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Effect of Honey and Vitamin C on Growth and Carcass Traits of Broiler Chicken During Summer Season

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ABSTRACT

A study was undertaken to investigate the dietary effect of different levels of honey and vitamin C on growth performance and carcass traits of commercial broilers. The study was conducted at the poultry farm of HSTU, Dinajpur during the period from 26 April to 23 May, 2018. A total of 96-day-old broiler chicks (Cobb 500) were randomly and equally distributed to 4 treatments having 3 replicates of 8 birds each. The birds were grouped as T_0, T_1, T2, and T_3 groups with ordinary water (control), 2.5 ml honey/L of drinking water, 5 ml honey/L of drinking water, and 125 mg vitamin C/L of drinking water, respectively. Body weight gains, Feed Conversion Ratio (FCR), mortality (%), and meat yield traits were recorded. Feed intake (g/bird) was almost similar ($P>0.05$) among the dietary treatment groups. Body weight gain (g) and FCR were significantly ($P<0.05$) differed among the dietary treatment groups. The highest body weight gain (g) was significantly ($P<0.05$) higher in T_2 (1659.02g±6.92), followed by T_1 (1630.75g±8.40), T_3 (1595.10g±9.50) and T_0 (1468.01g±5.40), respectively. The lowest FCR was found in T_2 (1.35±0.00) and the highest FCR in T_0 (1.48±0.01), the intermediate in T_1 (1.36±0.01) and T_3 (1.39±0.01), respectively. It was found that there was significant ($P<0.05$) difference among the dietary treatment groups in the case of live weight (g), carcass weight (g), dressing percentage (%), breast weight (g), thigh weight(g), liver weight(g), but there was almost similar ($P>0.05$) in case of different body part's weight. Based on the result, it could be concluded that 5ml of honey/L of drinking water can be used in broiler diet as a growth promoter, and it may also serve as an antioxidant during stress conditions.

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Introduction

The poultry sector is an integral part of farming systems and has become an unparalleled platform for a quick profit, the generation of local employment, and the production of cheaper animal proteins. It has created both direct and indirect employment opportunity, improved food security and enhanced supply of quality protein to people's meals, contributing country's economic growth and reducing poverty level in rural and urban areas of Bangladesh. More than half of the people are based on agricultural and livestock farming. In Bangladesh, livestock contributes 1.47 percent to the country's GDP (2018- 2019). Poultry production system has triggered the discovery and widespread use of a number of feed additives. The main objective of adding feed additives are increasing their growth rate, better-feed conversion efficiency, greater livability and lowered mortality in poultry birds. These feed additives are termed as "growth promoters" and often called as non-nutritive feed additives (Singh and Panda, 1992). The growth promoters have given positive responses in respect to growth improve feed efficiency and survivalist of broilers (Dash and Panda, 2001). Constant use of antibiotic growth promoters (AGPs) at sub therapeutic level can result in the development of drug resistant bacteria (Alexander *et al.,* 2008) which possess a serious threat to the life of human being. Poultry nutritionists have exerted great efforts to find natural products that could cause an improvement in growth, feed utilization, meat quality and immune system maintenance in turkeys, broilers and laying hens (Nghonjuyi *et al.,* 2015; Salah *et al.,* 2015; Ahossi *et al.,* 2016; Orayaga *et al.,* 2016; Raheema, 2016; Aguihe *et al.,* 2017).There is a new promising insight in the research of bee products like: propolis, pollen, bee venom, honey, and royal jelly (Seven *et al.,* 2014). The raw materials, crude extracts and purified active compounds of bee products have been found to exert antioxidant, antimicrobial and anti- inflammatory properties (Premratanachai and Chanchao, 2014).

The honey is a sticky resin material produced by the worker honey bee from the substances that are collected from different plants (Aygun *et al.,* 2012). Honey may help to improve the detrimental effects of oxidative stress on the body's defensive system (Mannaa *et al.,* 2011; Seven *et al.,* 2012b). The biological properties of honey are strictly associated with the topographical site which can impact honeys ability to exert health promoting effect in poultry when it is fed as a dietary supplement (Bankova, 2005). The compounds contained in honey (mainly flavonoids) are used in various pharmacological and biological products and play an important role in maintaining anti-inflammatory, anticancer, antimicrobial and antioxidant activities (Seven *et al.,* 2012; Aygun *et al.,* 2012). Moreover, some experiments showed that honey could ameliorate the adverse effects of oxidative stress that are caused by factors like heat stress and stocking density (Arslan *et al.,* 2014; Hosseini *et al.,* 2015; Mahmoud *et al.,* 2015). Dietary additives based on honey have already been used in broilers as growth promoters, immunity enhancers and/or antioxidant agents (Seven *et al.,* 2008). The strong antioxidant potential of honey that can lead to improved biological functions (liver morphological structure and lipid metabolism) (Babinska *et al.,* 2013). Seven *et al.,* (2012a) also recommended that the positive effects of honey on nutrient digestibility could be related to its promising palatable, anti-oxidant, antimicrobial, and/or immuno- modulatory properties. The antioxidant ability of propolis that improves glucocorticoid receptor activity in the hippocampus, and reduce the generation of ROS (reactive oxygen species) molecules and serum corticosterone level, thus ameliorating stress effects (Wang *et al.,* 2004). Therefore, the aim of this review article is to highlight the reported promising effects of honey as a natural feed additive. In the tropics and sub-tropics the birds are faced with the challenge of high ambient temperature and high humidity typically during growing-finishing phase which have been reported to affect the productive performance of chickens (Ahmad *et al.,* 2005; Daghir, 2008). Great losses are being encountered in broiler production every year due to the effect of heat-stress. The loss is attributed to the fact that the birds have rapid metabolism, high body temperature and no sweat gland (Abioja, 2010). Moreover, several natural substances that are rich in antioxidants have also been used on heat-stressed chickens. These include honey (Wang *et al.,* 2005).

Honey is a good example of natural substance that contains phytochemicals such as vitamin C, thiamine, riboflavin, pyridoxine, pantothenic acid, nicotinic acid, phenolic compounds, and enzymes glucose oxidase, catalase, and peroxidise. Moreover, Abioja *et al.,* (2010) reported on the inclusion levels of honey in drinking water of broiler chickens that affected the growth and reduced the body temperature while there was no change in the physiological responses and haematology on adding honey and its capacity to replace the synthetic growth promoters in poultry nutrition. Vitamin C is important for the optimal function of the immune system. It has direct virucidal and bactericidal activity against a number of pathogens in vitro; also it enhances the by cells infected with Newcastle disease (Siegel, 1987). A report by Thaxton and Siegel (1972) showed that, following infection with Infectious Bursal Disease virus, vitamin C protected the immune biological tissues in growing birds and reduced their total mortality. Moreover, vitamin C has been shown to have a role in the body as antioxidant. It was reported that supplementation gas corbate in vitro will delay the myoglobin oxidation and by that reduces retardation (Yin *et al.,* 1993). Sayed and Shoeib (1996) reported that vitamin C is effective in combating the effects of heat stress in broiler chickens either by supplementing them in diets and/or water. This is because it improved feed intake, weight gain and efficiency in broiler chickens as reported by Gross (1988). Abioja and M.O, (2010) reported that addition of vitamin C to broilers drinking water reduced rectal temperature and panting rate during afternoon in open-sided poultry house during hot-dry season. Vitamin C helps in inhibiting the secretion and release of corticosterone, which may be cytocytic at high concentration during stress episodes. Therefore, the current experiment was conducted to evaluate the effect of different levels of honey and vitamin C on growth performance and carcass characteristics and immune competence of broiler raised under heat stress conditions.

Materials and Methods

Statement of the research work

The experiment was conducted at the poultry farm of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, to investigate the effect of supplementation of different levels of honey and vitamin C on growth performance and meat yield traits of broilers (Cobb 500) during the period from 26 April to 23 May, 2018.

Experimental birds

A total of 96-day-old broiler chicks (Cobb 500) were purchased from Kazi Farms Limited, Sadar, Dinajpur, Bangladesh.

Layout of the experiment

The day-old chicks were reared at brooder house to adjust with the environmental condition up to 7 days. After 7 days, chicks were randomly allocated in four dietary treatment groups having three (3) replications in each and 8 birds per replications. The layout of the experiment is shown in table 1.

Procurement of feed ingredients

Required amounts of feed ingredients for making the experimental diets will be procured from the local market of Dinajpur town.

Collection and storage of honey and vitamin C

Honey and vitamin C purchased from local market; Dinajpur, Bangladesh. The purchased honey packed in a plastic bottle and preserved.

Table 1. Layout showing the distribution of experimental broilers

Dietary treatment groups		Number of broilers in each replication			Total
		R_1	R_2	R_3	
Control (without honey and vitamin C)	T_0	8	8	8	24
Control + 2.5ml honey/L drinking water	T_1	8	8	8	24
Control + 5ml honey/L of drinking water	T_2	8	8	8	24
Control + 125 mg vitamin C/L of drinking water	T_3	8	8	8	24
Total No. of broilers		32	32	32	96

Preparation of the experimental diet

Ready feed was used for the experimental study. At first required amount of ready feed ingredients were weighted by digital weighing balance. The experimental period was divided into two phases (broiler-starter and broiler-grower). The broiler chicks were fed broiler starter for 0 and 14 days and broiler grower for 15 to 28 days of age. The drinking water measured with beaker and the first treatment group T_O supplied water without honey and vitamin C. T_1, T_2 and T_3 groups were daily supplied with 2.5 ml honey/L, 5 ml honey/L and 125 mg vitamin C /L of drinking water mixing, respectively. During the time of mixing cross mixing was applied. Mixing was done manually.

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Management of the experimental birds

Similar care and management in all treatment groups throughout the experimental period was practiced. At the initiation of the experiment, chicks were individually weighed recorded as initial body weight. The following management practices were followed during the whole experimental period and these management practices were identical for all dietary groups.

Table 2. Calculated composition of experimental diets

Nutrients	Amount (kg/100kg feed)	
	Starter (1-14 days)	Grower (15-28 days)
Crude protein (%)	22	21
Crude fiber (%)	3	3
Crude fat (%)	5	5-6
Lysine (%)	1.30	1.25
Methionine (%)	0.52	0.50
Calcium (%)	1	0.90
Phosphorus (%)	0.50	0.48
Moisture (%)	11	11
Metabolizable Energy, ME (k Cal/kg)	3000	3100

Managemental practices

Housing and equipment

The experimental house contained 12 cages each had a floor space of 120 cm x 76 were considered for this trial. The cages were properly cleaned, washed and disinfected with bleaching powder. The experimental house was properly cleaned and washed by forced water using a hose-pipe. Then, the room was disinfected by bleaching powder solution. After 15 days, the room was disinfected with Virkon solution (50 ppm). At the same time, all feeders, plastic buckets, waterers and other necessary equipment's were also properly cleaned, washed and disinfected with bleaching powder solution, subsequently dried and left them empty for a week before the arrival of chicks.

Litter management

During the experiment period for the first 7 days litter was covered by clean newspaper and newspaper was removed when it becomes dirty. After that period the birds were reared on rice husk littered floor having a depth of 4 cm. Before use of litter calcium carbonate was spread on the floor. After first week, upper part of the litter with droppings were removed regularly and stirred three times a week up to the end of the experiment. The litter was disinfected with Virocid® solution in every other day. Litter materials, when found damp for any reason, were removed to prevent accumulation of ammonia and other harmful gases. At the end of each week, litter was stirred to break its compactness and maintain proper moisture. At the end of 2nd and 3rd weeks of age, dropping were cleaned from the surface of litter.

Brooding management

The experiment was conducted in summer (April to May/2018). Additional heat was provided to brood the chicks when it was necessary. Brooding temperature was kept at 34^{o} C in the first 1 week of age and decreased gradually until they were adjusted to normal environmental temperature of the house and final temperature was 28^{o} C at the end of experiment. Additional heat was provided by fitting 100-walt electric bulb at the center of the pen about 12 inches above the floor from the 7-day old. The height of the bulbs was increased by raising the bulb gradually as per need of temperature. Paper was used on two sides of the house and in ventilators to protect cold and stormy wind. These sheets were removed partly or completely particularly at the later stage of finishing period when room temperature was found favorable. Daily room temperature (^{o} C) was recorded every six hours with a thermometer.

Lighting management

All birds were exposed to continuous lighting of 23 hours and one hour dark period per day throughout the experimental period. The dark period was practiced to make the broilers familiar with the possible darkness due to electricity failure. Supplementary light at night was provided by electric bulb by hanging at a height of 2.8 miters to provide necessary lighting.

Temperature

The house temperature was maintained at 34°C for the first week. In the course of the trial period the temperature was gradually reduced from 34°C to 32°C during first week, 32°C to 30°C in the second week, 32°C to 28°C in the third week and there after remain almost constant until the end of the trial.

Floor, feeder and water space

An area of 8 sq. feet was allotted for 8 birds in each pen; therefore, floor space for each bird was 1 sq. feet. One round feeder and one round waterer were provided in each pen for 8 birds; required feeding and drinking space was providing according to the number of birds in each replication.

Feed and water management

At the first week feeds were supplied to the chicks on clean newspapers at three hours interval for the first 3 days. Linear feeder and round plastic drinker were used during brooding period. After that linear feeder was replaced by round plastic drinker. Feeds were weighted with measuring balance and supplied thrice daily (once at morning, at noon and again at night) in treatment T_0, T_1, T_2 and T_3. Water was supplied without honey and vitamin C in T_0 group. T_1, T_2 and T_3 group received 2.5ml honey/L, 5ml honey/L, 125 mg vitamin C/L of drinking water mixing thrice daily (once at morning, at noon and again at night). Feeders were cleaned at the end of each week and drinkers were washed daily.

Sanitation

Adequate sanitary measures were taken during the experimental period. The entrance point and veranda were kept clean and solution of bleaching powder and potassium permanganate ($KMnO_4$) was kept in foot bath alternatively.

Immunization

All birds were vaccinated against baby chick Ranikhet Disease and Infectious Bronchitis at day one by the company. The birds were vaccinated against Ranikhet and Infectious Bursal (Gumboro) diseases by following schedule at the evening (table 3):

Table 3. Applied vaccination program

Diseases	Day	Vaccine	Route	Time
Ranikhet	4	BCRDV	Eye	Evening
Gumboro	10	Gumboro vac	Eye	Evening
Gumboro	16	Gumboro vac	Eye	Evening
Ranikhet	21	NDLasota	Eye	Evening

Clinical observation

The birds were critically observed twice a day for clinical sign if any (slow movement, infrequent sitting, lack of appetite, significant changes of feathering, paralysis etc.) and for monitoring other activities.

Medication

Immediately after unloading from the chick boxes the chicks were given Glucose and Vitamin C to prevent the stress occurring during transport. Water soluble vitamin and normal saline were also provided for the first 3 days of brooding. During the course of experimental period, electrolytes and vitamin-C were added with the drinking water to combat stress due to high environmental temperature (33 to 35^{o} C).

Data collection and record keeping

The following records were kept during 28 days of rearing period:

i. Live weight
ii. Feed consumption.
iii. Feed conversion ratio.
iv. Mortality
v. Temperature: Five times daily during the experimental period.
vi. Dressing yield: At the end of the experiment one broiler was slaughtered from each replication to estimate dressing yield.

Live weight gain

Birds were weighed in a group at the beginning of the trial and then every week at the age of 7, 14, 21, 28 days. The weighting was done using pan balance. The average body weight gain of each replication was calculated by deducting initial body weight from the final body weight of the birds.

Body weight gain = Final weight — Initial weight.

Feed intake

Feed offered daily and refusal at the end of each week was recorded. Feed intake was calculated as the total feed consumption in a replication divided by number of birds in each replication.

$$\text{Feed intake (g/bird)} = \frac{\text{Feed intake per replication}}{\text{No. of birds per replication}}$$

$$\text{FCR} = \frac{\text{Feed intake (kg)}}{\text{Weight gain (kg)}}$$

Feed Conversion Ratio

Feed Conversion Ratio (FCR) was calculated as the total feed consumption divided by weight gain in each replication.

Temperature and relative humidity

During the experimental period the temperature and the Relative Humidity (RH) of the experimental house and pens at chick level were recorded two times a day (8AM and at 5 PM) with the help of an automatic thermo hygrometer.

Mortality

Mortality was recorded daily treatment wise when occurred.

Mortality rate (%) = No. of dead chickens / Total no. of birds as a group × 100

Processing of broilers

After termination of the experiment, one bird weighing average of pen weight from each replication was selected randomly. Feed was withdrawn from the pens 24 hours prior to slaughter but water was available to facilitate proper bleeding. Birds were slaughtered according to halal method. Following slaughter, broilers were allowed to bleed for about 2 minutes. Then the birds were scaled in hot water (55-65^{o} C) for about 120 seconds in order to loosen the feather of the carcasses and weighed again. Breast meat, thigh meat, drumstic meat were separated from the carcass. Finally, processing was performed by removing head, shank, viscera, oil gland, kidney and giblets. As soon as these were removed the gall bladder was removed from the liver and pericardial sac and arteries were cut from the heart. Cutting it loose in front of the proventriculus and then cutting with both incoming and outgoing tracts removed the gizzard. Then, it was split open with knife, emptied and washed and the lining removed by hand.

Dressing yield

Dressing yield is based on the relationship between the dressed carcass weight and live bird weight after things like the skin and internal organs have been removed (Figure 1). Dressing yield can be calculated by taking weight of the carcass divided by weight of live bird.

$$\text{Dressing yield} = \frac{\text{Weight of the carcass}}{\text{Weight of live bird}}$$

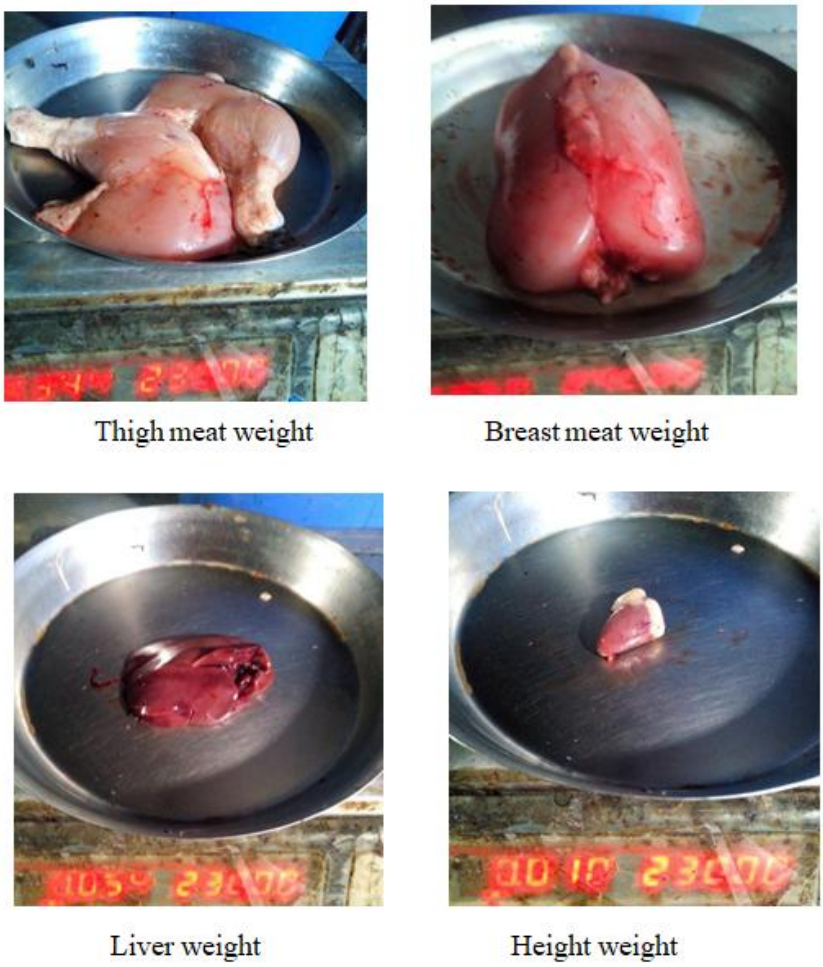

Figure 1. Various parts of dressed carcass weight

Economy of broiler production

The cost of broiler production for each treatment group was calculated based on the market price of feed ingredients, cost of chicks, citric acid and acetic acid and management cost (labor, medicine, electricity and litter depreciation) to produce per kg of live broiler at the time of trial. The income from per kg of live broiler in different treatment groups was calculated by the selling price of per kg live broiler.

Statistical analysis

Data on different variables were subjected to analysis of variance (ANOVA) in a Complete Randomized Design (CRD). The significant differences between the treatment means were calculated from analysis of variance (ANOVA) table. All analyses were performed by using ―IBM SPSS statistics 22‖ Program.

Results and Discussion

This experiment was held under the department of Dairy and Poultry Science, Faculty of Veterinary and Animal Science, HSTU, Dinajpur. Day old chicks were randomly divided into 4 groups (T_0, T_1, T_2 and T_3) after 7 days for assessing the efficacy of honey and vitamin C as growth promoter on broiler birds.

Performance of broiler of experimental birds

This experiment was conducted to study on feed consumption, feed conversion ratio, live weight gain and mortality of birds and carcass traits were used as criteria of response of broiler to different dietary levels of honey and vitamin C are presented in different tables and discussed under the following subheadings.

Effect of honey and vitamin C on body weight gain

The effect of honey and vitamin C on body weight gain of broiler is shown in table 4**.** The present study revealed that there was no significant (P>0.05) variation of initial body weight (g/broiler) among the treatment groups. The initial body weight (g/broiler) in T_0, T_1, T_2 and T_3 group was (39.70g±1.86), (39.93g±1.21), (41.00g±2.25) and (40.10g±1.27), respectively. At 7 days of age, the body weight was almost similar in different dietary treatment groups. The body weight was significantly (P<0.05) varied among the treatment groups during 14th, 21th, 28th days of age. The highest body weight was found in T_2 (1659.02g±6.92) followed by T_1 (1630.75g±8.40), T_3 (1595.10g±9.50) and T_0 (1468.01g±5.40), respectively.

Birds on dietary group T_0 showed the lowest (P<0.05) weight gain and dietary group T_2 showed the highest (P<0.05) weight gain among dietary treatment groups. Dietary groups T_2 showed improved growth when administration of 5ml honey/L of drinking water was done. The results obtained in the study agreed with previous findings (Monsuru *et al.,* 2012; Oyenguli *et al.,* 2016; Ahmed *et al.,* 2013; Gross 1988; Akibo and Titilayo Esther*.,* 2006; Ahamadu *et al.,* 2016*;* Vanthana *et al.,* 2002) where improved weight gain was observed with administration of honey and vitamin C at the rate of 0, 10 ml honey, 20 ml honey and 500 mg vitamin C /L of drinking water, respectively. The results contradict with the findings of previous researchers (Bunan and Luis.,1997; Abioja *and* M.O.,2010) where neither affected the growth nor reduced the body temperature with application of honey and vitamin C in diets.

Table 4. Effect of honey and vitamin C on body weight gain (g) and mortality in different dietary treatment groups of broilers

Parameters	Dietary treatment groups				Level of Significance
	T_0	T_1	T_2	T_3	
Initial body weight	39.70±1.86	39.93±1.21	41.00±2.25	40.10±1.27	(0.951) NS
Weight gain 7th days	189.52±3.46	186.73±4.33	191.11±5.61	194.11±4.25	(0.153) NS
Weight gain 14th days	328.01±3.86^{a}	372.63±5.29^{bc}	377.85±6.18^{c}	357.01±7.02^{b}	0.001*
Weight gain 21th days	432.48±5.98 ^{a}	472.07±7.68^{b}	480.05±8.06^{b}	466.52±2.37^{b}	0.001*
Weight gain 28th days	518.0±3.34^{a}	599.32±6.59^{c}	610.01±5.08^{c}	577.46±7.19^{b}	0.013*
Weight gain 1st -28th days	1468.01±5.40^{a}	1630.75±8.40^{c}	1659.02±6.92^{d}	1595.10±9.50^{b}	0.018*
Mortality (%)	00.00	00.00	00.00	00.00	NS

T_0= Basal diet, T_1= Basal diet + 2.5 ml honey/L of drinking water T_2= Basal diet + 5 ml honey/L of drinking water, T_3= Basal diet + 125 mg vitamin C/L of drinking water, ±= Standard error

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance NS= Non significant

Effect of honey and vitamin C on feed intake

The effect of honey and vitamin C on feed intake of broiler is shown in table 5**.** Feed intake (g/broiler) was almost similar (P>0.05) among the dietary treatment groups. The feed intake (g/broiler) in T_0, T_1 T_2, T_3 was (2161.47g±4.11), (2221.51g±14.15), (2233.85g ±6.60) and (2209.7g±5.44), respectively. Feed intake was lowest in dietary group T_0 (2161.47g±4.11) and the highest in dietary group T_2 (2233.85g±6.60). These results agreement with the finding of previous researchers (Oyenguli *et al.,* 2016; Akibo and Titilayo Esther*.,* 2006; Njoku ,1986; Bonomi *et al.,* 1976).

Table 5. Feed intakes (g) in different dietary treatment groups at different ages of birds

Age in days / Parameters	Dietary treatment groups				Level of Significance
	T_0	T_1	T_2	T_3	
7^{th}	201.82±2.69	196.92±4.80	202.05±5.54	200.23±7.11	0.879(NS)
14^{th}	441.75±6.42	469.51±6.17	466.15±9.32	458.06±7.53	0.114(NS)
21^{th}	668.67±6.27	675.07±7.39	678.60±7.08	678.49±3.87	0.665(NS)
28^{th}	854.23±7.66	880.01±8.77	887.05±11.08	872.92±9.95	O.162(NS)
$(1\text{-}28)^{th}$	2166.47±4.11	2221.51±14.15	2233.85 ±6.60	2209.70±5.44	0.101(NS)

T_0= Basal diet, T_1= Basal diet + 2.5 ml honey/L of drinking water T_2= Basal diet + 5 ml honey/L of drinking water, T_3= Basal diet + 125 mg vitamin C/L of drinking water, ±= Standard error

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance NS= Non significant

Effect of honey and vitamin C on Feed Conversion Ratio

The Feed Conversion Ratio (FCR) of the experimental birds is shown in table 6**.** From 1 to 7 days of age, the FCR was non -significant (P>0.05) in different treatment groups. Significant difference (P<0.05) on FCR was found among the treatment groups during 8-14 days,15-21 days and 22-28 days of age of broiler. The lowest FCR was in dietary treatment group T_2 (1.35±0.00) and highest in dietary group T_0 (1.48±0.01) at 28^{th} day (4 weeks) of age. From the table it is found that honey treated group (T_2) showed better FCR and control diet treated group (T_0) showed higher FCR but administration of honey treated group T_1 (1.36±0.01) showed better FCR than treatment T_3 (1.39±0.01). Administration of honey and vitamin C showed best FCR as compared to control group. The results are in well agreement with the findings of (Blaha and Kreosna, 1997; Oyenguli *et al.,* 2016; Mckee and Harrison, 1995; Vathana *et al.,* 2002) where FCR was found with administration of honey and vitamin C in poultry diet.

Table 6. Feed Conversion Ratio (wt gain/feed intake) of different birds of different dietary treatment groups

Age in days	Dietary treatment groups				Level of Significance
	T_0	T_1	T_2	T_3	
7^{th}	1. 06±0.01	1.05±0.02	1.06±0.03	1.03±0.02	0.631(NS)
14^{th}	1.35±0.00^{d}	1.26±0.00^{b}	1.23±0.01^{a}	1.28±0.01^{c}	0.012*
21^{th}	1.55±0.02^{c}	1.43±0.00^{ab}	1.41±0.01^{a}	1.45±0.00^{b}	0.015*
28^{th}	1.65 ±0.01^{c}	1.47 ±0.02^{a}	1.45 ±0.00^{a}	1.51±0.01^{b}	0.001*
$(1\text{-}28)^{th}$	1.48±0.01^{c}	1.36±0.01^{a}	1.35±0.00^{a}	1.39±0.01^{b}	0.009*

T_0= Basal diet, T_1= Basal diet + 2.5ml honey/L of drinking water T_2= Basal diet + 5ml honey/L of drinking water, T_3= Basal diet +125 mg vitamin C/L of drinking water, ±= Standard error

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance, S=Nonsignificant

Effect of honey and vitamin C on meat yield traits

Carcass weight

The effect of honey and vitamin C on carcass weight shown in table 7**.** It shows that live weight (g), carcass weight (g) were significantly (P<0.05) differed among the dietary treatment groups. The highest live weight found in treatment group T_2 was (1667.15g±5.40) followed by T_1 (1592.20g±7.57), T_3 (1539.10g±8.71) and T_0 (1464.61g±4.94), respectively which are significantly (P<0.05) varied. T_2 (1076.31g±6.96) group had significantly (P<0.05) higher carcass weight compared to T_0 (881.06g±4.13) whereas T_1 and T_3 had (1000.11g±4.65) and (942.79g±7.51).

Table 7. Meat yield traits of broilers of different dietary treatment groups (g)

Parameter (g)	Dietary treatment groups				Level of
	T_0	T_1	T_2	T_3	Significance
Live weight	1464.61±4.94^{a}	1592.20±7.57^{b}	1667.15±5.40^{c}	1539.10±8.71^{b}	0.001*
Carcass weight	881.06±4.13^{a}	1000.11±4.65^{bc}	1076.31±6.96^{c}	942.79±7.51^{b}	0.002*
Dressing percentage (%)	60.16±0.06^{a}	62.81±0.08^{b}	64.56±0.01^{c}	61.26±0.58^{a}	0.012*
Breast weight	371.37±5.44^{a}	419.70±7.28^{b}	472.52±6.18^{c}	396.96 ±4.93^{a}	0.013*
Thigh weight	244.98±4.35^{a}	292.20±7.90^{b}	332.24±4.19^{c}	269.27±4.70^{a}	0.017*
Head weight	35.50±1.16	40.11±2.12	42.55±2.56	38.29±1.30	(0.45) NS
Shank weight	47.12±0.18	52.98±0.10	54.55±0.12	49.58±0.11	(0.075) NS
Gizzard weight	41.22±1.19	44.52±2.21	45.96±2.05	43.08±1.25	(0.48) NS
Liver weight	40.05±0.08^{b}	38.27±0.17^{a}	37.77±0.29^{a}	39.19±0.13^{a}	0.10*
Heart weight	6.33±0.03	6.87±0.01	7.01±0.03	6.61±0.04	(0.214) NS
Spleen weight	2.14 ±0.04	2.71 ±0.02	2.94 ±0.10	2.43±0.03	(0.125) NS
Intestine weight	110.99±2.56	117.89±1.9	119.02±1.67	113.95±1.12	(0.092) NS

T_0= Basal diet, T_1= Basal diet +2.5ml honey/L of drinking water, T_2= Basal diet + 5ml honey/L of drinking water

T_3= Basal diet + 125mg vitamin C/L of drinking water, ±= Standard error

^{abcd} means having different superscript in the same row differed significantly (P<0.05)

*= 5% level of significance, NS= Nonsignificant

Dressing percentage

Dressing percentage differed significantly (P<0.05) among the dietary treatment group shown in table 7. The highest dressing percentage in 5ml honey treated group T_2 was (64.56%±0.01) and lowest in control group T_0 was (60.16%±0.06) whereas T_1 (62.81%±0.08) and T_3 (61.26%±0.58).

Breast meat weight

Breast meat weight differed significantly (P<0.05) among the dietary treatment groups shown in table 7. The highest breast meat weight in T_2 was (472.52g±6.18) and lowest in T_0 was (371.37g±5.44) whereas T_1 (419.70g ±7.28) and T_3 (396.96g ±4.93).

Thigh meat weight

Thigh meat weight also differed significantly (P<0.05) among the dietary treatment group shown in table 7. The highest thigh meat weight in 5ml honey treated group T_2 was (332.24g±4.19) and lowest in control group T_0 was (244.98g±4.35) whereas T_1 (292.20g±7.90) and T_3 (269.27g±4.70).

Effect of honey and vitamin C on weight of inedible meat weight

It is observed from the Table 7 that shank weight (g), Head weight (g), gizzard weight (g), intestine weight (g), heart weight (g) and spleen weight (g) did not significantly (P>0.05) varied among different treatment groups. Liver weight differ significantly (P<0.05). The highest liver weight in T_0 (40.05g±0.08) and lowest in T_2 (37.77g±0.29) whereas T_1 and T_3 had (38.27g±0.17) and (39.19g±0.13), respectively. The reduced liver relative weights observed in the birds offered honey and vitamin C in the present study points to the fact that the antioxidant content in the honey and vitamin C used in this study was potent enough to cause change in stress résistance. The results are in well agreement with the previous findings (Oyenguli *et al.,* 2016; Vanthana *et al.,* 2002; Monsuru *et al.,* 2012) where significant effect was observed.

Conclusion

The study was carried out 96-day old Cobb 500 broiler chicks to evaluate the effect of supplementation of different levels of honey and vitamin C on growth, feed intake, FCR and carcass characteristics of broiler. The experimental birds were distributed randomly to 4 dietary treatment groups namely T_0 (Control diet), T_1 (Control diet + 2.5ml honey/L of drinking water), T_2 (Control diet +5ml honey/L of drinking water), T_3 (Control diet+125 mg vitamin C/L of drinking water) each with 3 replications each having 8 broilers. At the terminal stage of experiment the cumulative body weight gain of different treatment groups was T_0 (1468.01g±5.40), T_1 (1630.75g±8.40), T_2 (1659.02g±6.92) and T_3 (1595.10g±9.50), respectively. Body weight gain was affected significantly (P<0.05) among the different treatment groups. Birds that received 5ml honey/L of drinking water was gained highest T_2 (1659.02g±6.92) body weight and lowest was found T_0 (1468.01g±5.40) in control group.

The feed intake among different treatment groups were non-significant (P>0.05).The cumulative maximum feed intake was observed in treated T_2 group (2233.92g±6.60) and minimum in control group T_0 (2166.47g±4.11). Feed efficiency of different treatment groups was statistically significant (P<0.05) compared treatment group T_2 to control group T_0. Respective feed efficiency was found T_0 (1.48±0.01), T_1 (1.36±0.01), T_2 (1.35±0.00) and T_3 (1.39±.01) But 5ml honey treated group (T_2) converted feed to meat most efficiently compared to T_1, T_3 and T_0 treatment groups, respectively. No mortality was found in all dietary groups. Obtained data on meat yield parameters no significant (P>0.05) difference among treatments groups except carcass weight,dressing percentage, breast meat weight and thigh meat weight was significantly (P<0.05) higher in T_2 group compared to control group T_0. Liver weight was significantly (P<0.05) higher in control group

T_0 compared to the honey and vitamin C treated group T_1, T_2 and T_3, respectively. The highest carcass weight was T_2 (1076.31g±6.96) in 5ml honey treated and the lowest in T_0 (881.06g±4.13) in control group. Considering the above facts it may be concluded that supplementation of 5 ml of honey/L of drinking water had positive significant effect on live weight, feed intake and Feed Conversion Ratio (FCR) with no detrimental effect on meat yield traits. Therefore, 5ml of honey can be used in broiler diet as growth promoter and it may also serve as an antioxidant during stress conditions.

Conflict of Interest

The authors declare no competing interests regarding the submitted manuscript and the research works.

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