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Impact of betaine on the performance and specific haemato-biochemical parameters in heat-stress exposed broiler chickens

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ABSTRACT

The present study revealed that there was a significant (P<0.05) effect of betaine on body weight, feed intake, and feed conversion ratio (FCR) of the broiler. Productive performance and blood cholesterol level of the broiler. A total of 150-day-old broiler chicks (Cobb 500) were placed into five dietary treatment groups: T0 (control diet), T1 (0.03% betaine in water), T2 (0.06% betaine in water), T3 (0.09% betaine in water), and T4 (0.12% betaine in water). Each group consisted of three replications containing 10 birds in each. Body weight gain (BWG), mortality rates, and meat yield characteristics were recorded. The collected data were analyzed by one-way ANOVA using SPSS version 25.00 software. Above, the total body weight was significantly highest in T2 (1758.3 ± 7.61 g), followed by T1 (1602.6 ± 10.16), T3 (1632.5±12.68 g), T4 (1606 ± 22.65 g), and T0 (1425.5 ± 10.14 g), respectively. The FCR was found to be lowest in T2 (1.36) and highest in T0 (1.49), whereas the FCR of T1, T3, and T4 were 1.43, 1.39, and 1.38, respectively. It was found that there was a significant difference (P<0.05) between the dietary groups for carcass weight, live weight, thigh weight, and breast weight. It was found that there was a significant difference among the treatment groups for cholesterol levels. During the experimental period, there was no mortality among the dietary groups. The T2 group generated a much larger net profit per broiler. Betaine supplementation in broilers is advantageous for growth performance, economic benefit, and lipid profile when used at 0.06% through drinking water, according to this study's findings. In the production of broilers, it may also be the best substitute as a growth promoter, stress reliever, and immune booster.

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Introduction

A high environmental temperature is one of the most important factors that causes heat stress among chickens and negatively affects poultry production (Meremikwu et al., 2013). Usually, the optimum temperature for growing broilers is 18 to 22 °C, and any temperature higher than that range could cause heat stress (Daghir, 2009). Heat stress normally happens in the summer season when there is a negative balance between the environmental temperature and body heat production. The management of heat stress (HS) is a subject of increasing concern for industry with increasing global

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temperatures and the incidence of sub-tropical and tropical broiler production (Henry et al., 2012). Broilers are susceptible to increased environmental heat loads for a variety of reasons, including that they lack sweat glands and feather coverage, and that increased selection for muscling means they are comparatively less resilient to heat than other production animals (Renaudeau et al., 2012). Broilers that are reared under hot conditions have a reduced growth rate, in part due to reduced feed intake. However, only half of the consequential reduction in growth rates is due to feed intake alone (Geraert et al., 1996), and skeletal muscle from thermally challenged broilers has reduced rates of protein synthesis and, to a lesser extent, proteolysis. Betaine is a naturally occurring substance found in a variety of plants and animals. It is the tri-methyl derivative of the amino acid glycine (Ratriyanto et al., 2009). A hydrocarbon made up of hydrogen and carbon is called betaine. It has three (CH3) methyl groups bound by the amino group of glycine amino acids to an amide group. Betaine is produced naturally and artificially from various plants and animals (Boch et al., 1994). Beet roots naturally contain higher concentrations of betaine (Wang et al., 2004). Betaine has a variety of purposes, one of which is to donate its labile methyl group, which is then employed in trans-methylation processes to create carnitine and creatine (Eklund et al., 2005; Kidd et al., 1997). When betaine reacts with homocysteine, it exerts a methionine-saving effect by donating a methyl group rather than methionine (Paniz et al., 2005). Osmolyte betaine supports cellular water equilibrium (Klasing et al., 2002). Supplementing with betaine in the diet likely lessens the need for other methylgroup donors like methionine and choline (Siljander-Rasi et al., 2003). Under heat-stressed conditions, betaine supplementation in feed enhances growth performance and feed intake (Hassan et al., 2005). Betaine has a beneficial effect since it makes chickens' bodies less hot to the touch (Klasing et al., 2002). Methionine is assumed to be spared from this function since betaine is a methyl-group donor, allowing methionine to be used more for growth and muscle development (Paniz et al., 2005). Heat-stressed birds have a dramatic drop in feed intake as a physiological reaction to reduce intrinsic heat production and preserve thermal homeostasis, which lowers feed efficiency, live weight gain, and survival rates (Geraert et al., 1996; Koh et al., 1999; Deaton et al., 1982; Faria Filho et al., 2007). The other detrimental impacts of heat stress that reduce the economic value of broiler carcasses are reduced breast-meat yield and increased carcass-fat deposition. In broiler production, a number of feed additives have been used to improve growth, feed efficiency, immune status, and antioxidant capacity (Abudabos et al., 2016). Various techniques are also practiced to reduce heat stress in poultry (Chand et al., 2016). Such methods include the use of electric fans, cooling pad systems, and the sprinkling of water through foggers (Khan et al., 2014). As most of these methods cannot be practiced due to high expenses, other strategies such as nutritional therapies, including the use of balancing nutrient contents and the addition of vitamin C, sodium bicarbonate, potassium carbonate, and aspirin in drinking water, can be followed. One of these nutritional strategies for reducing stress in the broiler is the use of betaine as a feed additive in the poultry diet (Zimmermann et al., 1996). Betaine, when examined as water or feed additives, has been shown to have many benefits to the poultry sector, involving enhanced carcass composition by altering the lipid metabolism (He et al., 2015), boosted intestinal morphology, enhanced antioxidant defenses, and decreased lipid peroxidation in the breast meat (M. Alirezaei et al., 2012). During heat stress, the body cells of birds are subjected to osmotic stress. In such instances, water is pulled out of the cell because of a higher concentration of salts or solutes outside the cells. This loss of water can cause the cells to shrink in volume, and if this water loss is not corrected, the cell will eventually die. Although poultry do not have a specific requirement for betaine, the osmolytic property of betaine could be beneficial to heat-stressed birds. The present study was conducted with the following objectives: 1. To investigate the effect of betaine on the productive performance of broilers. 2. determining the effect of betaine on the blood cholesterol level of broilers.

Materials and Methods

Experimental site

The experiment was carried out at the poultry farm of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, to determine the impact of supplementing with betaine on the performance and meat yield traits of broilers (Cobb 500) during the summer season from April 13 to May 11, 2022.

Experimental birds

For the experiment, 150-day-old broiler chicks (Cobb 500) were collected from the Kazi Farm hatchery via local traders.

Layout of the experiment

The chicks will be randomly assigned to one of five nutritional treatment groups (T0, T1, T2, T3, T4), each of which will consist of three replications with ten birds each. The following are the treatments: T0 = control, T1 = control + 0.03% betaine per liter of water, T2 = control + 0.06% betaine per liter of drinking water, T3 = control + 0.09% betaine per liter of water, and T4 = control + 0.12% betaine per litre of drinking water.

Collection and preparation of betaine and feed

Betaine was purchased from the local market in Dinajpur. For the experimental trial, ready-feed was used. The feed used in the experiment was bought from a feed store in the town of Dinajpur.

Managemental practices

Housing, litter, and feed (CP Feed Co. Ltd.) Broiler pre-starter: 1–7 days; broiler starter: 8–15 days; broiler grower: 16–28 days; water, lighting, sanitization, and vaccination were all necessities provided. Adequate precautions were implemented throughout the study period. During the whole experimental period, room temperature was maintained at 35 ºC. This study evaluated the survival ability of broilers at high temperatures with a supplement of betaine.

Calculation

1. Total gain in weight (g) = final weight – initial weight. **2**. Dressing percentage = (dressed weight ÷ body weight) x 100. **3**. Total feed consumption (g) = total feed offered – total left-over. **4.** Feed efficiency = total feed consumed / total gain in weight. **5.** Mortality rate (%) = no. of dead chickens / total no. of birds as a group × 100.

Hematological analysis

Blood samples were collected after 4 weeks using a vacutainer tube through the wing vein puncture tubes (BD vacutainer SST Gel-5 ml). They were then permitted to coagulate at room temperature (25 degrees Celsius) for an hour. The serum was recovered from the blood sample after centrifuging it at 2000 rpm for 15 minutes. Separated, non-hemolyzed serum samples were stored in clean, dry Eppendorf tubes in the deep freezer (-20 °C) for later use. The serum cholesterol concentration was tested using a suitable commercial analytical kit manufactured by the German cholesterol agent company Randof (2016). The experiment was carried out using a Merck Microlab 300 biochemistry analyzer (India) in accordance with the protocol provided in the manufacturer's leaflet.

Statistical analysis

SPSS version 25 software, using the one-way ANOVA method, was used to examine the data of feed consumption, growth performance, carcass features, and hemato-biochemical data in accordance with the principles of Complete Randomized Design (CRD). Significance was assessed when (P<0.05) and all results were given as mean ± SEM. Using the Duncan test, the means of the treatment groups were compared.

Results and Discussion

Performance of broiler of experimental birds

Feed consumption, feed conversion ratio, live weight gain, bird mortality, hemato-biochemical properties, cost effectiveness, heat stress, and carcass features were studied in this experiment to observe how broilers responded to various dietary doses of betaine. The results are shown in several tables and explained under the following topic.

Body weight

In the T0, T1, T2, T3, and T4 groups, the initial body weight (g/broiler) was 38.6±1.33, 37.3±1.33, 40.0±0.00, 38.6±0.67, and 39.3±0.67, respectively. At 7th and 14th days old, the body weights of different treatment groups were not significantly varied. At the ages of 21st and 28th days, there was a significant (P<0.05) effect of betaine on body weight. The T2 (1758.3±7.61g) group had the highest body weight, which was followed by T1 (1602.6±10.16 g), T3 (1632.5±12.68 g), 1606±22.65 g, and T0 (1425.5±10.14 g), respectively (Table.1). The results of this experiment's body weight gain are consistent with those of Attia et al. (2009). Broilers fed on 0.006% betaine in water showed higher (P<0.05) live body weight and body weight gain, according to Bowmaker and Gous (1991) and Hassan et al. (2005). However, Schutte et al. and Rostagno (1997) disagree. According to their findings, broilers treated with betaine at levels greater than 0.08% in the water level displayed (P<0.05) reduced live body weight. The fact that betaine is an amino acid supply and works as a protein source may be the cause of the broilers' improved weight gain while utilising betaine. Betaine supplementation affects carcass and part weights because of its methyl-group donor feature, which would boost methionine, cystine, and glycine for

Table 1. Effect of betaine on body weight of broiler

Age in days	Dietary groups (%)					Significance
	T_0	T_1	T_2	T_3	T_4	
Initial body weight	38.67 ± 1.33	37.33 ± 1.33	40.00 ± 0.00	38.6 ± 0.67	39.3 ± 0.67	NS
7th day	174.6 ± 1.76	176.6 ± 0.88	177.8 ± 0.73	174.8 ± 0.73	173.1 ± 1.01	NS
14th day	276.1 ± 1.96	286.0 ± 3.46	287.1 ± 2.59	279.6 ± 5.92	284.3 ± 2.46	NS
21st day	427.1 ± 1.74^a	492.8 ± 3.19^b	580.5 ± 2.60^d	513.5 ± 3.04^c	509.6 ± 16.90^c	*
28th day	508.8 ± 3.35^a	609.8 ± 1.30^c	672.8 ± 1.69^e	625.8 ± 2.32^d	599.5 ± 1.61^b	*
Total body weight (1st-28th)	1425.5 ± 10.14^a	1602.6 ± 10.16^b	1758.3 ± 7.61^d	1632.5 ± 12.68^c	1606 ± 22.65^b	*

a, b, c means having different superscript in the same row differed significantly (P<0.05). * = 5% level of significance , NS= Non-significant

Table 2. Feed intakes (g) in different groups at different ages of birds

Age in days	Dietary groups (%)					Significance
	T_0	T_1	T_2	T_3	T_4	
7th day	189.5 ± 1.89	191.5 ± 2.02	184.8 ± 2.74	183.1 ± 1.45	181.7 ± 3.58	NS
14th day	373.1 ± 1.17	386.5 ± 0.87	383.3 ± 1.88	378.6 ± 5.78	378.6 ± 0.88	NS
21st day	684.8 ± 1.88^a	732.5 ± 1.32^b	853.5 ± 27.00^e	746.3 ± 2.03^c	764.1 ± 6.93^d	*
28th day	882.7 ± 3.26^a	985.8 ± 2.20^c	972.3 ± 1.30^b	965.2 ± 2.66^b	883.8 ± 2.32^a	*
Total feed intake	2130.2 ± 8.2^a	2296.3 ± 6.41^d	2394.0 ± 32.92^e	2273.4 ± 11.92^c	2208.4 ± 13.71^b	*

a, b, c means having different superscript in the same row differed significantly (P<0.05). *= 5% level of significance , NS= Non significant

protein synthesis and also help to decrease fat deposition in the carcass through various metabolic pathways (McDevitt et al., 2000; Partridge, 2002).

Feed intakes

For broilers fed at 21 and 28 days of age, the difference in feed consumption was significant (P<0.05). At different dietary levels, feed intake did, however, vary modestly between 7 and 28 days of age. The amount of food consumed at 21 and 28 days of age varied depending on the diet. At 21 and 28 days old, feeding behavior seemed significant P<0.05) (Table 2). At 21 and 28 days old, feed consumption increased (P<0.05) when betaine was added to the water. It was discovered that the treatment groups at 0.03%, 0.06%, 0.09%, and 0.12% consumed the most, while the group at 0% consumed the least. This conclusion is consistent with that of Bowmaker and Gous (1991), who discovered that feed consumption peaked (P<0.05) at 0.06% betaine inclusion levels in water at various broiler developmental stages. There was a considerable impact on the betaine level in water during the entire period of the ages' rest. The findings of the current study demonstrated that broilers' growth performance and immunological state were considerably impacted by high ambient temperatures, while these parameters were enhanced by betaine supplementation. When under heat stress, there is a decrease in feed intake, which may be because there is minimal energy needed to maintain heat (Freeman, 1988). According to Awad et al. (2014), giving betaine at a level of 0.06% in the water results in significantly increased feed intake when compared to the control group. Similar to this, Sakomura et al. (2013) showed that broilers treated with betaine consumed considerably more feed than the control group.

Feed conversion ratio (FCR)

At ages 21 and 28, broilers in various treatment groups had varying weekly feed conversion ratios (P<0.05). There was no difference in the betaine levels at 7 and 14 days of age, which could have been caused by the increase in betaine in feed conversion. The lowest FCR was recorded at a betaine level of 0.06%. At 21 and 28 days of age, it was (P<0.05) superior to betaine levels of 0.00%, 0.03%, 0.09%, and 0.12% (Table 3). Our findings demonstrated that adding betaine considerably increased FCR in water at a rate of 0.03–0.08%. With higher levels of betaine, the feed conversion ratio seemed to improve. The inclusion of betaine at a level of 0.06% increased live weight and FCR in broilers, according to many investigators.

Table 3. Feed conversion ratio (feed intake/wt gain) of different birds of different groups

Age in days	Dietary groups (%)					Significance
	T_0	T_1	T_2	T_3	T_4	
7th day	1.08 ± 0.02	1.08 ± 0.01	1.04 ± 0.02	1.05 ± 0.01	1.05 ± 0.02	NS
14th day	1.35 ± 0.01	1.35 ± 0.01	1.34 ± 0.02	1.35 ± 0.01	1.33 ± 0.01	NS
21st day	1.60 ± 0.01^c	1.49 ± 0.01^a	1.47 ± 0.05^a	1.46 ± 0.01^a	1.50 ± 0.04^b	*
28th day	1.73 ± 0.02^d	1.62 ± 0.00^c	1.45 ± 0.00^a	1.54 ± 0.01^b	1.47 ± 0.01^a	*
Final FCR (1st-28th)	1.49 ± 0.81^c	1.43 ± 0.63^b	1.36 ± 4.33^a	1.39 ± 0.94^a	1.38 ± 0.61^a	*

a,b,c means having different superscript in the same row differed significantly (P<0.05). *= 5% level of significance NS= Non significant

Table 4. Effect of feeding betaine to broilers on dressing parameters at different ages

Parameter (g)	Dietary groups (%)					Significance
	T_0	T_1	T_2	T_3	T_4	
Live weight	1425.5 ± 10.14^a	1602.6 ± 10.16^b	1758.3 ± 7.61^d	1632.5 ± 12.68^c	1606 ± 22.65^b	*
Carcass weight	782.6 ± 6.73^a	886.1 ± 3.40^b	984.5 ± 2.86^e	953.1 ± 2.70^d	899.8 ± 3.21^c	*
Breast weight	231.0 ± 3.22^a	345.0 ± 1.93^d	403.1 ± 2.36^e	324.8 ± 6.67^c	309.6 ± 3.05^b	*
Thigh weight	200.2 ± 3.54^a	232.4 ± 3.04^b	285.0 ± 1.70^e	254.2 ± 2.29^c	269.8 ± 1.66^d	*
Head Weight	31.0 ± 0.71^a	35.2 ± 0.66^a	41.0 ± 0.71^c	37.2 ± 0.58^b	34.2 ± 0.37^a	*
Shank weight	37.8 ± 0.86^a	43.6 ± 0.51^a	52.4 ± 0.93^b	48.0 ± 0.71^b	41.2 ± 0.58^a	*
Gizzard weight	40.8 ± 0.86^a	42.0 ± 0.71^a	51.4 ± 1.08^b	58.8 ± 0.86^c	41.2 ± 0.86^a	*
Liver weight	38.6 ± 1.03^a	56.8 ± 1.43^c	74.0 ± 0.89^e	46.0 ± 1.82^b	71.4 ± 1.03^d	*
Heart weight	16.1 ± 0.57^a	19.1 ± 0.21^a	22.2 ± 0.57^b	22.5 ± 1.45^b	21.3 ± 1.15^b	*
Spleen weight	7.2± 0.35^a	7.8 ± 0.31^a	12.9 ± 0.34^b	11.6 ± 0.42^b	11.6 ± 0.70^b	*
Intestine weights	97.0 ± 0.71^a	111.6 ± 2.71^c	105.8 ± 1.59^b	126.6 ± 1.89^d	94.0 ± 1.58^a	*

a, b, c means having different superscript in the same row differed significantly (P<0.05). *= 5% level of significance , NS= Non significant

According to our findings, adding betaine significantly improved FCR in water at a rate of 0.03–0.08%. The results of this study are consistent with those of Attia et al. (2009), who found that adding betaine at a rate of 0.08% in water could partially alleviate chronic heat stress in poultry when compared to the negative treatment. Similar to this, EL Husseiny et al. (2007) found that the addition of betaine at a level of 0.75 g/L in water significantly improved FCR in comparison to the control group.

Meat yield characteristics

Table 4 shows that the highest live weight (1758.3±7.61 g) in group T2 and the lowest live weight (1425.5±10.14)in groups T0 and T1 weight (1602.6±10.16),other weight (1632.5±12.68) T3, and group (1606±22.65)T3, respectively, are significant. Carcass weights were significant, with the highest (984.50± 2.86) found in the T2 dietary group and the lowest (782.6± 6.73) in the T0 dietary group (Table 4). For the percentage of breast meat, drumstick meat, head weight, shank weight, gizzard weight, liver weight, spleen weight, heart weight, and intestinal weight at various diets, significant (P<0.05) variances were found. Broiler meat, particularly the breast and drumstick, nearly rises linearly as betaine levels rise. The tabulated results show that betaine levels significantly influenced the quality of the meat. However, there were changes in breast meat, drumstick meat, abdomen fat, and skin that were significant (P<0.05). Our findings demonstrated that supplementing with betaine at a dose of 0.06% considerably (P<0.05) increased dressing percentage. The osmotic effects of betaine, which promote water retention, may be to blame for the increase in dressing percentage (Waldroup and Fritts, 2005). Our findings are consistent with those of EL Shinnawy (2015). They stated that feeding with betaine at a rate of 800 mg/L at 32 days of age increased the dressing percentage significantly. The current study's findings are consistent with those of Attia et al. (2009), who found that adding betaine to water at a rate of 0.08% could partially relieve chronic heat stress in chickens as compared to the unfavorable treatment. El-Husseiny et al. (2007) and Mahmoudnia, N., et al. (2012) also found that adding betaine to water at a concentration of 0.75 g/L significantly increased FCR compared to the control group.

Measurement of effect of dietary betaine on heat stressed broiler

Heat stress reduced the BWG and feed intake, whereas it increased the FCR. Dietary betaine supplementation tended to improve the BWG and feed intake of broilers under heat stress. The effect of dietary betaine on heat stress broilers was measured by improved production performance rates of panting per minute and wings outstretched and feathers erect. Heat stress can be understood by the rectal temperature, which was between 41 and 42°C (Table 5). The tabulated results show that betaine levels significantly influenced the quality of the meat. Rectal temperature T0 is the highest, and T2 is the lowest. T3 heart rate is the lowest, while T0 is the highest. The improvement in production performance rate of panting/minute and wings outstretched and feathers erect were used to test the impact of dietary betaine on heat stressors in broilers (Mutibvu et al., 2017; Collins et al., 2012; and Ayo et al., 2011). Heat stress can be understood by the rectal temperature, which was between 41 and 42°C (Table. 5). The tabulated results show that betaine levels significantly influenced the quality of the meat.

Blood biochemical properties in broiler

Table. 6 shows the impact of betaine on the lipid profile of broilers. Between the therapy groups, there was a significant (P< 0.01) difference in total cholesterol levels, with T0 recording higher levels (138.1±0.91 mg/dl blood) and T3 recording lower levels (175.1±2.23 mg/dl blood). Triglycerides were also statistically significant (P<0.01), with T0 recording higher blood triglyceride levels of 72 ± 0.577 mg/dl and T4 recording lower levels of 42.6± 0.882 mg/dl. T3 recorded a greater value of 43.7± 0.312 mg/dl, and T0 recorded a lower value of 34.7± 0.371 mg/dl of blood for high-density lipoprotein (HDL), which was statistically significant (P<0.01). Additionally, low-density lipoprotein (LDL) was statistically significant (P<0.01), with T0 recording a higher value of 97.4 ± 0.56 and T3 recording a lower value of 50.5 ± 0.704 mg/dl blood. LDL levels were lower in the betaine-treated group than in the control group. The experimental group receiving betaine supplements had higher blood levels of HDL mg/dl. Betaine significantly reduced blood LDL levels. This may be because betaine acts as an antioxidant to stop the oxidation of LDL and cholesterol (Mathur et al., 1996), which slows the thermogenesis process. The level of betaine supplement was gradually reduced as it was increased in all treated groups. The results of Dalal et al. (2018) and Alzawqari, et al. (2016), who found that increasing levels of natural supplementation led to a reduction in serum cholesterol and achieved the best results with betaine supplementation, appear to be closely related to those of this study. Additionally, they noted that increasing levels of betaine supplementation led to higher and lower serum HDL (mg/dl) levels. The outcome appears to be consistent with the findings of Aljumaily et al. (2019), who discovered that natural organic supplements like betaine recorded lower triglyceride levels than control; Dalal et al. (2018), who discovered that betaine supplements had similar serum triglyceride levels to the control group (mg/dl), as well as similar LDL (mg/dl) levels.

Cost-effectiveness of broiler production

The price of producing different types of broilers is shown in Table 7. The average rearing expenditures of broilers kept in the treatment groups T0, T1, T2, T3, and T4 were, according to Table 4.6, 206.62 Tk, 232.29 Tk, 254.91 Tk, 236.64 Tk, and 232.87 Tk, respectively. The total cost of miscellaneous expenses, which comprised labor costs, disinfection costs, and predicted electricity costs, was 5 Tk per broiler. In groups T0, T1, T2, T3, and T4, the average live weight/ broiler was 1.425, 1.602, 1.758, 1.632, and 1.606 kg, respectively. The price of the broiler was Tk. 145/kg when sold on a live weight basis. In the T0, T1, T2, T3, and T4 groups, the net profit per kilogram of live weight was discovered to be taka 14.02, 24.02, 34.76, 26.25, and 22.45, respectively. The amount of betaine used in the diet demonstrated its impact on the broiler's profit margin. The current research backs up Zafar and Fatima's (2018) assertion that poultry is increasingly adopting organic rather than inorganic sources of minerals. They are supposed to lower feed costs by decreasing dose rates without adversely affecting performance since they are more bioavailable and effective. The organic mineral diet has a good effect on the economy, claim Abdallah et al. (2009). It was found that substituting organic minerals for inorganic ones improved bird performance and the immunological responses of chicks.

Table 5. Effect of betaine on rectal temperature and heart rate of broiler

Parameter	Dietary groups (%)					Significance
	T_0	T_1	T_2	T_3	T_4	
RT (°C)	41.7 ± 0.09^a	41.4 ± 0.08^a	41.1 ± 0.03^a	41.1 ± 0.02^a	41.1 ± 0.24^a	*
Heart rate	281.4 ± 8.82^d	256.3 ± 4.91^c	243.4 ±6.96^b	233.6 ±5.0^a	234.4 ±4.32^a	*

RT = Rectal temperature. a, b, c means having different superscript in the same row differed significantly (P<0.05). *= 5% level of significance, NS= non-significant

Table 6. Serum biochemical properties in broiler

Lipid profile (mg/dl)	Dietary groups (%)					Significance
	T_0	T_1	T_2	T_3	T_4	
Total cholesterol	175.1 ± 2.23^e	164.0± 1.53^d	145.1 ± 1.64^b	138.1 ± 0.91^a	157.4 ± 0.97^c	**
Triglyceride	72 ± 0.577^b	43± 0.577^a	45.6 ± 0.333^a	47.6 ± 0.882^a	42.6 ± 0.882^a	**
HDL	34.7 ± 0.371^a	41.7 ± 0.379^b	42.7 ± 0.309^b	43.7 ± 0.312^b	43.3 ± 0.524^b	**
LDL	97.4 ± 0.56^d	82.1± 0 .33^c	54.1 ± 1.16^a	58.1 ± 1.57^b	50.5 ± 0.704^a	**

a, b, c means having different superscript in the same row differed significantly (P<0.05). *= 5% level of significance, ** = 1% level of significance, NS = Non-significant

Table 7. Economics of broiler production kept under different treatment groups from day old chick to 28 days of age.

Parameters (Tk.)	Dietary groups with betaine				
	T_0	T_1	T_2	T_3	T_4
Chick cost	35	35	35	35	35
Litter cost / bird	4.5	4.5	4.5	4.5	4.5
Vaccine + medicine	13.8	13.8	13.8	13.8	13.8
Feed cost / broiler production	128.35	130	129	128	130
Dietary treatment cost / broiler production	0.00	5.5	6.5	7.5	8.5
Miscellaneous cost	5	5	5	5	5
Total cost/broiler	186.65	193.8	193.8	193.8	196.8
Average live weight/broiler (gr)	1425.5 ± 10.14^a	1602.6 ± 10.16^b	1758.3 ± 7.61^d	1632.5 ± 12.68^c	1606 ± 22.65^b
Sale price Tk./kg	145	145	145	145	145
Sale price / broiler	206.62	232.29	254.91	236.64	232.87
Net profit Tk./ broiler	19.97	38.49	61.11	42.84	36.07
Profit Tk./kg live weight	14.02	24.02	34.76	26.25	22.45

a, b, c means having different superscript in the same row differed significantly (P<0.05).

Conclusion

Utilizing varied levels of betaine also improved the quality of the carcass. Growth and meat yield performance responded favorably to betaine supplementation. With the addition of 0.06% more betaine, overall performance and quality were improved, which also improved financial gains. Conclusion: Adding betaine to a diet may be beneficial for producing broilers economically and effectively. As a result, adding betaine at a rate of 0.06% to the diet of broilers may be appropriate.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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