (Mean \pm SE)

Parameters	CS	PH	CS+ H_3BO_3	PH+ H_3BO_3
Live weight (g)	2150 ^b \pm 76.40	2150 ^b \pm 50.00	2500 ^a \pm 28.90	2400 ^a \pm 28.90
CW (g)	1400 ^b \pm 28.90	1467 ^b \pm 44.10	1780 ^a \pm 11.50	1700 ^a \pm 28.90
Dressing%	65.19 ^b \pm 1.18	68.22 ^a \pm 1.31	71.21 ^a \pm 0.36	70.83 ^a \pm 0.35

a,b,c : Means within the same row with different superscript are significantly different ($P < 0.05$).
CS: Chopped straw PH: Paddy husk, H_3BO_3 : Boric acid CW: Carcass weight

Treatments : CS - Birds raised in Chopped Straw, PH- Birds raised in Paddy Husk, CS + H₃BO₃ - Birds raised in Boric acid treated Chopped Straw, PH + H₃BO₃ - Birds raised in Boric acid treated Paddy Husk.

Organ Size

Table 3 shows the effect of litter amendment with boric acid on the relative organ weights of broiler chickens. Relative weights of gizzard, spleen and lungs were differed significantly ($p < 0.05$) among the treatment groups. These results indicate that boric acid treated litter materials do not have much effect on the relative organ weights of broiler chickens when compared to the corresponding untreated liter material, except lungs. The lower relative ($p < 0.05$) weights of lung was recorded from the birds raised on boric acid treated chopped straw and paddy husk, compared to that of untreated chopped straw which was similar ($p > 0.05$) to the birds from untreated paddy husk. According to Al-Mashhadani and Beck (1985), the thickness of lung wall in broiler

chickens increases when they exposed to atmospheric ammonia and this might be the reason for the increased lung weight of broilers from untreated chopped straw when compared with the boric acid treated groups. The relative weight of gizzard recorded from the birds of PH was significantly ($p < 0.05$) greater than those of CS and CS+ H₃BO₃. However, Younis *et al.* (2016) reported that litter treatment increases the gizzard weight of broiler chickens when compared to the control. Thus, it is evident that paddy husk as litter material increases the gizzard weight in broilers than chopped straw, regardless of litter treatment. However, relative weight of spleen was significantly higher ($p < 0.05$) in the birds of CS than those of PH and PH+H₃BO₃. Thus, the immunity of birds in the chopped straw would be higher than those of paddy husk.

Table 3. Effect of litter amendment with boric acid on relative organs weights of broiler chickens (Mean \pm SE)

Relative Organ Weights (%)	CS	PH	CS+ H ₃ BO ₃	PH+ H ₃ BO ₃
Gizzard	1.40 ^c \pm 0.10	2.20 ^a \pm 0.10	1.57 ^{bc} \pm 0.17	1.86 ^{ab} \pm 0.03
Heart	0.46 \pm 0.04	0.39 \pm 0.03	0.40 \pm 0.01	0.41 \pm 0.02
Spleen	0.13 ^a \pm 0.00	0.10 ^b \pm 0.01	0.12 ^{ab} \pm 0.01	0.09 ^b \pm 0.01
Liver	1.97 \pm 0.1	1.92 \pm 0.07	2.16 \pm 0.08	2.14 \pm 0.07
Lungs	0.49 ^a \pm 0.04	0.44 ^{ab} \pm 0.02	0.37 ^b \pm 0.02	0.39 ^b \pm 0.01
Bursa of fabricius	0.04 \pm 0.01	0.04 \pm 0.00	0.04 \pm 0.01	0.04 \pm 0.01

a,b,c : Means within the same row with different superscript are significantly different ($P < 0.05$).

CS: Chopped straw PH: Paddy husk, H₃BO₃ : Boric acid

Treatments : CS - Birds raised in Chopped Straw, PH- Birds raised in Paddy Husk, CS + H₃BO₃ - Birds raised in Boric acid treated Chopped Straw, PH + H₃BO₃ - Birds raised in Boric acid treated Paddy Husk.

Conclusion

It could be concluded that broiler chickens raised on the litters either chopped straw or paddy husk amended with boric acid increases their growth performance and carcass characteristics. However, an increase in dressing percentage of birds could be obtained when the birds are kept on the boric acid treated chopped straw. Regardless of boric acid amendment, the litter chopped straw increases the spleen weight in broilers while reduces the gizzard weight than paddy husk.

References

- Al-Mashhadani, E.H. and Beck, M.M. (1985). Effect of atmospheric ammonia on the surface ultrastructure of the lung and trachea of broiler chicks. *Poultry Science* 64(11):2056-61.
- Anderson, D.P., Beardand, R.P. and Hanson, C.W. (1964). The adverse effects of ammonia on chickens including resistance to infection with Newcastle Disease virus. *Avian Disease* 8:369-379.
- Caveny, D.D., Quarles, C.L. and Greathouse, G.A. (1981). Atmospheric ammonia and broiler cockerel performance. *Poultry Science* 60:513-516.
- Cotterill, O.J., and Winter, A.R. (1953). Some nitrogen studies on built-up litter. *Poultry Science* 32:365-366.
- Do, J.C., Choi, I.H., and Nahm, K.H. (2005). Effects of Chemically Amended Litter on Broiler Performances, Atmospheric Ammonia Concentration, and Phosphorus Solubility in Litter. *Poultry Science* 84: 679-686.
- Dufour, L., Sander, J.E., Wyatt, R.D., Rowland, G.N. and Page, R.K. (1992). Experimental exposure of broiler chickens to boric acid to assess clinical signs and lesions of toxicosis. *Avian Diseases* 36(4): 1007-1011.
- Huff, W.E., Malone, G.W. and Chaloupka, G.W. (1984). Effect of litter treatment on broiler performance and certain litter quality parameters. *Poultry Science* 63:2167-2171.
- Kitai, K. and Arakawa, A. (1979). Effect of antibiotics and caprylohydrozamic acid on ammonia gas from chicken excreta. *British Poultry Science* 20:55-62.
- Kristensen, H.H. and Wathes, C.M. (2000). Ammonia and poultry welfare: A review. *World's Poultry Science Journal* 56:235-245.
- McWard, G.W. and Taylor, D.R. (2000). Acidified clay litter amendment. *Journal of Applied Poultry Research* 9:518-526.
- Moore, P.A.Jr., Daniel, T.C., Edwards, D.R. and Miller, D.M. (1995). Effect of chemical amendments on ammonia volatilization from poultry litter. *Journal of Environmental Quality* 24:293-300.
- Moore, P.A. Jr., Daniel, T.C., Edwards, D.R. and Miller, D.M. (1996). Evaluation of chemical amendments to reduce ammonia volatilization from poultry litter. *Poultry Science* 75:315-320.
- Moore, P.A., Daniel, T.C. and Edwards, D.R. (1999). Reducing phosphorus runoff and improving poultry production with alum. *Poultry Science* 78:692- 698.
- Nakaue, H.S. and Koelliker, J.K. (1981). Studies with clinoptilolite in poultry. 1. Effect of feeding varying levels of clinoptilolite (zeolite) to dwarf single comb white Leghorn pullets and ammonia production. *Poultry Science* 60: 944.
- Parkhurst, C.R., Hamilton, P.B. and Baughman, G.R. (1974). The use of volatile fatty acids for the control of microorganisms in pine sawdust litter. *Poultry Science* 53(2): 801.

Quarles, C. and Fagerberg, D.J. (1979). Evaluation of ammonia stress and coccidiosis on broiler performance. *Poultry Science* 58:465-468.

Quarles, C.L. and Kling, H.F. (1974). Evaluation of ammonia and infectious bronchitis vaccination stress on broiler performance and carcass quality. *Poultry Science* 53:1592-1596.

Reece, F.N., Lott, B.D. and Deaton, J.W. (1979). Ammonia control in broiler houses. *Poultry Science* 58:754-755

Seltzer, W., Moum, S.G. and Goldhaft, T.M. (1969). A method for the treatment of animal wastes to control ammonia and other odours. *Poultry Science* 48: 1912.

Smith, D.R, Moore, P.A. Jr, Haggard, B.E, Maxwell, C.V, Daniel, T.C, Van Devander, K and Davis, M.E. (2004). Effect of aluminum chloride and dietary phytase on relative ammonia losses from swine manure. *Journal of Animal Science* 82: 605-611. 2004.

Steel, R.G.D. and J.H. Torrie. (1981). Principles and procedures of statistics: A biometrical approach. 2nd Ed. McGraw-Hill, Singapore.

Younis, M., Bazh, E., Ahmed, H.A.A. and Elbestawy, A.R. (2016). Growth Performance, Carcass Characteristics and Litter Composition of Broilers Raised on used Litter Managed by two Types of Acidifier Amendments. *Journal of Animal Science Advances* 6(9): 1756-1765.