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Effects of Dietary Ascorbic Acid on Performance, Carcass Composition and Bone Characteristics of Turkeys during High Summer Temperature*

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ABSTRACT : Heat stress is major welfare problem in the poultry industry. Huge economic losses occur every year because of mortality and decreased production due to high environmental temperatures. This experiment was conducted to determine the effects of level of inclusion of ascorbic acid supplementation to the diet on performance, carcass composition and bone characteristics of male turkeys during high summer temperature. A total of 120 day-old turkey chicks were wing banded at hatch and randomly distributed into 3 treatment groups. Three diets were formulated to provide a similar nutrient profile with the exception of using three graded levels of ascorbic acid, namely 0, 150 and 300 mg/kg of the diet. The experimental diets were used from 0 to 18 weeks of age. Body weights, feed intake and feed conversion ratio, slaughter weight, carcass yield, portions, composition and thigh and breast pigmentation of the turkeys were not affected by ascorbic acid (p>0.05). Also, shank and tibia bone characteristics were not affected by ascorbic acid (p>0.05). (**Key Words :** Turkey, Ascorbic Acid, Performance, Carcass Composition, Bone Traits)

INTRODUCTION

Turkeys in modern environments can experience a variety of stressors such as in the form of environmental, pathological, or nutritional. Environmental stressors include extreme or unusual climates. It is known that the stress of high ambient temperature may negatively influence the performance of poultry.

The global environmental temperature is also showing an upward trend. In the poultry industries of the world, huge economic losses occur every year because of mortality and decreased production in relation to high environmental temperatures. High ambient temperatures depressed feed intake, resulting in reduced body weight gain and breast yield in turkeys (Veldkamp et al., 2000).

The effects of climatic changes on turkeys have not received a high level of attention. Because, turkeys are known to be less sensitive to heat stress due to better heat dissipation from their relatively large wattles (Yahav, 1998; Yahav, 1999). In earlier reports showed that turkeys could be reared in environmental temperatures between 10 and 26°C if dietary energy regulated (Albuquerque et al., 1978). Yahav (1999) reported a significant decline in weight gain and feed intake when turkeys raised at 35°C versus 25°C and body temperatures were at the normal levels.

Several methods are available to alleviate the negative effects of high environmental temperature on performance of poultry. Because of the high cost and impracticality of cooling animal buildings, interest in dietary manipulations has increased. Studies have shown that antioxidant nutrient supplementation; especially ascorbic acid or vitamin C (VC) can be used to attenuate the negative effects of environmental stress (Sahin et al., 2003). There has been considerable interest in the possible nutritional role for ascorbic acid on the basis that endogenous synthesis may not be adequate to meet the full needs of poultry at all times or requirements for VC may be increased under certain circumstances as stressful conditions (Whitehead and Keller, 2003). Ascorbic acid supplementation improved performance of heat challenged broiler chickens and lowered corticosterone level in the blood (Pardue at al., 1985a). Thus, substantial attention has been paid to the role of nutritional additives to minimize the effect of heat stress. Dietary VC alleviated the effects of heat stress in poultry (Pardue and Thaxton, 1986).

Ascorbic acid plays an important role in the synthesis of

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steroid hormones. These are responsible for mobilizing the energy needed for various vital functions, among other things, for maintaining body temperature. If there is a VC deficiency corticosteroids are formed inadequately. Moreover, corticosteroids and, indirectly VC, play an important role in immunity processes (Seeman, 1991). One of the hormonal responses to heat stress is an increase in the level of corticosterone in blood, the primary glucocorticoid hormone produced by the avian adrenal gland. Ascorbic acid may influence bone development by mediating the biosynthesis of 1,25-dihydroxycholecalciferol and collagen (Farquharson and Jefferies, 2000; McCormack et al., 2001) and, also, may be involved calcium mobilization in bone (Dorr and Balloun, 1976). It is reported that dietary supplementation of VC improved some bone traits (Lohakare et al., 2004), but this was not found in the other studies (Rowland et al., 1973; Orban et al., 1993; Franchini et al., 1994; McCormack et al., 2001).

Supplementation of VC to broiler diet may alleviate effect of heat stress on the performance of broiler chicks reared under heat stress (Kutlu and Forbes, 1993a; Kutlu, 2001; Çelik and Öztürkcan, 2003). Broiler chicken seems to have a special appetite for VC and tends to consume more diet supplementing VC at high temperature (Kutlu and Forbes, 2000). However, there are some reports that adding VC to poultry diets did not positively affect broiler (Stilborn et al., 1988; Marron et al., 2001; Erdoğan et al., 2005) and turkey performance (Dorr and Balloun, 1976; Değirmencioğlu and Ak, 2003) or decreased live weight of broilers (Njoku, 1986).

Therefore, the present study was conducted to determine the effects of dietary inclusion levels of vitamin C on performance, carcass composition and bone characteristics of male turkey during high summer temperature.

MATERIALS AND METHODS

Diets

Three experimental diets were formulated to provide a similar nutrient profile with the exception of using three graded levels of vitamin C, namely 0, 150, 300 mg per kg diet. Maize-wheat-soybean based diets were utilized and all were formulated using linear programming to be isoenergetic, isonitrogenic and to contain equal level of dry matter, crude fiber, crude ash, calcium, total phosphorus, sulphur amino acids and lysine. Therefore, the arrangement of treatments was: (1) C, control without any addition, (2) ascorbic acid (L-ascorbic acid, Rovimix® Stay C®35, specifically produced for use as a stabilized source of ascorbic acid in feed Roche, Levent-İstanbul, Turkey) was added at the rate of 150 mg per kg diet, (3) ascorbic acid was added at the rate of 300 mg per kg diet. Fresh feed with VC was mixed at 7 day intervals. Small amounts of the basal diet were first mixed with the respective amounts of vitamin C as a small batch, and then with a larger amount of

Table 1. The composition of diets at 0 to 18 weeks (%)

Ingredients	0 to 4 wk	4 to 8 wk	8 to12 wk	12 to 16 wk	16 to 18 wk
Maize	43.76	40.00	40.00	40.00	40.00
Wheat	-	9.81	21.25	29.42	36.04
Soybean meal	51.48	45.41	33.98	25.51	18.55
Vegetable oil	0.18	0.95	1.34	2.00	2.78
Vitamin-mineral premix[1]	0.25	0.25	0.25	0.25	0.25
Limestone	2.04	1.72	1.49	1.32	1.16
Mono calcium phosphate	1.85	1.45	1.18	1.08	0.87
Coccidiostat[2]	0.10	0.10	0.10	0.10	0.10
L-lysine	0.14	0.06	0.06	0.05	-
DL-methionine	-	0.05	0.15	0.07	0.05
NaCl	0.20	0.20	0.20	0.20	0.20
Chemical composition (%)[2]					
Dry matter	90.73	90.46	90.70	90.65	90.52
Crude protein	28.37	24.58	20.87	19.07	16.32
Crude fiber	4.08	3.40	3.14	3.35	2.64
Crude ash	7.78	6.85	5.37	5.72	4.94
Crude fat	2.46	3.11	3.20	3.66	3.97
Calcium	1.24	1.04	0.88	0.78	0.66
Available Phosphorus	0.57	0.48	0.41	0.37	0.32
Lysine	1.56	1.40	1.12	0.91	0.74
Methionine	0.46	0.41	0.39	0.34	0.27
ME (MJ/kg)	11.19	11.65	12.18	12.68	13.17

[1] Supplied per kg of the feed: Vitamin A, 15,000 IU; Vitamin D_3, 2,000 IU; Vitamin E, 40.0 mg; Vitamin K, 5.0 mg; Vitamin B_1 (thiamin), 3.0 mg; Vitamin B_2 (riboflavin) 6.0 mg; Vitamin B_6, 5.0 mg; Vitamin B_{12}, 0.03 mg; Niacin, 30.0 mg; Biotin, 0.1 mg; Calcium D-pantothenate, 12 mg; Folic acid, 1.0 mg; Colin Chloride, 400 mg; Manganese, 80.0 mg; iron, 35.0 mg; zinc, 50.0 mg; copper, 5.0 mg; iodine, 2.0 mg; cobalt, 0.4 mg; selenium, 0.15 mg.

[2] Calcium, available phosphorus, lysine, methionine and metabolizable energy (ME, MJ/kg) contents of feed was calculated according to NRC (1994).

the basal diet until the total amount of the respective diets were homogeneously mixed. The experimental diets used in this study are given in Table 1.

Experimental design and traits measured

A total of one hundred twenty day-old male BUT6 turkey chicks were individually weighed, wing banded and distributed into three treatments with 5 replicate pens and 8 chicks per pen. Each floor pen was furnished with wood shavings litter and population density of 3.2 birds/m^2.

Toms were weighed individually at 0, 4, 8, 12, 16 and 18 weeks of age. Body weight gains were calculated from 0 to 4, 4 to 8, 8 to 12, 12 to 16 and 16 to 18 weeks. Feed and water were offered *ad libitum*. Lighting was 24 h light from 0 to 3 d and 16 h light and 8 h darkness from 4 to 126 d of age. Total feed intake was measured per pen at 4, 8, 12, 16 and 18 weeks of age. Mortality was recorded daily. Feed intake and feed conversion ratio were adjusted for mortality.

This study was conducted during the months of May through September in Izmir, Turkey. This region is one of the very hot regions of Turkey in summer season. Temperature and humidity of the facility were recorded three times daily at 8:00 h, 15:00 h and 20:00 h.

Thirty toms were sampled randomly for carcass evaluations at 126 d of age and slaughtered. Their feathers were plucked mechanically, eviscerated by hand. Whole carcass, abdominal fat pad (excluding the gizzard fat), liver, empty gizzard and heart weights were recorded individually. Left breast meat without bone (only pectoralis muscles) and thigh portions were separated from carcass and weighed. Individual part yields were obtained as part weight: carcass weight ratio. Cold carcass weight was recorded after carcasses were kept at +4°C for 18 h.

In all, ten breast and thigh samples each group (totally 60 samples) were collected in plastic trays, weighed and stored in an air tight plastic bag in a freezer until samples were required for analysis, when they were homogenized using a blender and analyzed for dry matter, nitrogen, ether extract and crude ash. Dry matter content of feed, breast and thigh samples was determined by oven-drying at 105°C for 18 h. Ether extract content of feed, breast and thigh samples was obtained by the Soxhlet extraction using anhydrous diethyl ether. The Kjeldahl method was used for the analysis of total nitrogen content of feed, breast and thigh samples and crude protein was expressed as nitrogen×6.25 (AOAC, 1980). Crude ash content was determined after heating in a muffle furnace at 550°C for 16 h. The crude fibre content of feed was determined using 12.5% H_2SO_4 and 12.5% NaOH solutions (Nauman and Bassler, 1993).

The pH value of the samples was determined with a pH meter (Hanna Instruments-8413) and measured using a direct probe by thrusting the probe into the breast and thigh. The colors of breast and thigh were measured using a Minolta colorimeter (CM508d) to measure CIE Lab values (L* measures relative lightness, a* relative redness and b* relative yellowness).

The left tibia bones were removed. Bones were cleaned of adheral tissues, then weighed; length and width (at midpoint) were measured with a digital caliper. Bones were frozen at -20°C until analyses. After thawing to room temperature bone breaking strength was determined by Instron Testing Machine and the bones were subjected to test at the midshaft of each bone until they fractured (Norgaard and Nielsen, 1990). The ash content of tibia bone was determined after heating in a muffle furnace at 550°C for 16 h. The bones were ashed at 600°C for 24 h and ash percentage was calculated. At slaughter, right leg was removed from each carcass and tibia was examined for the prevalence of tibial dyschondroplasia (TD) (Edwards and Veltman, 1983).

Left shank length and width were measured with a caliper rule at 4, 8, 12, 16 and 18 weeks of age. Gait score was measured at 126 d of age. Turkeys were classified into 4 different categories by two observers consulting together at 126 d of age; 0: the bird walked normally; 1: the bird able to walk but had an obvious gait defect, 2: the bird walked only when driven 3: the bird did not walk (Yalçın et al., 1998).

Statistical analysis

Data were subjected to ANOVA using General Linear Models (SAS, 1996). The model included level of dietary VC content is presented. Pen means served as the experimental unit for statistical analysis. Means were separated using Duncan's multiple range tests. The results of statistical analysis were shown as mean values and standard error mean (SEM) in tables.

RESULTS AND DISCUSSION

Average temperature was 26.1±0.6, 31.5±0.3, and 31.7±0.3°C and average humidity was 50.8±1.2; 38.2±0.9 and 36.6±0.7 (%) respectively. Average livability value was 96.7±2.87 (%) for experiment and there were no treatment differences.

Body weight, body weight gain, feed intake and feed conversion ratio for the period from 0 to 18 weeks are presented in Table 2. Body weight, body weight gain, feed intake and feed conversion ratio were not affected by VC supplementation ($p>0.05$). However, body weights and body weight gains were numerically higher in toms fed on the 150 or 300 mg per kg of feed VC supplemented diet compared with control at the end of the experiment. No effects ($p>0.05$) of VC were found for feed intake and feed conversion ratio. However, feed intake was numerically higher in toms fed on the 150 mg per kg of feed VC

Table 2. Effects of ascorbic acid levels on body weight (kg), body weight gain (g), feed intake (g) and feed conversion ratio (feed/gain)

Trait	Period (wk)	Dietary ascorbic acid (mg/kg)			p*	SEM**
		0	150	300		
Body weight (kg)	0	0.059	0.057	0.058	0.729	0.001
	4	0.850	0.873	0.890	0.482	0.02
	8	3.22	3.26	3.23	0.936	0.09
	12	7.18	7.32	7.29	0.845	0.17
	16	11.17	11.34	11.47	0.556	0.20
	18	13.25	13.26	13.54	0.469	0.21
Body weight gain (g)	0-4	28.3	29.1	29.7	0.468	0.83
	4-8	83.9	84.8	83.2	0.896	2.42
	8-12	141.7	145.2	143.2	0.849	4.26
	12-16	143.2	143.7	147.0	0.637	3.12
	16-18	145.8	147.5	144.7	0.968	7.65
	0-18	104.5	106.9	107.0	0.468	1.55
Feed intake (g)	0-4	46.1	45.4	46.1	0.911	1.40
	4-8	174.0	181.8	178.0	0.383	3.84
	8-12	318.6	324.5	301.3	0.364	11.47
	12-16	457.3	454.3	448.5	0.906	14.28
	16-18	423.1	435.8	434.2	0.669	10.76
	0-18	283.6	287.2	282.8	0.812	3.46
Feed conversion ratio (feed:gain)	0-4	1.63	1.56	1.55	0.343	0.04
	4-8	2.03	2.15	2.12	0.650	0.09
	8-12	2.32	2.18	2.16	0.506	0.11
	12-16	3.11	3.09	3.21	0.677	0.10
	16-18	6.40	6.09	6.45	0.806	0.42
	0-18	3.10	3.01	3.10	0.812	0.10

* p: probability, ** SEM: pooled standard errors.

supplemented diet than that of toms fed on the 300 mg per kg of feed VC supplemented diet and control. The addition of VC at the rate of 150 mg per kg of feed numerically decreased the feed conversion ratio. Results of the present experiment indicate that the toms fed a diet with 150 or 300 mg per kg of feed VC during 0 to 18 weeks had no differences (p>0.05) in body weight, total feed intake and feed conversion ratio.

Studies with VC in the turkeys are very limited. There have not been consistent reports on the effects of VC on the performance of turkeys or broilers. Present results are in agreement with the finding of some researchers, in contrast the others. These results may be related mainly nutrient composition of the diet, levels of VC or its form and managerial or environmental conditions. Dorr and Balloun (1976) found no difference in performance of turkey poults at 8 and 12 weeks when VC was incorporated at the rate of 3,000 mg per kg diet at normal temperature. Değirmencioğlu and Ak (2003) found that including VC in turkey diets at 0, 50, 100 and 150 ppm did not significantly affect body weight gain, feed intake and feed conversion ratio during 70-154 days of age in autumn season. The studies with broiler chickens showed that 0 to 1000 ppm doses of VC supplementation to the diets did not affect body weight, body weight gain and feed conversion ratio (Pardue et al., 1985b; Stilborn et al., 1988; Marron et al., 2001; Erdoğan et al., 2005). However, Al-Taweil and Kassab (1990) and Lohakare et al. (2005) noted that VC supplementation increased body weight but did not affect feed intake and feed conversion ratio (Lohakare et al., 2005). It is reported that VC did not improve livability in broiler chicks (Pardue et al., 1985b) and quails (Ipek et al., 2007).

Dietary supplementation of VC (150 to 1,000 mg/kg) increased performance traits of broilers under heat stress (Pardue et al., 1985a; Kutlu and Forbes, 1993a, b; Kassim and Norziha, 1995; McKee and Harrison, 1995; McKee et al., 1997; Sahin et al., 2003a; Lohakare et al., 2005) and in quail (Sahin et al., 2003). On the other hand, the broilers receiving VC with drinking water (500 mg/kg) improved body weight gain and feed conversion ratio (Çelik and Öztürkcan, 2003). Contrary to the results above, Njoku (1986) concluded that VC reduced the body weights of broilers.

None of bone characteristics influenced by dietary VC (p>0.05) (Table 3). Shank width and length at 28, 56, 84, 112, and 126 days of age were not affected by VC levels. Vitamin C levels did not significantly affect weight, length, width and ash content of tibia and tibia strength at 126 days of age. Dorr and Balloun (1976) found that dietary VC did not affect femur mineralization, but femur mass reduced by dietary VC (3,000 mg/kg) in turkey poults. Studies with broilers have shown that VC supplementation to diet did not affect bone properties (Rowland et al., 1973; Orban et al.,

Table 3. Effects of ascorbic acid levels on length (cm) and width (mm) of shank and tibia bones, tibia strength (kg-force), weight (g) and ash content (%) of tibia

Weeks		Dietary ascorbic acid (mg/kg)			p*	SEM**
		0	150	300		
Shank traits						
4	Length	5.95	6.01	5.91	0.802	1.02
	Width	7.8	7.85	8.03	0.489	0.14
8	Length	10.48	10.63	10.42	0.439	1.14
	Width	12.3	14.0	11.9	0.530	1.43
12	Length	14.88	17.68	14.64	0.382	1.7
	Width	13.8	13.6	13.6	0.270	0.11
16	Length	16.97	17.37	17.34	0.280	1.98
	Width	15.2	16.8	14.7	0.316	0.21
18	Length	17.45	17.62	17.69	0.229	2.12
	Width	15.8	17.4	15.5	0.339	0.26
Tibia traits						
18	Length	23.72	23.78	24.03	0.558	2.14
	Width	14.85	14.30	14.71	0.276	0.25
	Wet weight	103.44	103.67	104.72	0.883	1.93
	Breaking strength	62.9	59.1	60.7	0.903	5.97
	Crude ash	36.00	35.50	37.23	0.379	0.89

* p: probability, ** SEM: pooled standard errors.

Table 4. Effects of ascorbic acid levels on some carcass traits (%)

Trait	Dietary ascorbic acid (mg/kg)			p*	SEM**
	0	150	300		
Slaughter weight (kg)	13.58	13.83	14.47	0.089	0.28
Carcass yield	82.7	82.6	82.5	0.431	0.29
Breast meat yield	13.7	13.9	14.0	0.896	0.32
Thigh	29.5	29.0	28.7	0.592	0.56
Neck	4.1	4.3	4.2	0.619	0.16
Liver	1.3	1.4	1.3	0.583	0.06
Heart	0.38	0.38	0.38	0.981	0.02
Empty gizzard	1.56	1.38	1.36	0.072	0.07
Wing	12.4	12.8	12.2	0.099	0.20
Abdominal fat pad	0.60	0.52	0.54	0.740	0.07

* p: probability, ** SEM: pooled standard errors.

1993; McCormack et al., 2001). However, it is showed that dietary supplementation VC could increase tibia breaking strength (Chee et al., 2005; Lohakare et al., 2005) and ash (Lohakare et al., 2005) in broilers.

In the present study, treatment did not affect walking ability scores of toms at 126 d of age. There were two toms with score 1 and one tom score 3 in control group and one each tom with score 1, score 2, score 3 in toms fed on the 150 mg per kg of feed VC supplemented diet and one tom with score 3 in toms fed on the 300 mg per kg of feed VC supplemented diet but differences were not significant. Interestingly, there was no tom with TD neither in control nor treatments. This should be because of selection and genetic studies have been done on TD. Edwards (1989), Roberson and Edwards (1994) and Leach and Burdette (1985) did not find any effect of dietary VC (100 to 500 ppm) on TD in broilers.

It is generally assumed that the role of VC in bone metabolism is limited to hydroxylation of proline for formation of collagen and bone matrix during the growth phase of bone (Orban et al., 1993). Moreover, Thornton (1968) reported that VC seemed to enhance the reduction in ossification of the epiphysical plate, mineralization of new cancellous bone and the reduction in the degrees of calcification of both types. So, this might partially explain why bone properties were not appreciably affected in the present study.

Carcass and breast meat yield, abdominal fat pad, neck, liver, heart, empty gizzard, thigh and wing proportions were not influenced by VC levels ($p>0.05$) (Table 4). Dietary VC did not affect carcass yield and its parts but in the control group percentage of empty gizzard aimed to be higher than others. In particular decreasing abdominal fat pad with supplemental VC is attracting to attention. These results agreed with Değirmencioğlu and Ak (2003). They found that 0, 50, 100 and 150 ppm VC did not have significant effects on the slaughter weight, carcass and abdominal fat proportion of the turkeys. Lohakare et al. (2005) found that

Table 5. Effects of ascorbic acid levels on thigh and breast composition (%)

		Dietary ascorbic acid (mg/kg)				
		0	150	300	p*	SEM**
Trait						
Thigh	Dry matter	25.77	26.09	26.35	0.709	0.48
	Crude protein	22.91	23.26	23.60	0.704	0.56
	Crude fat	1.81	1.77	1.66	0.965	0.40
	Crude ash	1.05	1.07	1.09	0.518	0.02
Breast	Dry matter	26.87	27.79	26.71	0.330	0.53
	Crude protein	23.98	24.69	23.77	0.598	0.66
	Crude fat	1.79	1.96	1.77	0.912	0.35
	Crude ash	1.11	1.14	1.17	0.398	0.03
Color of thigh and breast						
Thigh	L*	47.86	47.19	48.90	0.475	1.76
	a*	9.80	10.59	8.80	0.226	0.75
	b*	8.04	7.34	6.20	0.769	1.11
Breast	L*	45.96	46.02	47.25	0.757	1.40
	a*	5.17	6.21	6.03	0.267	0.46
	b*	5.10	4.94	5.49	0.544	0.41

* p: probability, ** SEM: pooled standard errors.
L*: relative lightness, a*: relative redness, b*: relative yellowness.

0, 10, 50, 100 and 200 ppm VC did not have significant effects on abdominal fat and decreased breast weight. Fletcher and Canson (1991) also reported that treatment with VC during broiler rearing (973 mg/L tap water) had no effect on carcass processing yields. However, some studies suggested that supplementing 250 ppm VC to the broiler rations increased carcass weight (Kutlu, 2001; Şahin et al., 2003a; Lohakare et al., 2005), liver, heart, spleen and empty gizzard weight (Şahin et al., 2003a) but decreased abdominal fat pad with 250 or 300 ppm VC (Kafri et al., 1988; Şahin et al., 2003a).

Supplementation of VC to turkey diets did not affect dry matter, crude protein, crude fat and crude ash in thigh and breast meat ($p>0.05$) (Table 5). Kutlu (2001) find that inclusion of 250 ppm VC in the broiler ration increased carcass protein but decreased fat content. Dietary VC supplementation to the turkey fattening rations did not influence color of thigh and breast muscles of toms ($p>0.05$) (Table 5). Similar results were obtained by Lohakare et al. (2004) in broilers and Peeters et al. (2006) in porks. On the other hand, Lohakare et al. (2005) determined that ascorbic acid positively affected meat color and increased L* and a* values while lowered b* values during summer months in broilers. Seasonal heat stress has been linked to an increased incidence of pale soft exudative (PSE) meat in turkeys (McCurdy et al., 1996). Providing VC before slaughtering did not affect meat pH, color and water holding capacity in broiler chickens (Young et al., 2003) and swine (Pion et al., 2004).

In the present study, the highest measured temperature was 31.7°C. Positively responded studies to VC supplementation were conducted at higher temperature than current study (36°C; Kutlu and Forbes, 1993a). However, our study was carried out in a practical condition that had natural summer heat condition in which house temperature varied between 26.1 to 31.7°C. Therefore, probably turkeys may be adjusted diurnal feed intake at lower temperature in morning early hours. On the other hand, Balnave (2004) reported that temperature stress begins to occur when ambient temperature rises above 25°C if a bird is acclimated to a low temperate, but in semitropical and tropical areas birds is acclimated at high temperatures. Therefore, in these areas, temperatures below 32°C are not considered unduly oppressive and much higher temperatures must be accepted. Similarly, birds adapt better to a high daily maximum temperature when the night temperature falls to 25°C or lower. This knowledge is correcting our results, because work area is a semitropical and night house temperature probably below to 25°C. In the other hand, standing of heat stress of turkeys better due to heat dissipation from their relatively large wattles (Yahav, 1998).

There are a lot of literature on vitamin C and heat stress in poultry. However, as indicated that in the paper, the results have been inconsistent. The reported work failed to demonstrate and beneficial effects of vitamin C supplementation in turkeys under hot conditions. There is a possibility that the ambient temperature was not high enough to cause significant changes in performance and carcass characteristics. The benefits of vitamin C supplementation to poultry would be more obvious under higher temperature. Whitehead and Keller (2003) reported that it is difficult to establish the degree of stress experienced by birds under practical conditions; responses to dietary VC have been more variable in poultry.

In conclusion, in the present study, adding VC to tom ration did not affect body weight, body weight gain, feed intake and conversion ratio, carcass, meat and bone properties. This experiment results did not suggest that dietary supplementation with VC had benefit for measured characteristics during hot summer season of turkey poults. Moreover there were a number of fundamental differences among reports, including the basal diets, genetic stocks used, and length of the experiments. Studies with VC in turkey rations and effectiveness are very limited. Further experiments should need to be conducted to determine whether the effect of VC at different condition in turkeys.

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