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Ascorbic Acid and Heat Stress in Laying Hens

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Abstract: There are so many stressors, like heat, effects the egg production in laying hens. Experiment was conducted in a poultry farm in Bursa. 1730 Hy-Line W77 layer aged 40 weeks assigned to caging unit were used as research materials. Hens were divided into six groups and had different amount of ascorbate supplementation; 0, 50, 100, 150, 200 and 250 mg kg^{-1} feed. Egg production and body weighted were recorded. As result the best ascorbate supplementation to decrease heat stress for this experiment was 100 mg kg^{-1} feed.

Key words: Ascorbic acid, egg production, heat stress, laying hens, poultry farm

INTRODUCTION

A hot environment is one of the important stressor in poultry production. Under the routine production conditions various type of stress are experienced by chickens such as heat/cold, transport, pre-slaughter holding and humidity where the air temperature plays the major role. The optimum temperature for performance is likely to be 19-22°C for laying hens (Charges, 2002).

Both low and high temperatures stimulate the hypothalamo-hypophseal-adrenocortical axis and the sympathic nervous system which may after susceptibility of animal to infectious disease resulting in production loss, high mortality, decreased feed consumption poor body weight gain, meat quality, poor laying rate, egg weight and shell quality (Yahav, 2000; Howlider and Rose, 1987; Lin *et al*., 2006).

At temperature above and below thermoneutral zone corticosteroid secretion increases in response to stress. By decreasing synthesis and secretion of corticosteroid, vitamin C alleviates the negative side effects of stress. Although, it was believed that supplementation of ascorbic acid has no effect on chicken which can synthesize its own demands. When ascorbic acid was fed to heat stressed chickens and definite improvements in egg production was observed. Previously, Thorton (1960) reported that heat stressed hens and reduced blood ascorbic acid levels and increased the need for the vitamins.

In the chicken ascorbate levels were found to be decreased in plasma with age whereas the concentration of ascorbate increased in heart muscle and spleen with age (Dorr and Nockels, 1971). In general domestic animals like chicken, goat, cow, sheep, cat, dog and swine have the ability to biosynthesize ascorbic acid with in their body (Chatterjee, 1973). The ability to synthesize ascorbic acid biosynthetically from glucose is absent in insects, invertebrates and fish. The chick was shown to have biosynthetic capacity located in kidney. During 1st day after hatching only a slow rate of ascorbate synthesis could be determined which however, increased several fold until 20-30 days of age.

Supplementation of ascorbate to feed had beneficial effects on growth rate, egg production, egg shell strength and thickness. Dietary ascorbate (1000 mg kg^{-1} feed) prevented depletion in plasma and tissue and contributed to intestinal repair in experimental coccidiosis (Kechik and Sykes, 1979).

Antioxidants play a major role in protecting cells from various actions of reactive oxygen species by reducing chemical radicals and preventing the process of lipid peroxidation, lower plasma concentrations of antioxidant vitamins such as vitamin C, E, folic acid has been inversely correlated to increased oxidative damage in stressed poultry (Cheng *et al*., 1990). Benabdeljelil *et al*. (1990) established that ascorbic acid had little practical value for brown layer. Krautmann *et al*. (1990) provided many recommendations of vitamin C supplementation in feed or in drinking water when chickens submitted to chronic or acute stress.

In the present study, it was aimed to see the effects of ascorbic acid supplementation on egg production and body weighted during heat stress.

MATERIALS AND METHODS

The experiment was conducted in a private poultry farm, near Bursa in the North-West of Turkey with hot

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summer outside temperature over 30°C. About 1730 Hy-Line W 77 layers aged 40 weeks were randomly assigned to caging units (Helmann types), 4 hens each. Hens were fed a basal diet containing 16.5% CP and and 2700 kcal kg^{-1} ME three times in a day and drinking water *ad libitum* from Automated Watering System. Basal diet formulated using NRC guidelines (NRC, 1994) and their ingredients and chemical composition were shown in Table 1.

During the experiments the temperature of hen's house were measured 3 times a day 08.00, 14.00 and 20.00. The average daily temperature in the hen house was 31±3°C. The presented experiment was carried out between June 24 to August 30 also outside temperature was high around farm area.

Hens were divided into 6 groups. First group was control had only water and feed. The other 5 groups had water and feed supplemented with 50, 100, 150, 200 and 250 mg kg^{-1} feed ascorbate (Rovimix STAYC 35, Roche), respectively.

Egg productions of all groups were recorded for 2 weeks before the ascorbate supplementation and 7 weeks during ascorbate supplementation in order to analyze percent production differences. Body weights of 30 randomly chosen hens from each group were measured at the end of experiment.

Table 1: Ingredients and chemical composition of basal diet fed to laying hens

Ingredients	Values (kg ton^{-1})
Ground corn	340
Wheat	224
Sun flower pomace	170
Soybean	110
Wheat germ	40
Bean	10
DCP	13
Vitamin mix	2.5
Mineral mix	1
Salt	3
Marble dust	85
Methionine	0.5
Lysine	1
Crude protein	16.5%
ME	2700 kcal kg^{-1}

RESULTS AND DISCUSSION

The average body weight of hens was shown in Table 2. There were no big differences between groups but the lowest weight was observed in group 1. The 100 mg kg^{-1} feed ascorbate supplemented group had higher body weight.

The percent egg production of Hy-Line hens before ascorbate supplementation was shown in Table 3. Average egg production of all group were between 59.75-51.65%. In Table 4, egg production of hens for 7 weeks were shown. Final egg production percentages were between 59.83-66.51%. The best performances were seen in 100 and 200 mg kg^{-1} feed ascorbate supplemented group.

Of the domestic animals the chick is subjected to manifold stress condition such as rapid growth, exposure to hot and cold environmental temperature, starvation, vaccination and others. When the ascorbate synthesis rate under normal condition is low and the avaibility of ascorbic acid by endogenous synthesis is limited. Chicks not prepared to have renal biosynthesis capacity for ascorbic acid induced by stress conditions (Hornig, 1975).

Even ascorbate is not necessary for chicken under normal conditions, feed supplementation of ascorbate increases the growth rate of chicks. It was reported that

Table 2: Final body weights of some hens randomly chosen from each group

Groups	n	Average body weight (g)
1 (Control)	30	1320±13
2 (50 mg kg^{-1} feed)	30	1450±24
3 (100 mg kg^{-1} feed)	30	1560±25
4 (150 mg kg^{-1} feed)	30	1490±21
5 (200 mg kg^{-1} feed)	30	1510±26
6 (250 mg kg^{-1} feed)	30	1470±33

Table 3: Percent of egg production of hens before ascorbate supplementation

Groups	1st week	2nd week	Average
1	56.4	60.3	58.35
2	56.6	57.3	56.95
3	54.7	56.7	55.70
4	51.1	52.2	51.65
5	59.1	60.4	59.75
6	50.8	55.9	53.35

Table 4: Weekly average egg production of laying hens with different amount of ascorbic acid

		Weeks							
Groups	n	1	2	3	4	5	6	7	Average
1 (Control)	260	57.6	58.4	58.9	60.2	60.8	60.3	62.6	59.83
2 (50 mg kg^{-1} feed)	290	61.6	60.7	59.2	64.4	63.1	63.3	67.4	62.81
3 (100 mg kg^{-1} feed)	300	59.2	63.4	64.6	69.2	68.5	69.8	70.9	66.51
4 (150 mg kg^{-1} feed)	320	56.0	56.2	58.1	59.0	62.6	63.0	66.3	60.17
5 (200 mg kg^{-1} feed)	280	61.6	63.2	62.9	64.2	65.2	65.9	67.0	64.28
6 (250 mg kg^{-1} feed)	280	57.7	58.9	58.8	62.1	62.0	59.8	63.2	60.36

ascorbate supplementation increases egg production 8. Blood ascorbic acid levels were depressed during egg production, generally tissue levels of ascorbate were unaffected by supplementation. Ascorbic acid consumption reduced plasma and adrenal corticosteroid levels too (Nockels *et al*., 1973).

In the presented study, different amounts of ascorbate were added to the diet of Hy-Line laying hens and daily egg productions were recorded. The egg production was observed in the 2 group which had 100 mg kg^{-1} feed ascorbate when compared control and other groups. The 200 mg kg^{-1} feed ascorbate was also better than others in general addition of ascorbate to the feed of laying hens positively increased egg production. The 100 and 200 mg kg^{-1} feed ascorbate supplementation increased egg production 11.12 and 10.74%, respectively.

Many researches reported that dietary supplementation of ascorbic acid under heat stress result better performance such as improved egg production, live weight, egg quality (Thorton, 1960; Benabdeljelil *et al*., 1990; Nockels *et al*., 1973; El-Boushy and Von Albada, 1970). It is well documented that temperature above or below thermoneutral zone growth rate and egg production decreases, corticosteroid synthesis and secretion increases. Supplementation of ascorbic acid reduces the corticosteroid secretion as a response to heat stress (Katri and Cherry, 1984).

Ascorbate supplementation of feed had positive effects on egg production and body weights. As shown in Table 4, the best percent egg production was observed in 100 mg kg^{-1} feed ascorbate group. Also 200 mg kg^{-1} feed ascorbate addition increased egg production. The higher average body weight was found hens fed with 100-200 mg kg^{-1} feed ascorbate supplementation.

CONCLUSION

Results of this study showed that dietary supplementation of ascorbic acid (100 mg kg^{-1} feed) provides better performance in Hy-Line laying hens reared under heat stress.

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