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Evaluation of Betaine and Vitamin C in Alleviation of Heat Stress in Broilers

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ABSTRACT

The study showed that all the treatment groups A, B, C and D of chicks (n = 100; control without heat stress, control under heat stress, vitamin C and Betafin, respectively) had an effect on weight gain, feed consumed, feed conversion ratio and antibody levels in serum against Newcastle disease virus vaccine. The data showed that group A had the highest average weight gain i.e. 1400.15 g per bird. The highest average feed consumption was observed in group C 2634.0 g per bird. The highest level of antibody titres against Newcastle disease virus vaccine was in group A i.e. GMT = $\log_2$ 7.0. On the basis of results obtained, it could be suggested that desert cooler is one of the appropriate method for minimizing the effect of heat stress and for improving the immune status of birds especially against NDV.

Key Words: Betaine; Vitamin C; Poultry

INTRODUCTION

One of the problems challenging our poultry industry is the high ambient temperature, which persists for almost 5 months of the year (May to September) in most agro-ecological zones of Pakistan. Poultry experiences heat stress when there is high ambient temperature, accompanied by high relative humidity zones. Birds do not have sweat glands, and use non-evaporative cooling (radiation, conduction, and convection) for heat dissipation. If panting (open-mouth breathing) fails to prevent their body temperatures from rising, birds become listless, then comatose, and soon die due to respiratory, circulatory, or electrolyte imbalances (Saif *et al*., 2003).

The negative effects of high and low temperatures on poultry performance has been minimized by appropriate housing design, installation of cooling systems, feed formulation according to feed intake and long term acclimatization. Suppression of immune response may be due to temporary or permanent damage to primary lymphoid organs (bursa of Fabricius and thymus) which results in increased susceptibility of the host of various bacterial, viral and parasitic infections (Thigpen *et al.*, 1973; Muneer *et al*., 1988.) Non infectious factors of immunosuppression are environmental conditions e.g., temperature (Henken *et al*., 1982), humidity, population density and other stress factors (Gross & Siegel, 1982).

Various techniques are being practiced by the farmers to minimize the heat stress. Such methods include: nutritional therapies like use of low energy and high protein rations, adding vitamin C, sodium bicarbonate, potassium chloride or aspirin in drinking water of birds, use of electric fans and pad cooling system, sprinkling of water through foggers, use of desert cooler, etc. The present project has been designed to study the comparative effect of betaine (Betafin) and vitamin C during acute heat stress on the performance and immune status of birds.

MATERIALS AND METHODS

This study was conducted at the Department of Clinical Medicine and Surgery, University of Veterinary and Animal Sciences (UVAS), Lahore, during the months of July and August 2003.

One hundred, day-old broiler chicks were purchased from the S.B. Poultry Breeders Hatchery, 18 Km Sheikhupura-Faisalabad Road, Lahore. These birds were reared at experimental room of University of Veterinary and Animal Sciences, Lahore, under standard conditions. All the chicks were weighed and randomly divided into four experimental groups, having 25 chicks each. These groups were marked with separate colors and designated as A, B, C and D. All the birds were vaccinated against Newcastle disease virus at day 7 and 22 using LaSota strain (IZP, Ghazi Brothers, Pakistan). Vaccination against infectious bursal disease (IBD) was carried out at day 10 and 28 of the experiment. Vaccination against Hydropericardium syndrome (HPS) was also given at day 14 of the experiment.

For collection of blood on the first day, twelve experimental chicks were slaughtered and approximately 1.25 to 1.5 mL of blood was collected from each bird. Subsequently, blood samples on day 17th and 32nd were collected through jugular vein of the birds. From each bird approximately 1-2 mL of blood was drawn and held at room temperature for 4-5 h. The serum on its separation, was

collected in sterile screw capped plastic bottles and stored at –20 °C till further use. Prior to antibody analysis the serum samples were thawed by placing bottles in a water bath at 56°C. Normal saline solution (pH 7.4) was used in Haemagglutination Inhibition (HI) test (Beard, 1989). Each serum sample was processed in duplicate for HI test.

The chicks were brooded at 35°C for the first week and 32.5°C for the second week of experiment. The treatments were applied to the first day of experiment but Group "A" was shifted in front of air-cooler at the start of third week of experiment while other groups B, C and D remained under heat-stress condition. Fresh, clean water and light were provided ad libitum for 24 h throughout the experiment.

Group-A. (Control without Heat Stress): Birds in this group were reared using the standard managemental practices and desert cooler with 18 inch fan were used from 14 to 35 days of age starting from 8.00 am to 6:00 pm daily for minimizing heat stress.

Group-B. (Control with Heat Stress): Birds in this group were reared, using the standard managemental practices without using desert cooler.

Group-D. Birds in this group were reared using the standard managemental practices without using desert cooler. Betaine (Betafin, Danisco, U.K.), was administered to this group at the dose rate of 50 g / 50 kg of feed from the first day of experiment.

Parameters Studied

(i) Weight gain was recorded on day one and thereafter on weekly basis upto the termination of experiment, (ii) Feed consumed by the chicks was calculated by substracting feed refused from feed offered to each group on weekly basis, (iii) Feed conversion ratio was calculated from 0-3, 4-5 and 0-5 weeks.

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Total feed consumed}}{\text{Total weight gain}}$$

(iv) One mL of blood was collected form birds of day 1, 17 and 32 of their life; the syringes carrying blood were placed in refrigerator in slanting position for overnight to separate serum from the blood. The harvested serum was stored at –20°C in sterilized eppendorf microfuge tubes, till further use. These serum samples were later processed for the determination of anti-NDV antibody titres by the procedure as described earlier (Beard, 1989). The data thus collected were processed of calculation of final geometric mean titres (GMT; Brugh, 1978).

RESULTS AND DISCUSSION

The result of weight gain analysis showed that birds of group A (control without heat stress) provided with desert cooler (temperature less then 27°C) gained highest average weight 1400.15 g per bird as compared to all other groups i.e. B, C and D. The lowest weight gain was observed of group B (control with heat stress) at average temperature 34.6°C, 1290.13 g per bird (Table I). These results are in agreement with Deeb *et al.* (2001) who concluded that high ambient temperature reduced feed consumption and body weight in broilers. Hussainy and Creger (1980) found that lower environmental temperature enhanced growth rate and feed consumption in birds brooded in the cooler environment, and had high weight gain values. The birds of group C (vitamin C) gained more average weights (1332.00 g per bird) as compared to the group B (control with heat stress) i.e. (1290.13 g per bird). Raja and Qureshi (2000) reported significant improvement in body weight of birds provided with ascorbic acid in the feed. Kutlu (2003) observed that ascorbic acid supplementation increased body weight gain in broilers exposed to high ambient temperature. It was observed that betaine supplementation to group D in heat stress resulted in more average weight gain i.e. 1354.95 g per bird as compared to birds of group B (control with heat stress) i.e. 1290.13 g per bird. Chen and Chiang (2002) reported that dietary betaine supplementation improved the weight gain of broilers under high temperature. Nilipoul (1998) found that the weight gain of birds supplemented with betaine was higher (1992 g/bird) than that of control group (1925 g/bird).

It was observed that lower temperature enhance the feed consumption. The average feed consumption of group A was 2621.00 g per bird as compared to 2464.76 g per bird that of group B (heat stress) (Table II). These results are in agreement with Hussainy and Creger (1980) who concluded that lower environmental temperature enhanced growth rate and feed consumption. Thus all of the three methods to reduce the effects of heat stress (i.e. desert cooler, betafin and vitamin C) showed better results than control group (with heat stress).

The data obtained by analysis of blood serum samples for specific antibodies against Newcastle disease virus vaccine, showed that desert cooler was appropriate method for enhancing the immunity of birds. The GMT on 17th and 32nd day showed that best titer was in group A (control without heat stress) i.e. $\log_2$ 7.0, followed by group D (betafin) $\log_2$ 7.6 and $\log_2$ 6.6, group C (vitamin C) $\log_2$ 7.2 and $\log_2$ 6.0 and group B (control with heat stress) $\log_2$ 5.8 and $\log_2$ 4.9, respectively (Table III). Heat stress was found to reduce the immunity of bird against Newcastle disease virus vaccine, while lower temperature environment is beneficial to improve the immunity of birds. Also it was observed that betafin and vitamin C can improve immunity of bird during heat stress as compared to the birds exposed to heat stress without supplementation. These results are in agreement with the work of Zhan (2001) who reported that betafin (betaine) addition significantly improved the immune response and alleviated the response of body temperature. These results also justify the work of Gross (1992) who reported that chicken fed a diet containing ascorbic acid showed increased resistance to a combined Newcastle disease virus and *Mycoplasma gallisepticum* infection and to a secondary *Escherichia coli* infection. Therefore, it is suggested that desert cooler is the most

Table I. Average weight gain per bird* (in grams)

Group	0-3 week	4-5 week	0-5 week
A	604.40	768.75	1400.15
B	582.00	680.00	1290.13
C	611.00	720.00	1332.00
D	597.40	727.08	1354.95

*n= 25 chicks were induced in each control and treatment groups.
A= Control without heat stress = desert cooler was used.
B= Control with heat stress = No desert coolor provided.
C= Heat stressed group = vitamin C was added at dose rate of 20gm/50kg of feed and no desert cooler was provided to this group.
D= Heat stressed group = Betaine was added at dose rate of 50 mg/ 5kg of feed with no provision of desert cooler.

Table II. Average feed consumption per bird* (in grams)

Group	0-3 week	4-5 week	0-5 week
A	1080.00	1541.00	2621.00
B	1040.00	1424.76	2464.76
C	1114.00	1520.80	2634.80
D	1080.00	1533.33	2613.33

Table III. HI-GMT of antibodies against Newcastle disease virus vaccine in serum samples of birds* in control and treatment groups

Group	0-Day	17th Day	32nd Day
A	$\log_2$ 6.5	$\log_2$ 8.5	$\log_2$ 7.0
B	$\log_2$ 6.5	$\log_2$ 5.8	$\log_2$ 4.9
C	$\log_2$ 6.5	$\log_2$ 7.2	$\log_2$ 6.0
D	$\log_2$ 6.5	$\log_2$ 7.6	$\log_2$ 6.6

appropriate method to minimize the effect of heat stress and to improve the immune status of birds especially against NDV followed by addition of betafin and vitamin C in ration during hot summer season in our county.

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