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Original Article

Effect of Ascorbic acid and Yucca Extract Supplementation on the Performance and Hematology of Broiler Chickens Exposed to Heat Stress

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A B S T R A C T

The experiment was performed by applying different concentration levels of ascorbic acid and yucca extract to assess the production performance of broiler chickens during heat stress. A trial of 300 day-old commercial broiler chicks was carried out on littered floor for a period of 4 weeks. The chicks were randomly allocated into five treatments and each dietary treatment consisted of 4 replicates having 15 chicks in each of the replication. The experimental treatments were follows: T_1 (control group without any additives), T_2 (1ml YE with 16L drinking water), T_3 (200 mg AA per kg feed), T_4 (1ml YE with 16L drinking water and 200 mg AA per kg feed) and T_5 (1ml YE with 20L drinking water and 150 mg AA per kg feed). The findings revealed that there had significant effects ($P<0.05$) in body weight gain, feed consumption and FCR value. Among the treatment groups FCR value found better in T_4 group. The results also revealed that the treatments had significant effects ($P<0.05$) in dressed wings, breast, back, thigh, drumstick. However, in treatment T_4 group the carcass weight is better than the other treatment groups. The Hemoglobin, WBC, RBC, Neutrophil, Lymphocyte, Monocyte, PCV and MCV was statistically insignificant ($P>0.05$) among different treatments. In economic aspect, though total expenditure was lower in control group but higher profit per bird was found in other treatment groups. Therefore, this study suggested that the Yucca extract and ascorbic acid perform better in broiler rearing even they are on stressed condition.

Introduction

Poultry farming has emerged as one of the fastest growing agribusiness industries in the world, even in Bangladesh. Research on meat production globally indicates poultry as the fastest growing livestock sector especially in developing countries. It is of utmost significance for the livestock industry to benefit from inexpensive, highly efficient, and safe diets. However, heat stress is one of the most important factors adversely affecting overall poultry production in the tropics. In Bangladesh, temperature remains well beyond the higher side of thermo-neutral zone for the greater part of the year and adverse effect of heat make poultry production a difficult and uneconomical pursuit. It has been shown that heat stress has detrimental effects on the performance of 4-8 wk old broiler birds reared in the open-sided poultry houses; principally through reducing feed intake, growth rate, negatively affect feed efficiency and carcass quality as well as health (Temim *et al.*, 2000; Har *et al.*, 2000; Oskan *et al.*, 2003). Khan *et al.* (2012) stated that heat stress adversely affects feed intake, body weight, growth, carcass characteristics of birds associated with successful production. Moreover, chronic heat stress increases the time to reach market weight and increase mortality rate (Ozbey and Ozceilik, 2004).

Ascorbic acid supplementation during heat stress has beneficial effects on FCR, immune status and ratio of weight of the immune organs to body weight of the birds (Shamoon, 2005). Dietary supplementation of broiler chicken diets with 200 mg AA per kg is necessary and economically advantageous (Njoku, 1986). McKee and Harrison (1995) also reported that AA, particularly at 150 ppm, enhanced performance of broiler chicks exposed to multiple concurrent environmental stressors. *Yucca schidigera* (Agavaceae family), commonly named yucca is documented as a source of sustenance and herbal drug by native Indians due to its health-promoting activity (Patel, 2012). The former fractions

of Yucca Extract (YE) are steroidal saponins and polyphenols are involved in the reduction of ammonia gas and act as an antioxidant (Piacente *et al.*, 2005). Furthermore, Cheeke (2001) stated that saponins are capable to stimulate the immune system and enhance resistance to a disease challenge. YE can be used as a feed additive due to its capability to improve feed efficiency, immune and antioxidative function in broilers (Su *et al.*, 2016). However, there have been a limited number of studies performed associated with the combined effect of ascorbic acid and yucca extract supplementation on heat stress. Therefore, the present study was planned to investigate the efficacy of ascorbic acid and yucca extract on the growth performance and hematology of broiler chickens during hot environmental temperature.

Materials and methods

Experimental chicks, treatments and management

A total of 300-day old chicks of "Lohman Meat (Indian River)" strain having 43g average body weight were collected from local market, Savar, Dhaka. The collected chicks were carried to the university poultry farm. They were kept in electric brooders equally for 7 days by maintaining standard brooding protocol. After seven days, the chicks were randomly selected from brooders and kept under elevated temperature (34-35°C) distributed for dietary treatments with ascorbic acid and yucca extract supplementation. For proper handling and data collection, the chicks of each treatment group were divided into four replications and in each replication of dietary treatment, there were 15 birds. After 28 days of nursing and feeding, data were collected for the following parameters: feed intake, live weight, body weight gain, feed conversion ratio, carcass characteristics, total blood count, profit per bird and benefit-cost ratio.

The experimental treatments were followings: T_1 = Control (without additives), T_2 = 1ml YE with 16L drinking water, T_3 = 200 mg AA per kg feed, T_4 = 1ml YE with 16L drinking water and 200 mg AA per kg feed and T_5 = 1ml YE with 20L drinking water and 150 mg AA per kg feed.

The chicks were vaccinated with commercial Newcastle disease vaccine (NDV) and Infectious bronchitis (IB) vaccine through eye drops at 4 days and 21 days. The Gumboro vaccines were given through drinking water at days 9 and 17 days of the experiment respectively. Throughout the study period, the chicks were raised in an open-sided broiler house with rice husk-littered floor pens. *Ad libitum* feeds (Table 1) and water were provided for rapid growth of broiler chicks up to the end of the four weeks. The experiment was conducted according to the standard procedures of rearing and treating of farm animals approved by ethical committee of Sher-e-Bangla Agricultural University.

Collection of experimental chemicals

Yucca schidigera (Agavaceae) is a native plant in arid deserts of American southwest and Mexico. It also found in Zhejiang Province, China grown as an ornamental. Yucca powder and juice are available in the market of our country as various commercial names. The experimental chemical, *Yucca schidigera* extract (No- Gas™ ACI Animal Health) was purchased from local market. The plant extract contains saponin steroids and glycocomponents. The experimental ascorbic acid was Ceegram™ tablet of Incepta pharmaceuticals Ltd that contains Vitamin-C 1000 mg (As Ascorbic acid BP).

Statistical analysis

Total data were compiled, tabulated and analyzed in accordance with the objectives of the study. Excel Program was practiced for preliminary data calculation. The collected data was subjected to statistical analysis by applying one-way ANOVA using Statistical Package for Social Sciences (SPSS- version 16.0). Differences between means were tested using Duncan's multiple comparison test and significance was set at $P<0.05$.

Table 1. Ingredients and nutrient composition (as-dry basis) of basal diet.

Ingredients	Composition (%, unless otherwise noted)
Maize	45.5
Soybean meal (CP 46%)	17.0
Wheat flour	10.0
Bread flour	5.00
Rice bran	4.45
Crude palm oil	3.50
Corn gluten meal (CP 62%)	3.60
Distiller dried grains (CP 27%)	3.00
Meat bone meal (CP 49%)	2.80
Chicken feather meal (CP 79%)	2.00
Bone meal (CP 22%)	1.50
Lysine	0.55
Methionine	0.37
L-threonine	0.08
Salt	0.15
Premix[1]	0.50
Analysed composition:	
Metabolizable energy (kcal/kg)	3,300
Dry matter	89.6
Crude protein	21.9
Crude fat	6.40
Crude fiber	5.62
Ash	6.39

[1]Mineral-vitamin premix per kg of diet: Ca 2.250 g, P 0.625 g, Fe 3.570 mg, Cu 0.640 mg, Mn 5.285 mg, Zn 0.003 mg, Co 0.001 mg, Se 0.013 mg, I 0.016 mg, vit A 375 IU, vit D 150 IU and vit E 0.080 mg

Results and Discussion

Production performances of broiler chicken

Data presented in Table 2 showed that the final live weight in T_4 and T_5 group were better than the other groups. The results revealed that the treatments had significant effects ($P<0.05$) in body weight gain, feed consumption and FCR value on the treatment groups. However, in treatment T_4 group final live weight and FCR value were better than on other treatment groups. The present findings were in agreement with previous findings by Cheeke (2001) and Khan *et al* (2012), who reported that production performance of broiler chicken is better when treated with yucca extract and ascorbic acid. Patoary *et al* (2020) also statistically ($P<0.05$) found the higher body weight and better FCR value on the group treated with yucca extract.

Carcass characteristics

Data presented in Table 3 showed that the carcass weight in T_4 and T_5 groups were better than the other groups. The results revealed that the treatments had significant effects ($P<0.05$) in dressed wings, breast muscle, drumstick and dressing percentage. However, in treatment T_4 group the

carcass weight is better than on other treatment groups. These results were in agreement with previous findings by Patel (2012) and Khan *et al* (2012), who reported that higher carcass and breast meat yield in broilers' carcass that treated with yucca and ascorbic acid. Patoary *et al* (2020) also found significantly (P<0.05) higher dressing percentage on yucca treated groups.

Table 2. Effects of ascorbic acid and YE on Production performances of broiler chicken.

Treatment	Final Live weight (g/bird)	Average BWG (g/bird)	Total FC (g/bird)	Final FCR
T_1	1535.60^{c}± 2.47	1492.40^{c}± 2.47	2292.27^{b}± 3.73	1.54^{a}± .01
T_2	1613.87^{b}± 9.76	1570.33^{b}± 7.48	2326.80^{a}± 1.38	1.48^{b}± .07
T_3	1632.03^{ab}± 3.40	1590.83^{ab}± 3.40	2338.63^{a}± 1.02	1.47^{b}± .03
T_4	1645.87^{a}± 5.16	1602.67^{a}± 4.16	2306.40^{a}± 1.15	1.44^{c}± .03
T_5	1641.87^{a}± 5.16	1598.67^{a}± 5.16	2310.40^{a}± 1.15	1.45^{c}± .03
Significance	*	NS	*	*

Here, T_1 = Control (without additives), T_2 = 1ml YE with 16L drinking water, T_3 = 200 mg AA per kg feed, T_4 = 1ml YE with 16L drinking water + 200 mg AA per kg feed, T_5 = 1ml YE with 20L drinking water + 150 mg AA per kg feed. Values are Mean ± SE (n=20) one-way ANOVA (SPSS, Duncan method). *Mean with different superscripts are significantly different (P<0.05). Mean within same superscripts don't differ (P>0.05) significantly, SE= Standard Error, NS=Non-Significant (P>0.05).

Table 3. Effects of ascorbic acid and YE on carcass characteristics of broiler chicken.

Treatments	Breast	Wing	Drumstick	Dressing Percentage
T_1	514^{b}± 7.54	79.66^{b}± 3.17	164.33^{b}± 4.40	65.66^{b}± 2.17
T_2	527^{ab}± 4.35	86.33^{ab}± 3.48	170^{ab}± 6.08	68.33^{ab}± 2.48
T_3	528^{ab}± 5.50	85.45^{ab}± 2.88	169^{ab}± 4.16	67.45^{ab}± 2.88
T_4	537^{a}± 4.35	89.33^{a}± 3.48	175^{a}± 6.08	71.33^{a}± 2.48
T_5	536^{a}± 5.50	87.23^{a}± 2.88	176^{a}± 4.16	70.32^{a}± 2.88
Significance	*	*	*	*

Here, T_1 = Control (without additives), T_2 = 1ml YE with 16L drinking water, T_3 = 200 mg AA per kg feed, T_4 = 1ml YE with 16L drinking water + 200 mg AA per kg feed, T_5 = 1ml YE with 20L drinking water + 150 mg AA per kg feed. Values are Mean ± SE (n=20) one-way ANOVA (SPSS, Duncan method). *Mean with different superscripts are significantly different (P<0.05). Mean within same superscripts don't differ (P>0.05) significantly, SE= Standard Error, NS=Non-Significant (P>0.05).

Hematology

The blood parameter Hemoglobin, WBC, RBC, Lymphocyte, Monocyte, Neutrophil, Eosinophil, PCV and MCV was counted and the data has presented in Table 4. The Hemoglobin, WBC, RBC, Neutrophil, Lymphocyte, Monocyte, PCV and MCV was statistically insignificant (P>0.05) among different treatment. The highest Hemoglobin (12.55±1.99), RBC (5.49±0.23), WBC (12080 ± 1472.58), Lymphocyte (15.42±2.08) and Monocyte (2.10±0.57) were found in T_4. Highest neutrophil (82.33±1.20) and eosinophil (3.47±1.45) were found in T_5. These results are agreed with the findings of Khan *et al* (2012) and Patel (2012). They concluded that the Yucca extract and ascorbic acid has effect in blood parameter. In addition, Patel (2012) indicated that the yucca extract had no significant effect on the hemoglobin concentration of broilers.

Table 4. Effects of ascorbic acid and YE on hematology of broiler chicken.

Parameters	T_1	T_2	T_3	T_4	T_5	Significance
Hemoglobin (g Dl^{-1})	10.66±0.58	10.55±0.99	11.66± 0.58	12.55±0.99	11.61±1.54	NS
RBC (million/mm^3)	4.69±0.25	5.13±0.23	5.29±0.25	5.49±0.23	5.34±0.50	NS
WBC (10^3/mm^3)	9200±1157.69	11000±972.58	10800±1257.69	12080±1472.58	12210± 1059.87	NS
Neutrophil (%)	81.43±1.00	82.13±2.60	81.23± 1.00	81.73±2.60	82.33±1.20	NS
Lymphocyte (%)	14.78±1.73	15.13±2.08	15.21± 1.02	15.42±2.08	15.12±1.09	NS
Monocyte (%)	1.95±0.33	2.01±0.57	1.98±0.66	2.10±0.57	2.06± 0.66	NS
Eosinophil (%)	3.43±0.88	3.26±0.33	3.33± 1.45	3.36±0.33	3.47± 1.45	NS
PCV (%)	30.88±5.78	31.87±2.92	31.57± 1.75	31.67±2.92	31.58±1.75	NS
MCV (FI)	82.83±4.64	83.46±3.91	84.25± 2.01	84.46±3.91	84.21±2.01	NS

Here, T_1 = Control (without additives), T_2 = 1ml YE with 16L drinking water, T_3 = 200 mg AA per kg feed, T_4 = 1ml YE with 16L drinking water + 200 mg AA per kg feed, T_5 = 1ml YE with 20L drinking water + 150 mg AA per kg feed. Values are Mean ± SE (n=20) one-way ANOVA (SPSS, Duncan method). *Mean with different superscripts are significantly different (P<0.05). Mean within same superscripts don't differ (P>0.05) significantly, SE= Standard Error, NS=Non-Significant (P>0.05).

Table 5. Effects of ascorbic acid and YE on economic aspects of broiler chicken farming.

Treatment	Total Expenditure	Receipt Per Bird	Profit Per Bird	Benefit Cost Ratio
T_1	179.05^{b}±2.39	233.78^{b}±2.70	54.73^{b}±1.19	1.30^{b}±0.02
T_2	185.71^{a}±1.13	245.99^{a}±2.21	60.27^{a}±2.29	1.33^{a}±0.01
T_3	184.83^{a}±1.22	246.01^{a}±2.61	61.18^{a}±2.83	1.32^{a}±0.02
T_4	189.05^{a}±2.29	251.28^{a}±1.70	62.23^{a}±1.19	1.33^{a}±0.02
T_5	188.71^{a}±1.13	249.99^{a}±2.21	61.28^{a}±2.39	1.32^{a}±0.01
Significance	*	*	*	*

Here, T_1 = Control (without additives), T_2 = 1ml YE with 16L drinking water, T_3 = 200 mg AA per kg feed, T_4 = 1ml YE with 16L drinking water + 200 mg AA per kg feed, T_5 = 1ml YE with 20L drinking water + 150 mg AA per kg feed. Values are Mean ± SE (n=20) one-way ANOVA (SPSS, Duncan method). *Mean with different superscripts are significantly different (P<0.05). Mean within same superscripts don't differ (P>0.05) significantly, SE= Standard Error, NS=Non-Significant (P>0.05).

Economics

The cost of different treatment groups and control group were presented in Table 5. Production cost included feed cost and common costs (litter cost, vaccine, medicine, electricity etc.) for both the treated groups and untreated group. The result of economic analysis revealed that total expenditure per bird was higher in all treated groups than the control group but also significantly ($P<0.05$) higher profit per bird was found in treatment groups. The T_4 group had significantly ($P<0.05$) better profit than the other groups. These results are in agreement with those of previous researchers Patoary *et al* (2020), Patel (2012) and Khan *et al* (2012) reported the application of yucca and ascorbic acid on economic analysis revealed that it could be cost-effective management practice to improve shed environment and in turn performance of broiler chicks.

Summary and conclusion

Therefore analyzing the above research findings, this study suggested that the Yucca extract and ascorbic acid perform better in broiler rearing even they are on stressed condition. The findings revealed that the treatments had significant effects ($P<0.05$) in body weight gain, feed consumption, FCR value and carcass characteristics on the treatment groups. Yucca extract and ascorbic acid had no significant effect on the hemoglobin concentration and other blood parameters of broilers. In economic aspect, higher profit per bird was found in the treatment groups. Hence, Yucca extract and ascorbic acid could be safely used in broiler rearing for higher economical return without any adversity.

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