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Effect of Ascorbic Acid and Acetylsalicylic Acid Supplementation on Performance of Broiler Chicks Exposed to Heat Stress

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Abstract: A total of 100, day-old broiler chickens were randomly divided into 5 groups and kept under elevated temperature (34-36°C) to see the effect of ascorbic acid and acetylsalicylic acid (Sb-Asper-C, a commercial product) on the feed conversion ratio (FCR), immune status and ratio of weight of bursa, thymus and spleen to body weight. Heat stress increased the FCR but decreased the immune response and ratio of bursa, thymus and spleen to body weight of the birds. Ascorbic acid and acetylsalicylic acid supplementation during heat stress had beneficial effects on FCR, immune status and ratio of weight of bursa, thymus and spleen to body weight of the birds. Grossly, bursa thymus and spleen of heat stressed birds were atrophied but ascorbic acid and acetylsalicylic acid supplemented birds were not atrophied, No specific histopathological changes were observed in all groups.

Key words: Ascorbic acid, acetylsalicylic acid, immune status, feed conversion ratio

Introduction

Heat stress is one of the most important factors adversely affecting overall poultry production in the tropics. In Pakistan temperature remains well beyond the higher side of thermo-neutral zone for the greater part of the year and adverse effects of heat make poultry production a difficult and uneconomical pursuit (Yaqoob, 1966). The domestic fowl is a homeotherm which can live comfortably only in a relatively narrow zone of thermo-neutrality extending from 14.5 to 25.5°C (Freeman, 1969). Any deviation especially on the higher side depresses both the survival and the production.

It is generally agreed that heat stress reduces the body weight (Lecui *et al.*, 1998), immune response (Savic *et al.*, 1993) and also causes mortality (Ridell, 1997).

Different therapeutic measures are used to minimize the harmful effects of heat stress on performance of broiler chicks, e.g. ascorbic acid (Cier *et al.*, 1992), B-Complex (Bashir *et al.*, 1998), vitamin E (Williams, 1996), acetylsalicylic acid (Stilborn *et al.*, 1988), sodium chloride (Smith *et al.*, 1983), potassium chloride, potassium carbonate, ammonium chloride (Teeter and Smith, 1986) and sodium bicarbonate (Branton *et al.*, 1986) etc.

The purpose of present study is to determine the role of combined ascorbic acid and acetylsalicylic acid for minimizing the negative effects of heat stress on performance of broiler chicks. The results of this study will help in management of birds in hot weather.

Materials and Methods

One hundred (day old) broiler chicks were divided into 5 groups designated as A, B, C, D and E, containing 20 birds each on 14th day of experiment.

Group A: This group was subjected to heat nor supplemented with Sb-Asper-C.

Group B: This group was not subjected to (34-36°C) environmental temperature only during 3rd and 4th week of age and Sb-Asper-C was not given to this group.

Group C: This group was subjected to (34-36°C) environmental temperature only during 3rd and 4th week of age and Sb-Asper-C was also given during this period.

Group D: This group was subjected to (34-36°C) environmental temperature only during 5th and 6th week of age and Sb-Asper-C was not given to this group.

Group E: This group was subjected to (34-36°C) environmental temperature only during 5th and 6th week of age and Sb-Asper-C was also given during this period.

This experimental design may be summarized as in Table 1.

Table 1: Experimental design

Group	Heat	Sb-Asper-C
A	-	-
B	+ (3+4 weeks)	-
C	+ (3+4 weeks)	+ (3+4 weeks)
D	+ (5+6 weeks)	-
E	+ (5+6 weeks)	+ (5+6 weeks)

All the birds were vaccinated with NDV (Lastosta strain) on day 1 and 14. FCR was calculated at the end of experiment. Geometric mean haemagglutination

Table 2: Feed conversion ratio (FCR)

Group	Average Feed consumed/ bird (kg)	Average weight gain/bird (kg)	Average FCR/bird
A	2.09	1.4929	1.40
B	1.93	1.2281	1.57
C	2.02	1.4003	1.44
D	1.88	0.9873	1.90
E	2.1	1.3187	1.59

Table 3: Geometric mean haemagglutination inhibition (gmhi) titer against newcastle disease virus

Groups	GMHI titer (log_2) on day			
	1	14	28	42
A	5.25	7.0	7.38	4.75
B	5.25	7.0	5.25	3.88
C	5.25	7.0	6.38	4.13
D	5.25	7.0	7.31	2.5
E	5.25	7.0	7.35	3.0

inhibition (GMHI) titers were determined on day 1, 14, 28 and 42 Thayer and Beard (1998). Five birds from each group were slaughtered on day 28 and 42 for collection of bursa, thymus and spleen for pathological examination. Ratio of night of bursa, thymus and spleen to body weight were also calculated on day 28 and 42 Lecui *et al*. (1998). The data this collected was analyzed statistically.

Results and Discussion

In this study, the birds of group A which were not exposed to heat stress had better FCR than birds of groups B, C, D and E which were exposed to heat stress. So our finding was that heat stress increased the feed conversion ratio. This finding was similar with Sahota *et al*. (1998); Pardue *et al*. (1985) and Smith *et al*. (1983), who reported that heat stress increased FCR. On the other hand it was not similar with Stilborn *et al*. (1988), who reported that feed conversion ratio was not affected by heat stress.

The group C, which was subjected to heat stress and supplemented with Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) only during third and fourth weeks of age, had better FCR than group B, which was subjected to heat stress only during third and fourth weeks of age without supplementation of Sb-Asper-C. Similarly the group E, which was subjected to heat stress along with Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) only during fifth and sixth weeks of age, had better FCR than group D which was subjected to heat stress only during fifth and sixth weeks of age without supplementation of Sb-Asper-C. It was inferred that improvement in FCR of C and E groups was due to ascorbic acid and acetylsalicylic acid supplementation. Our finding was not similar with stilborn *et al*. (1988), who reported that ascorbic acid and acetylsalicylic acid had no beneficial effects on FCR but it was favoured by Sahota *et al*. (1992) and Njokue (1986), who reported that ascorbic acid improved feed conversion ratio. Sharma and Bhatti (1998) reported that aspirin improved feed conversion ratio.

The GMHI titer of group A, which was not exposed to heat stress, was higher than groups B, C, D and E which were exposed to heat stress. So our finding was that heat stress reduced the immune response, which was similar with Mikec (1990) and Savic *et al*. (1993) but was not similar with Muneer *et al*. (1998), who reported that at high temperature immune response was increased. On day 28 and 42, the GMHI titer of group C, which was subjected to heat stress along with Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) only during third and fourth weeks of age, was higher than group B which was subjected to heat stress only during third and fourth weeks of age without supplementation of Sb-Asper-C. Similarly on day 42, the GMHI titer of group E, which was subjected to heat stress along with Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) only during fifth and sixth weeks of age, was higher than group D which was subjected to heat stress only during fifth and sixth weeks of age without supplementation of Sb-Asper-C. This high GMHI titer was probably due to supplementation of ascorbic acid and acetylsalicylic acid. Our this finding was similar with Tuekam *et al*. (1994), who reported that there was a positive correlation between antibody titer and ascorbic acid supplementation.

On day 28, the mean value of BBWR of group B, which was exposed to heat stress, was significantly decreased from group A which was not exposed to heat stress. This migh be due to increased level of cortisol in body in response to heat stress, which causes atrophy of bursa (Guyton and Hall, 1997).

On day 28, the group C, which was subjected to heat stress along with Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) only during third and fourth weeks of age, showed non-significant difference from group B, which was not supplemented with Sb-Asper-C. This was probably due to increase in weight of bursa due to ascorbic acid supplementation. Our finding was confirmed by Takahashi *et al*. (1991) and Bashir *et al*. (1998), who reported that supplementation of ascorbic acid increased the weight of bursa.

On day 42, no significant differences were recorded among the mean values of BBWR of group A, B, C, D and E. This finding was in line with Muneer *et al*. (1998) but was not similar with Lecui *et al*. (1998), who reported that in heat stressed birds the weight of bursa and its ratio to body weight was lower.

On day 28, there were no significant difference of mean values of TBWR among all the group A, B, C, D and E. This might be due to reason that chicks upto 3 weeks were more tolerant to heat stress (Jordan, 1990).

Table 4: Mean organ body weight ratio on day 28

Organ	Mean				
	Group A	Group B	Group C	Group D	Group E
Bursa	1.512^{a}±0.145	0.995^{b}±0.086	1.307^{c}±0.204	1.505^{a}±0.145	1.508^{a}±0.145
Thymus	3.467^{a}±0.497	2.989^{a}±0.309	3.056^{a}±0.338	3.458^{a}±0.499	3.463^{a}±0.498
Spleen	0.698^{a}±0.054	0.517^{a}±0.055	0.548^{a}±0.106	0.692^{a}±0.056	0.695^{a}±0.055

a = groups having superscript a in row are non-significant to each other
b = group having superscript b in row is significant to those groups having superscript a
c = group having superscript c in row is non-significant to all groups

Table 5: Mean organ body weight ratio on day 42

Organ	Mean				
	Group A	Group B	Group C	Group D	Group E
Bursa	0.579^{a}±0.136	0.488^{a}±0.071	0.536^{a}±0.046	0.306^{a}±0.073	0.419^{a}±0.110
Thymus	1.902^{a}±0.174	1.573^{a}±0.236	1.737^{a}±0.231	0.778^{b}±0.064	1.351^{c}±0.246
Spleen	0.829^{a}±0.102	0.709^{a}±0.107	0.780^{a}±0.066	0.399^{b}±0.103	0.648^{c}±0.101

a = groups having superscript a in row are non-significant to each other
b = group having superscript b in row is significant to those groups having superscript a
c = group having superscript c in row is non-significant to all groups

Table 6: Gross pathological lesions in bursa

Day	Group	Size			Colour		Consistency		Haemorrhages		Congestion
		Normal	Atrophy	Hypertrophy	Normal	Abnormal	Normal	Abnormal	External surface	Internal surface	
28	A	+	–	–	+	–	+	–	–	–	–
	B	–	+	–	+	–	+	–	–	–	–
	C	+	–	–	+	–	+	–	–	–	–
	D	+	–	–	+	–	+	–	–	–	–
	E	+	–	–	+	–	+	–	–	–	–
42	A	+	–	–	+	–	+	–	–	–	–
	B	+	–	–	+	–	+	–	–	–	–
	C	+	–	–	+	–	+	–	–	–	–
	D	+	–	–	+	–	+	–	–	–	–
	E	+	–	–	+	–	+	–	–	–	–

\+ = Present - = Absent

On day 42, the mean value of TBWR of group D, which was exposed to heat stress, was significantly decreased from group A which was not exposed to heat stress. This finding was similar with Lecui *et al.* (1998), but not similar with Muneer *et al.* (1998), who reported that mean thymic weight was increased at high temperature. On day 42, the group E, which was subjected to heat stress along with Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) only during fifth and sixth weeks of age, showed non-significant difference from group D which was not supplemented with Sb-Asper-C. This was probably due to increase in weight of thymus due to ascorbic acid supplementation. Our this statement was confirmed by Takahashi *et al.* (1991) and Bashir *et al.* (1998), who reported that ascorbic acid increased the weight of thymus.

On day 28, there were no significant differences of mean values of SBWR among all the group A, B, C, D and E. This might be due to reason that chicks upto 3 weeks were more tolerant to heat stress (Jordan, 1990).

On day 42, the mean value of SBWR of group D, which was exposed to heat stress, was significantly decreased from group A which was not exposed to heat stress. Our this finding was similar with Lecui *et al.* (1998).

On day 42, the group E, which was subjected to heat stress along with Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) only during fifth and sixth weeks of age, showed non-significant difference to group D which was not supplemented with Sb-Asper-C. This was probably due to increase in weight of spleen due to ascorbic acid supplementation. Our this statement was confirmed by Takhashi *et al.* (1991) and Bashir *et al.* (1998), who reported that ascorbic acid increased the weight of spleen.

On day 28, only the bursa of group B showed atrophy. On day 42, only the thymus and spleen of group D showed atrophy and this finding was similar with Lecui *et al.* (1998). The bursa of all groups were normal in size and this finding was not similar with Lecui *et al.* (1998). No change in colour and consistency was seen. There were

Table 7: Gross pathological lesions in thymus

Day	Group	Size			Colour		Consistency		Haemorrhages		Congestion
		Normal	Atrophy	Hypertrophy	Normal	Abnormal	Normal	Abnormal	External surface	Internal surface	
28	A	+	–	–	+	–	+	–	–	–	–
	B	+	–	–	+	–	+	–	–	–	–
	C	+	–	–	+	–	+	–	–	–	–
	D	+	–	–	+	–	+	–	–	–	–
	E	+	–	–	+	–	+	–	–	–	–
42	A	+	–	–	+	–	+	–	–	–	–
	B	+	–	–	+	–	+	–	–	–	–
	C	+	–	–	+	–	+	–	–	–	–
	D	–	+	–	+	–	+	–	–	–	–
	E	+	–	–	+	–	+	–	–	–	–

\+ = Present, – = Absent

Table 8: Gross pathological lesions in spleen

Day	Group	Size			Colour		Consistency		Haemorrhages		Congestion
		Normal	Atrophy	Hypertrophy	Normal	Abnormal	Normal	Abnormal	External surface	Internal surface	
28	A	+	–	–	+	–	+	–	–	–	–
	B	+	–	–	+	–	+	–	–	–	–
	C	+	–	–	+	–	+	–	–	–	–
	D	+	–	–	+	–	+	–	–	–	–
	E	+	–	–	+	–	+	–	–	–	–
42	A	+	–	–	+	–	+	–	–	–	–
	B	+	–	–	+	–	+	–	–	–	–
	C	+	–	–	+	–	+	–	–	–	–
	D	–	+	–	+	–	+	–	–	–	–
	E	+	–	–	+	–	+	–	–	–	–

\+ = Present, – = Absent

no haemorrhages and congestion in bursa, thymus and spleen of all the groups.

On day 28 and 42, no histological changes were observed in bursa and spleen of all groups. Our result was not similar with Shubai *et al*. (1999). On day 28 and 42, no histological changes were observed in thymus. Our this finding was similar with Shubai *et al.* (1999) who observed no histopathological change in thymus of heat stressed birds.

Our results indicated that heat stress increased the FCR of the birds but decreased the immune response (GMHI) and ratio of bursa, thymus and spleen to body weight of the birds. On gross pathological examination, heat stress caused atrophy of bursa, spleen and thymus but no microscopic changes were observed.

This study also indicated that Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) supplementation during heat stress had beneficial effects on FCR, serum antibody development and ratio of weight of bursa, thymus and spleen to body weight of birds.

It is concluded from this experiment that the Sb-Asper-C (containing ascorbic acid and acetylsalicylic acid) has expressed itself as an anti-heat stressor and also shown to be an immunopotentiating agent under heat stress. So Sb-Asper-C is recommended in heat stressed birds.

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Abbreviations key: BBWR = Bursa / Body weight ratio. TBWR = Thymus / Body weight ratio. SBWR = Spleen / Body weight ratio.