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PRODUCTION PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER TREATED WITH GRADED LEVEL OF ACETIC ACID

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A B S T R A C T

To investigate the effect of graded level of acetic acid on the production performance and carcass characteristics of broiler, present study was conducted for a period of 35 days in a controlled shed. A total of 240 Cobb 500 day old broiler chicks were divided into four dietary treatment groups (T_0, T_1, T_2 and T_3), each group with three replications and each replication having 20 birds. Control group (T_0) birds were fed with the basal diet without any acetic acid. Birds of T_1, T_2 and T_3 group were treated with 0.1%, 0.2% and 0.3% acetic acid in drinking water, respectively along with basal diets. Recorded data were analysed in SPSS software by using ANOVA and significance level was considered as 5%. Results showed that, acetic acid has significantly ($P<0.05$) improved live weight, live weight gain, feed conversion ratio (FCR) and some meat characteristics (carcass weight, thigh weight and breast weight) of experimental broilers. However, there were no significant ($P>0.05$) differences were observed between control group and acetic acid treated groups of birds in terms of feed intake, dressing percentage, liver weight, heart weight and abdominal fat. Net profit was higher in birds treated with acetic acid than the control group and the best performances were observed in the birds treated with 0.3% acetic acid.

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INTRODUCTION

Poultry sector is one of the most vibrant segments of agriculture sector in Bangladesh. Poultry farming is currently contributing to the employment sector by creating more than 6 million jobs by direct, indirect employment, including support services (Ansarey, 2012). Also, the poultry sector has proved an attractive investment opportunity sector in Bangladesh (Hamid et al., 2017). Among poultry meat of broiler is a tremendous protein source and nutrients which are necessary for health and growth of the human body (Rana et al., 2012). Broiler meat can rapidly and efficiently fulfil the shortage of protein requirements as it can be produced within a short time compared to that of other animals (Mbuza et al., 2017). The demand for broiler meat has been rising daily as most people, irrespective of caste and religion, prefer chicken (Hossain et al., 2011). Therefore, the number of poultry farmers on a commercial basis is being increased in Bangladesh (Kamruzzaman et al., 2021).

Broiler farming success depends on the good health condition and feed efficiency of birds to utilize and convert the feed into meat. To maintain this, farmers often extensively uses antibiotics in poultry production to promote growth (Barceló, 2007) and protect the health of birds by modifying the immune status of broiler chickens (Lee et al., 2012). This is mainly due to the control of gastrointestinal infections and microbiota modification in the intestine (Dibner and Richards, 2005). But extensive use of antibiotics leads the poultry products as an antibiotic depot which is dangerously harmful for its consumers and there are also human health concerns about the presence of antimicrobial residues in meat (Mirlohi et al, 2013), eggs (Goetting et al., 2011) and other animal products (Addo et al., 2011). So, application of non-antibiotics chemical substances (Yang et al., 2007) are to be explored as an alternatives of antibiotics which will improve the performances of broiler without any adverse effect. Organic acids, prebiotics, probiotics and plant extracts can give similar results in the infectious diseases prevention or control and finally shows the growth promoting action and improved feed efficiency (Wolfenden et al., 2007). Organic acids may be a replacement (both individual as well as blends of several acids) of antibiotics in the animal production (Sheikh et al., 2010). Short chain fatty acids (SCFA) are considered as potential alternative to antibiotic growth promoter amongst the organic acids, (Van Immerseel et al., 2005).

Organic acids are used as feed preservatives as well as growth promoters (Haque et al., 2009). It also reduces the pH of the feed and decreases bacterial contamination before consumption by birds, making them useful as feed preservatives (Mroz et al*.,* 1997). Organic acid also reduces colonization of pathogens and production of toxic metabolites, improve digestibility of protein, availability of Ca, P, Mg and Zn (Kirchgessner and Roth, 1988). The supplementation of organic acids in the diet of broilers enhanced nutrient utilization, growth, and feed efficiency (Denil et al., 2003). The use of organic acid creates an acidic environment (pH 3.5 to 4.0) in the gut that favors the development of lactobacilli and inhibits the replication of *Escherichia coli*, *Salmonella*, and other gram-negative bacteria (Choudhury et al., 2009). The organic acids in non-dissociated (nonionised, more lipophilic) form can penetrate the bacteria cell wall and disrupt the normal physiology of certain types of bacteria (Dhawale, 2005). Apart from the antimicrobial activity, they reduce the pH of digesta, increase the pancreatic secretion, and have trophic effects on the mucosa of gastro-intestinal tract (Dibner and Buttin, 2002). Lactic acid, ascorbic acid and citric acid are used in broiler diets and their usefulness on the broilers performances is proved (Hajati, 2018). However, no notable work has been done on the potential use of acetic acid on growth performances and carcass characteristics of broilers in Bangladesh except the work of Islam et al. (2008) and this type of study may encourage Bangladeshi broiler farmers to use organic acids instead of antibiotics. Therefore, the present study was conducted to investigate the effect of dietary supplementation of acetic acid on production performance, carcass characteristics and economic efficiency of broiler production.

MATERIALS AND METHODS

Experimental farm and birds

The experiment was conducted with 240 day old broilers of Cobb 500 strain for a period of 35 days (from February to March, 2019) in a controlled poultry shed adjacent to Gono Bishwabidyalay, Savar, Dhaka, Bangladesh. Experimental birds were collected from Kazi Hatchery Limited, Bangladesh. All experimental birds were healthy, disease free and kept under same management throughout the experiment.

Experimental agent

Commercial acetic acid (100% glacial acetic acid) was purchased from Kuri & Company (Pvt.) Limited, Dhaka, Bangladesh which was manufactured by Sigma Aldrich, USA.

Experimental design

A total of 240 day old Cobb 500 broiler bird was randomly assigned into four dietary treatment groups (T_0, T_1, T_2 and T_3), each group having 3 replications and each replications had 20 birds. Acetic acid was supplied with drinking water in following concentration to the different groups-

T_0 = Basal feed + 0% acetic acid with drinking water
T_1 = Basal feed + 0.1% acetic acid with drinking water
T_2 = Basal feed + 0.2% acetic acid with drinking water
T_3 = Basal feed + 0.3% acetic acid with drinking water

Housing of the experimental birds

A controlled poultry shed adjacent to Gono Bishwabidyalay, Savar, Dhaka, Bangladesh was used for this experimental purpose. The experimental room was thoroughly brushed, swiped and properly washed by water after that bleaching powder @ 1 kg/500sq.ft. was spread over the floor kept for 24 hours. By using forced tap water bleaching powder was cleaned. After that the room was disinfected by TH4+ solution (Manufactured by Sogeval, France, Marketed by-Century Agro Ltd, Bangladesh). Feeders, waterers, buckets and all other necessary equipment's were also properly, washed and disinfected by TH4+ solution. Then fresh and dry rice husks were spread on the floor of the pens as a litter material. The room was partitioned into 12 pens of equal size by using wire net and bamboo materials. Area of each pen was l6 square feet (4ft×4ft). Clean and dry rice husk was used as litter materials at a depth of about 5cm. After 10 days, all old litter was replaced by fresh rice husk. When the birds are free from the risk of trapped, the litter materials were removed. 1 sq. ft/ bird floor space was allotted to ensure comfort of the birds.

Feeding and watering management

One round tube feeder and one round drinker with a capacity of eight litters were provided in each pen. The feeder and drinker were fixed in such a way that the broilers were able to eat and drink conveniently. Feeders were cleaned once in a day while waterers were cleaned twice every day at morning and afternoon. Basal diets broiler pre starter and starter was purchased from Nourish Poultry and Hatchery Ltd. ®, Bangladesh and its composition is following-

Table 1. Composition of the supplied ration (kg/100kg)

Ingredients	Broiler pre starter	Broiler starter
Maize	43.00 kg	43.64 kg
Wheat	10.00 kg	10.00 kg
Rice polish	4.00 kg	10.00 kg
Soybean	26.00 kg	22.50 kg
Meat and Bone meal	9.00 kg	8.00 kg
Oyster shell	1.00 kg	1.00 kg
Salt	300 g	250 g
Methionine	200 g	180 g
Lysine	30 g	30 g
Vitamin Premix (broiler)	250 g	250 g
Feed zyme	-	50 g
Soybean oil	6.5 kg	4.00 kg
DCP	2.50 g	-
Choline chloride	100 g	100 g
Total	100.00 kg	100.00 kg

Source**:** Nourish Poultry and Hatchery Ltd. ®, Bangladesh

Immunization of birds

Experimental birds were vaccinated against Newcastle Disease (*Ranikhet*) and Infectious Bursal Disease (Gumboro). The vaccination schedule followed during the experimental period is given below in Table 3. The experimental birds were Immunization against Newcastle (*Ranikhet*) disease and Infectious bursal disease (Gumboro) as per Table 1.

Table 2. Vaccination schedule

SL. No	Age of vaccination	Name of Vaccines	Trade Name	Company	*Doses	Method of vaccination
1	5th day	IB+ND	MA5+ Clone30	(Intervet International, B.V. BOXMEER- The Netherlands)	1000	Eye drop
2	10th day	Gumboro	GM97	Hipra, Spain	1000	Eye drop
3	17th day	Gumboro	GM97	Do	1000	Eye drop
4	21st day	ND	Clone30	(Intervet International, B.V. BOXMEER- The Netherlands)	1000	Eye drop

*****As per manufactures' instructions

Record keeping and data processing

All experimental data were recorded carefully and at to the point without any biasness. Before start of the experiment, initial weight of the birds was taken and then they were weighed at weekly interval. Feed intake was calculated as the deduction of feed residue from the feed supplied to the birds of each replication and dividing it by the number of birds of this replication. Feed efficiency (FE) was calculated as the amount of feed consumed per unit of weight gain. To determine the meat yield characteristics 3 birds from each replication i.e. total 9 birds from each group was slaughtered then the weight of the different organs were taken and compared. To determine cost effectiveness of production all costs for rearing the birds were deducted from the total income by selling the birds and compared among the groups.

Statistical analysis

Collected data were spread at MS excel sheet (Microsoft office excel–2007, USA) and then subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) employing Statistical Package for Social Science (SPSS) version 20 and results were expressed as Mean ± SEM, data were considered significant at 5% level of significance.

RESULTS AND DISCUSSION

Production performance of broiler

Effect of supplementation of different level of dietary acetic acid (AA) with drinking water of broiler increases their live weight and live weight gain with the increasing level of acetic acid (Table 1). Present study shows that birds treated with different level of dietary acetic acid had significantly ($P>0.05$) different final live weight and live weight gain. Birds treated with 03% acetic acid (T_3) with drinking water had highest final live weight at 35 days of age (1897.25 g) and birds treated with no acetic acid in drinking water (control group; T_0) had the lowest final live weight (1740.87g), while birds treated with 0.1% (T_1) and 0.2% (T_2) acetic acid also had significantly higher live weight (1789.33 g and 1855.50 g, respectively) than the control group (1740.87g). Similarly final live weight of experimental birds significantly ($P>0.05$) differed among different dietary treatment groups (Table 1 and Figure 1). Highest weight gain was found 1737.0 g in the birds treated with 0.3% acetic acid with drinking water (T_3) while lowest was at the control group (T_0, 1580.78g). Birds treated with 0.1% (T_1) and 0.2% (T_2) acetic acid with drinking water also had significantly higher live weight gain (1628.21g and 1693.75 g, respectively) than the control group (T_0, 1580.78g). Better live weight and live weight gain in acetic acid treated group of birds may be due to lesser microbial load in treatment group which in turn promotes better digestibility and absorption of nutrients. Present findings is an agreement to the findings of the Islam et al., (2008), in which they have also found higher weight gain of broiler by treating with acetic acid and citric acid but with different higher concentrations. Dhobi et al., (2015) has also found an increase in body weight of broiler by supplying different organic acids. However, present findings do not support the findings of the Agboola et al., (2018) and Pinchasov et al. (2000) in which they have not found any positive relationships between supplemental acid and broiler live weight gain.

Feed Intake and FCR

Feed intake was not significantly (P>0.05) differed among control and different level of acetic acid treated groups. However, treatment of acetic acid has significantly improved the FCR of experimental broilers. Best FCR was observed in the birds administered with 0.3% acetic acid (1.84) followed by T_2 (0.2% AA) and T_1 (0.1% AA) group of birds (1.88 and 1.96, respectively) in compare to control group (2.00). This improvement in FCR of treated group of birds may be due to the anti-microbial as well as anti-coccidial activity of acetic acid which in turn helps in the maintenance of gut health (Abbas et al., 2011). Afsharmanesh and Pourreza (2005) have also found better feed conversion with the administration of citric acid in poultry. Acidifier fed birds showed better FCR which is in accordance to Pollman et al. (1980). Present findings also support the findings of Islam et al., (2008) and Dhobi et al., (2015) in which they also individually found better FCR in birds treated with different organic acids.

Table 3. Growth performance of broilers at 35 days of received different levels of acetic acid in drinking water

Parameter	Dietary treatment				Level of significance
	T_0 (0% AA)	T_1 (0.1% AA)	T_2 (0.2% AA)	T_3 (0.3% AA)	
Initial Live Weight at 1 day (g/bird)	41.5 ± 0.23	41.2 ± 0.35	41.4 ± 0.77	41.2± 0.45	NS
Final Live Weight at 35 days (g/bird)	1740.87± 18.74^{a}	1789.33±35.16^{ab}	1855.50±15.93^{b}	1897.25±21.87^{b}	**
Total Live Weight Gain (g/bird)	1580.78± 18.45^{a}	1628.21± 15.34^{b}	1693.75±35.04^{b}	1737.0 ± 21.39^{c}	*
Total Feed Intake (g/bird)	3154.91 ± 28.38	3185.98 ± 13.91	3178.32 ± 57.02	3198.41 ± 60.36	NS
Feed conversion ratio (FCR)	2.00^{b}± 0.01	1.96^{b}± 0.01	1.88^{a}± 0.04	1.84^{a} ± 0.01	*

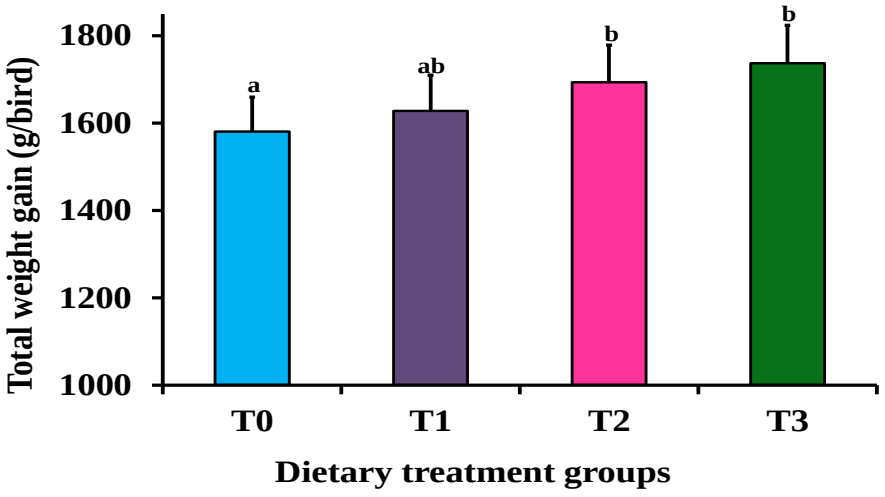

Figure 1. Total weight gain of broiler birds treated with different levels of Acetic Acid in drinking water. (T_0= 0% AA, Control group, T_1=0.1% AA of drinking water, T_2 0.2% AA of drinking water and T_3= 0.3% AA of drinking water). Each bar with error bar represents Mean±SEM value. Differences were significant (P<0.05) among the groups.

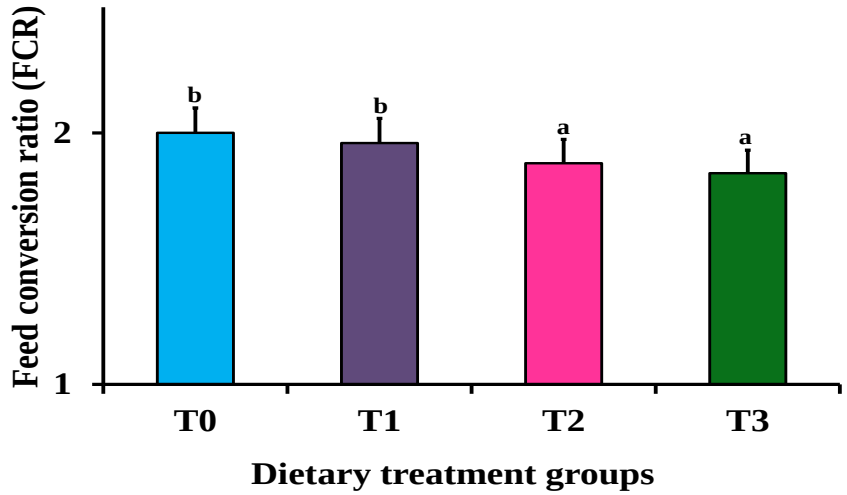

Figure 2. Feed conversion ratio of broiler birds treated with different levels of Acetic Acid in drinking water. (T_0= 0% AA, Control group, T_1=0.1% AA of drinking water, T_2 0.2% AA of drinking water and T_3= 0.3% AA of drinking water). Each bar with error bar represents Mean ± SEM value. Differences were significant (P<0.05) among the groups.

Meat yield characteristics

Meat yield Characteristics of broiler treated with graded level of acetic acid is illustrated in Table 5. Carcass weight, thigh weight and breast weight of broiler treated with acetic acid in drinking water were significantly (P>0.05) higher than that of the control group and the best figure was observed in T_3 (0.3% AA) group in all these three parameters. On the contrary, dressing percentage, liver weight, heart weight and abdominal fat weight did not significantly differed (P>0.05) among the experimental birds. Present findings support the findings of Pinchasov et al. (2000) and Islam et al., (2008) in which they also have not found significant effect of supplemental organic acid on the dressing percentage of birds.

Table 4. Meat yield characteristics of broilers

Parameters	Dietary treatments				Level of significance
	T_0 (0% AA)	T_1 (0.1% AA)	T_2 (0.2% AA)	T_3 (0.3% AA)	
Carcass weight (g)	1169.52± 19.74^a	1200.54±9.55^b	1231.78±20.73^b	1285.56±9.17^c	*
Dressing percentages (%)	67.18 ± 0.89	66.87 ± 0.47	67.96 ± 0.38	68.82 ± 0.71	NS
Thigh weight (g)	240.12 ± 3.80^a	285.22 ± 3.48^b	298.62 ± 3.66^b	317.12 ± 3.70^c	*
Breast weight (g)	383.57 ± 5.43^a	456.12±10.28^b	478.12 ± 6.45^b	488.75 ± 5.48^b	*
Liver weight (g)	50.38 ± 0.34	49.87 ± 1.00	50.37 ± 0.45	50.12 ± 0.57	NS
Heart weight (g)	11.60 ± 0.30	11.35 ± 0.14	11.72 ± 0.22	11.65 ± 0.13	NS
Abdominal fat weight (g)	45.72 ± 0.37	47.37 ± 1.16	48.62 ± 0.80	48.80 ± 0.74	NS

Table 5. Cost benefit analysis of broilers treated with different level of acetic acid

Description	Dietary Treatment Groups			
	T_0 (0% AA)	T_1 (0.1% AA)	T_2 (0.2% AA)	T_3 (0.3% AA)
Cost/chick (Taka)	35	35	35	35
Average feed consumed kg/birds	3.15	3.19	3.18	3.20
Feed price/Kg (Taka)	42	42	42	42
Feed cost (Tk./ bird)	132.3	134.0	133.56	134.4
Acetic acid (Tk./bird)	0	4.25	8.5	12.75
Miscellaneous (Tk./ bird)	15	15	15	15
Total cost/broiler (Taka)	182.3	188.25	192.06	197.15
Average live weight (kg)	1.740	1.789	1.855	1.897
Sale price/Kg live wt. (Taka.)	125	125	125	125
Sale price/broiler (Taka)	217.5	223.6	231.9	237.1
Net profit/broiler (Taka.)	35.2	35.35	39.84	39.95
Benefit over control/ broiler (Taka)	0	0.15	4.64	4.75

Cost benefits analysis

Cost benefit analysis for broiler production treated with different level of acetic acid depicted in Table 7. At the end of the experiment total production cost per bird were 182.3Tk for control group (T_0), 188.25, 192.06 and 197.15 Tk. for birds treated with 0.1%, 0.2% and 0.3% acetic acid, respectively. Net profit was comparatively higher in the acetic acid treated groups than the control. Highest net profit over control group was observed in the birds treated with 0.3% acetic acid (4.75 Tk.), while it was 0.15 and 4.64 Tk. in the group of birds treated with 0.1% and 0.2% acetic acid, respectively. Present findings support the findings of Islam et al. (2008), they have also found higher net profit in birds treated with acetic acid and citric acid in compare to the control group.

CONCLUSION

It can be concluded that supplementation of acetic acid in drinking water of broiler may improve their production performances such as growth, feed conversion and meat yield characteristics. Use of acetic acid is profitable as well. However, extensive histopathological and biochemical study including determination of the effect of acetic acid on cellular and blood level of broiler may be needed before drawing a concrete final conclusion.

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CONFLICT OF INTEREST

There is no conflict of interest.

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