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MEHMET AVCI

MUĞDAT YERTÜRK

OKTAY KAPLAN

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Research Article

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Mehmet AVCI
Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Harran University, Şanlıurfa – TURKEY
e.mail: mavci@harran.edu.tr

Muğdat YERTÜRK
Department of Animal Sciences, Faculty of Veterinary Medicine, Harran University, Şanlıurfa - TURKEY

Oktay KAPLAN
Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Harran University, Şanlıurfa - TURKEY

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Abstract: The effects of ascorbic acid on the performance and some blood parameters of Japanese quails reared under hot conditions were investigated. Three hundred Japanese quails, 7 days of age, were randomly divided into one control and two experimental groups, comprising five replicates of 20 birds each. Ascorbic acid (500 and 1000 mg/kg) was given to the experimental groups. The body weight gain increased significantly ($P < 0.05$) in the group given 500 mg/kg of ascorbic acid until the fourth week. Feed consumption also increased ($P < 0.05$), depending on the quantity of ascorbic acid supplementation until the fourth week. However, ascorbic acid did not affect the concentrations of blood pH, PCO_2, sodium (Na), potassium (K), hematocrit (PCV), bicarbonate (HCO_3), or hemoglobin (Hb). In conclusion, 500 mg/kg of ascorbic acid may be added to the quail diet to prevent heat stress until the fourth week.

Key Words: Quail, heat stress, ascorbic acid, performance, blood parameters

Sıcak Koşullarda Barındırılan Japon Bıldırcınlarında Askorbik Asidin Performans ve Bazı Kan Parametreleri Üzerine Etkileri

Özet: Bu çalışma, sıcak şartlarda yetiştirilen Japon bıldırcınlarında askorbik asidin performans ve bazı kan parametreleri üzerindeki etkilerini belirlemek amacıyla yapıldı. Toplam 300 adet 7 günlük Japon bıldırcını, her bir grupta 20 bıldırcın içeren beş tekerrürden oluşan bir kontrol ve iki deneme olmak üzere rastgele gruplandırıldı. Deneme gruplarına iki farklı düzeyde (500 ve 1000 mg/kg) askorbik asit verildi. Deneme hayvanlarının karma yemlerine 500 mg/kg askorbik asit ilavesi ile günlük canlı ağırlık kazancı dördüncü haftaya kadar belirgin derecede arttı ($P < 0,05$). Karma yemdeki askorbik asit düzeyine bağlı olarak yem tüketimi de yine dördüncü haftaya kadar arttı ($P < 0,05$). Ancak, askorbik asit katkısı kan pH, PCO_2, sodyum (Na), potasyum (K), hematokrit (PCV), bikarbonat (HCO_3), ve hemoglobin (Hb) konsantrasyonlarını etkilemedi. Bu sonuca göre, sıcaklık stresinin olumsuz etkilerinden korunmak amacıyla dördüncü haftaya kadar yeme 500 mg/kg askorbik asit katılabilir.

Anahtar Sözcükler: Bıldırcın, ısı stresi, askorbik asit, performans, kan parametreleri

Introduction

Heat stress reduces growth rate, feed consumption, egg production and feed efficiency in poultry (1-3). There have been many reports of attempts to alleviate the consequences of heat stress by nutritional manipulation (4-6). It has been reported that supplemental ascorbic acid alleviates the effect of heat stress on the performance of broiler chicks reared under heat stress (7,8). Birds are normally able to synthesize adequate amounts of ascorbic acid. However, there are many indications that they cannot produce enough ascorbic acid for their metabolic needs under heat stress and they require dietary ascorbic acid supplementation (9). For protective purpose, ascorbic acid is commonly used in the poultry diet because of its antistress effects (10).

The aim of the present study was to investigate the effects of ascorbic acid supplementation on the performance and some blood parameters of Japanese quails reared under hot conditions.

Materials and Methods

The study was conducted at hot climate conditions (July and August 2003). Three hundred 7-day-old Japanese quails (Coturnix coturnix japonica) were used. The birds were randomly assigned to one control and two experimental groups based on their initial body weight, comprising five replicates of 20 birds each. They were fed a basal diet or the basal diet supplemented with either 500 (group 1) or 1000 (group 2) mg/kg of ascorbic acid. Ingredients and chemical compositions of the basal diets are shown in Table 1. Small amounts of the basal diet were first mixed with the respective amount of ascorbic acid as a small batch and then with a larger amount of the basal diet until the total amounts of the respective diets were homogeneously mixed.

The birds were fed with a starter diet until 21 days of age. Thereafter, they were fed with a finishing diet. The diets and water were given for ad libitum consumption throughout the experiment. The birdhouse was lit 24 h/day. Body weights and feed consumption data were recorded at weekly intervals. Body weight gain and feed conversion ratio were also calculated.

Temperature in the poultry house was recorded with a TESTO 175 instrument. The values weekly mean temperature and humidity data are shown in Table 3. The average daily temperatures in the hen-house ranged from 32.7 to 34.8 °C during the experiment.

Chemical compositions of the diets were analyzed using the international procedures of AOAC (11).

Venous blood samples (2 ml) were collected into heparinized plastic syringes. The samples were analyzed by a portable blood gas analyzer (I-STAT) for the determination of concentrations of pH, PCO_2, sodium (Na), potassium (K), hematocrit (PCV), bicarbonate (HCO_3), and hemoglobin (Hb).

Data were statistically analyzed by a one-way ANOVA, and the means were compared by the Duncan's multiple-range test. Furthermore, male and female distribution of groups were also analyzed by the General Loglinear method in SPSS (12).

Table 1. The composition of the experimental diets.

	Starter wk 1-3	Grower wk 4-6
Ingredients (%)		
Yellow corn	44.20	53.65
Wheat	11.00	11.00
Soybean meal (44% CP)	34.40	30.00
Fish meal (60% CP)	5.65	1.20
Vegetable oil	2.50	1.20
Calcium carbonate	1.20	1.30
Dicalcium phosphate	0.40	1.00
Salt	0.25	0.25
Vitamin premixa	0.25	0.25
Trace mineral premixb	0.15	0.15
Total	100	100
Analyzed values (%)		
DM	88.94	88.70
Crude protein	24.00	20.04
Crude fat	4.93	3.74
Crude cellulose	3.81	3.65
Calcium	0.80	0.80
Total phosphorus	0.60	0.60
Calculated values (%)		
ME (Kcal/kg)	3002	3000
Lysine	1.41	1.10
Methionine+cystine	0.82	0.69

a Ingredients in 1 kg of Premix (Rovimix 124/V): vitamin A, 7,500,000 IU; cholecalciferol, 1500 IU, vitamin E, 7 500 IU; menadione, 1250 mg; vitamin B1 500 mg; vitamin B2, 5000 mg; niacin, 35,000 mg; d-pantothenic acid, 10,000 mg; vitamin B12 2000 mg; folic acid, 1000 mg; biotin, 50 mg.
b Premix (Remineral CH) supplied for 1 kg: Mn, 40,000 mg; Fe, 12,500 mg; Zn, 25,000 mg; Cu, 3500 mg; Iodine, 150 mg; Se, 75 mg; Colin chloride, 175,000 mg.

Results

There was no significant difference ($P > 0.05$) between male and female distribution of all groups (Table 2).

Body weight and body weight gain in all groups are shown in Tables 3 and 4, respectively. As seen, 500 mg/kg of the ascorbic acid supplementation resulted in an improved body weight ($P < 0.01$) and body weight gain ($P < 0.05$) until the fifth week.

Feed consumption increased significantly ($P < 0.05$) depending on the quantity of ascorbic acid supplementation. Feed conversion ratio in group 1 and the control was better than that in group 2 (Table 4).

Table 2. Sexual distribution of the groups

	1		2		3		4		5	
	M	F	M	F	M	F	M	F	M	F
Control	11	8	9	11	14	6	7	11	8	11
Group 1	9	11	10	7	11	7	12	7	8	11
Group 2	13	7	11	9	7	12	10	7	10	8

M: Male F: Female NS: P > 0.05

Table 3. Effects of ascorbic acid on body weight (g), (n=100).

	1st wk	2nd wk	3rd wk	4th wk	5th wk	6th wk
Temperature	32.7 °C	33.6 °C	34.8 °C	33.8 °C	34.5 °C	34.8 °C
Humidity	54	54	53	52	53	53
Groups	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM
Control	23.29 ± 0.35	42.80 ± 0.72^{b}	75.60 ± 0.98^{b}	109.4 ± 1.20^{c}	139.3 ± 1.67^{b}	160.0 ± 1.31^{a}
Group 1	23.28 ± 0.41	49.51 ± 056^{a}	79.00 ± 0.66^{a}	118.5 ± 1.00^{a}	147.8 ± 1.13^{a}	162.4 ± 1.29^{a}
Group 2	23.39 ± 0.36	47.40 ± 0.60^{a}	76.32 ± 0.80^{b}	113.7 ± 1.02^{b}	139.6 ± 1.13^{b}	155.0 ± 1.26^{b}
ANOVA	NS	**	*	**	**	**

a, b, c: means in the same parameter with different letters are significantly different.

NS: P > 0.05; * P < 0.05; ** P < 0.01

Table 4. Effects of ascorbic acid on performance (n=5).

		2nd wk	3rd wk	4th wk	5th wk	6th wk	2-6th wk
	Groups	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM
BWG	Control	2.78 ± 0.10^{b}	4.69 ± 0.37	4.86 ± 0.22 ^{b}	4.35 ± 0.10	3.07 ± 0.10^{a}	3.95 ± 0.15
(g/day)	Group 1	3.75 ± 0.10^{a}	4.21 ± 0.10	5.66 ± 0.10^{a}	4.22 ± 0.32	2.09 ± 0.18^{b}	3.99 ± 0.16
	Group 2	3.43 ± 0.11^{a}	4.13 ± 0.12	5.41 ± 0.16^{ab}	3.68 ± 0.24	2.04 ± 0.20^{b}	3.74 ± 0.15
P		**	NS	*	NS	**	NS
FC	Control	7.41 ± 0.24^{b}	12.14 ± 0.20^{ab}	12.32 ± 0.20^{b}	15.60 ± 0.51	17.70 ± 0.30^{a}	13.03 ± 0.29
(g/day)	Group 1	9.54 ± 0.40^{a}	11.75 ± 0.20^{b}	13.95 ± 0.28^{a}	15.98 ± 0.52	16.55 ± 0.29^{b}	13.55 ± 0.34
	Group 2	8.65 ± 0.20^{a}	12.53 ± 0.20^{a}	14.16 ± 0.40^{a}	17.18 ± 0.50	16.19 ± 0.31^{b}	13.74 ± 0.32
P		**	*	**	NS	*	NS
FCR	Control	2.66 ± 0.01^{a}	2.68 ± 0.08^{b}	2.55 ± 0.03^{a}	3.58 ± 0.03^{b}	5.78 ± 0.09^{b}	3.34 ± 0.06^{b}
	Group 1	2.54 ± 0.02^{b}	2.76 ± 0.02^{b}	2.46 ± 0.02^{b}	3.90 ± 0.38^{b}	8.10 ± 0.54^{a}	3.39 ± 0.05^{b}
	Group 2	2.53 ± 0.03^{b}	3.04 ± 0.05^{a}	2.62 ± 0.03^{a}	4.71 ± 0.18^{a}	8.18 ± 0.68^{b}	3.63 ± 0.06^{a}
P		*	*	*	*	**	*

BWG: Body weight gain; FC: Feed consumption; FCR: Feed conversion ratio

a-b: means in the same parameter with different letters are significantly different (P < 0.05).

NS: P > 0.05 *: P < 0.05 **: P < 0.01

Body weights at slaughter, carcass weights and carcass yield were not affected by the ascorbic acid supplementation (Table 5).

Blood parameters such as pH, PCO_2, Na, K, PCV, HCO_3, and Hb were not affected by the ascorbic acid supplementation under hot conditions (Table 6).

Discussion

A 500 mg/kg supplementation of ascorbic acid improved body weight ($P < 0.01$) until the fifth week (Table 3). In group 1, body weight gain was significantly higher than that in the control group ($P < 0.05$) until the fourth week, but no significant differences were found between the control group and group 1 at the fifth week. These results may be attributed to the fact that quails in group 1 have begun to produce eggs one week earlier than in the control group. Similarly, no increase in body weight gain was reported in quails at the egg production period (2,13).

Feed consumption in groups 1 and 2 increased when compared with the control group ($P < 0.05$) until the fifth week. In group 1, feed conversion ratio was higher ($P < 0.05$) than control until the fourth week. At the fifth week it was similar, whereas it was lower at the sixth week in group 1 compared with the control group. However, feed conversion ratio in group 1 and control was better ($P < 0.01$) than that in group 2 (Table 4). Ascorbic acid supplementation did not affect body weights or carcass parameters at slaughter (Table 5). Sahin and Kucuk (6) reported that supplemental vitamin C increased performance in Japanese quails reared under heat stress. Similarly, Kutlu and Forbes (14) noted that growth rate, feed consumption and feed efficiency of broiler chickens reared under heat stress reduced, but ascorbic acid supplementation improved these parameters. Furthermore, vitamin C supplementation resulted in a better performance in broiler chickens (7,8,15,16).

Body weight gain ($P < 0.05$) and feed conversion ratio ($P < 0.05$) in group 2 were lower than in group 1 during the period of the study. This may be explained by excessive supplementation of ascorbic acid. Moreover, it has been reported that gastrointestinal disturbances may occur when excessive ascorbic acid is given (17,18). Similarly, excessive vitamin C supplementation could reduce the performance of broiler chicks (7,14).

Table 5. Effects of ascorbic acid on carcass characteristics (n = 10).

Treatments	Live weight at slaughter (g)	Chilled carcass weight (g)	Chilled carcass yield (%)
	Mean ± SEM	Mean ± SEM	Mean ± SEM
Control	161.7 ± 0.41	111.7 ± 0.50	69.2 ± 0.31
Group 1	160.9 ± 0.42	110.5 ± 0.34	68.7 ± 0.42
Group 2	160.2 ± 0.41	109.9 ± 0.26	68.6 ± 0.28
P	NS	NS	NS

NS: $P > 0.05$

Table 6. Effects of ascorbic acid on some blood parameters (n = 10).

	Na mmol/l	K mmol/l	pH	PCO_2 mmHg	Hct %PCV	HCO_3 mmol/l	Hb g/dl
Groups	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM
Control	151.60 ± 1.17	2.08 ± 0.14	7.43 ± 0.02	27.58 ± 0.19	35.9 ± 1.09	23.90 ± 0.50	12.2 ± 0.42
Group 1	150.80 ± 1.42	2.10 ± 0.14	7.41 ± 0.02	28.71 ± 0.17	36.4 ± 1.12	23.20 ± 0.56	12.3 ± 0.45
Group 2	151.40 ± 1.40	2.09 ± 0.15	7.42 ± 0.01	28.66 ± 0.17	36.3 ± 1.11	23.18 ± 0.58	12.2 ± 0.45
P	NS	NS	NS	NS	NS	NS	NS

NS: $P>0.05$

Blood parameters such as pH, PCO_2, Na, K, PCV, HCO_3, and Hb of Japanese quails reared under hot conditions were not affected by the dietary ascorbic acid. The values of blood parameters investigated in this study were supported by the other studies under hot climate conditions (19-21).

In conclusion, the results of the present study showed that 500 mg/kg of ascorbic acid provides the greatest performance of Japanese quails reared under hot conditions until the fourth week. Based upon this result, 500 mg/kg of ascorbic acid may be added to the diet to prevent the negative effects of heat stress until the fourth week.

References

1. Emery, D.A., Vohra, P., Ernst, R.A., Morrison, S.R.: The effect of cyclic and constant ambient temperatures on feed consumption, egg weight and shell thickness of hens. Poult. Sci., 1984; 63: 2027-2035.
2. Sauveur, B., Picard M.: Environmental effects on egg quality in the laying hen. In: Wells R.G., Belyavin, C.G. Eds. Egg quality current problems and recent advances. Butterworths, London, 1987; 219-234.
3. Ensminger, M.E., Oldfield, J.E., Heinemann, W.W.: Feeds and Nutrition. The Ensminger Publishing Company, USA, 1990; 108–110.
4. Pardue, S.L., Thaxton, J.P., Brake, J.: Role of ascorbic acid in chicks exposed to high environmental temperature. J. Appl. Physiol, 1985; 58: 1511-1516.
5. Leeson, S.: Nutritional considerations of poultry during heat stress. World Poultry. Sci. J., 1986; 42: 69-81.
6. Sahin, K., Kucuk, O.: Effects of vitamin C and vitamin E on performance, digestion of nutrients and carcass characteristics of Japanese quails reared under chronic heat stress (34 °C). J. Anim. Physiol. Anim. Nutr. 2001; 85: 335-341.
7. Kafri, I., Cherry, J.A.: Supplemental ascorbic acid and heat stress in broiler chicks. Poult. Sci., 1984; 63 (Suppl. 1): 125-126.
8. McKee, J.S., Harrison, P.C.: Effects of supplemental ascorbic acid on the performance of broiler chickens exposed to multiple concurrent stressors. Poultry. Sci., 1995; 74: 1772-1785.
9. Coates, M.E.: Metabolic role of the vitamins. In: Freeman, B.W. Ed. Physiology and Biochemistry of the Domestic Fowl. Academic Press, London, 1984; 27-36.
10. Sykes, A.H.: Vitamin C for poultry; some recent research. Roche Symp., 1978; 5-15.
11. AOAC Official Methods of Analysis, 15th Edition. Association of official analytical chemists. Washington, DC; 1990.
12. SPSS: SPSS for Windows 9.3 base systems user's guide. Release 9.0 copyright 1998 by SPSS Inc., USA, 1996.
13. Öztürk, E.: Bıldırcın rasyonlarına sodyum bikarbonat ilavesinin yumurta verim ve kalitesi ile bazı kan parametrelerine etkileri Turk. J. Vet. Anim. Sci., 1999; 3: 359-365.
14. Kutlu, H.R., Forbes, J.M.: Changes in growth and blood parameters in heat-stressed broiler chicks in response to dietary ascorbic acid. Livest. Prod. Sci., 1993; 36: 335-350.
15. Njoku, R.C.: Effect of dietary ascorbic acid (vitamin C) supplementation on the performance of broiler chickens in a tropical environment. Anim. Feed. Sci. Tech., 1986; 16: 17-24.
16. McKee, J.S., Harrison, P.C., Riskowski, G.L.: Effects of supplemental ascorbic acid on the energy conversion of broiler chicks during heat stress and feed withdrawal. Poult. Sci., 1997; 76: 1278-1286.
17. Kubler, W., Gehler, J.: On the kinetics of the intestinal absorption of ascorbic acid: a contribution to the calculation of an absorption process that is not proportional to the dose. Int. J. Vit. Nutr. Res., 1970; 40: 442-453.
18. Graumlich, J., Ludden, T.M., Conry-Cantilena, C., Cantilena, L.R., Wang, Y., Levine M.: Pharmacokinetic model of ascorbic acid in humans during depletion and repletion. Pharmaceut. Res., 1997; 14: 1133-1139.
19. Hussein, S.Y.: Influence of dietary ascorbic acid on growth performance, some blood constituents and thyroid hormones of *Oreochromis niloticus* exposed to ambient ammonia. Assiut J. Agri. Sci., 1995; 26: 299-323.
20. El-Barody, M.A.A.: Ascorbic acid injection in stressed lambs and its effect on performance and some physiological reactions. Alexandria J. Agri. Res., 1996; 4: 83-91.
21. Ladmakhi, M.H., Buys, N., Dewil, E., Rahimi, G., Decuypere, E.: The prophylactic effect of vitamin C supplementation on broiler ascites incidence and plasma thyroid hormone concentration. Avian Pathol., 1997; 26: 33-44.