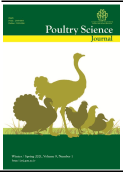

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Effect of Adding Watermelon Juice, Vitamin E-Selenium, and Vitamin C into the Drinking Water on Growth Performance, Internal Organs' weight and Prececal Nutrient Digestibility in Broilers under Heat Stress

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Abstract

This study investigated the effect of adding watermelon juice, vitamin E-selenium and vitamin C to the drinking water on growth performance, internal organs' weight, and prececal nutrient digestibility in broilers under heat stress. Two hundred and fifty Hubbard F15 day-old broilers were allocated to five treatments with five replicates of 10 broilers per each replicate, based on a completely randomized design. The birds in the control treatment did not receive any supplement in drinking water and reared in thermoneutral temperature. Birds in the other four treatments received watermelon juice at 60% or 30%, vitamin C at 50 mg/L, or vitamin E-Selenium at 1 mL/L of drinking water during the heat stress period. Heat stress applied for 9 hours from day 12 onward. Results indicated birds that received 60% watermelon juice had similar body weight and feed intake compared to control birds. The relative weight of proventriculus, intestine length, and prececal dry matter nutrient digestibility was significantly higher in 60% watermelon juice treatment than other treatments. It is concluded that watermelon juice supplementation at 60% concentration into the drinking water could improve the performance of birds reared under heat stress as a result of restoring water and feed intake and also better prececal dry matter digestibility.

Introduction

In many world regions, chickens are rearing under heat stress in which environmental temperature exceeds the standard limits. Heat stress causes a significant reduction in feed intake, feed efficiency, body weight gain, immunity, and carcass quality especially when birds rise in a high-density condition. Heat stress leads to increased lactate production; reducing meat pH value by accelerating meat glycolysis, and eventually reducing meat quality in poultry (Zhang *et al*., 2012). Branton *et al.* (1986) reported that the imbalance of blood electrolytes and alkalosis in birds under heat stress leads to death after some hours. This is responsible for huge economic loss in the poultry industry. In the United States, for example, heat stress results in an annual loss of over 100 million dollars in poultry farms (Mohammed *et al*., 2019).

Some researchers reveal that heat stress leads to increasing pro-oxidants like superoxide and hydroxyl radicals but reducing vitamin C production by the chicken's kidney, resulting in decreased levels of it in the blood or adrenal gland (Pardue & Thaxton, 1986; Ross Breeder Limited, 1999). These risk factors finally cause the shortage of vitamin E and vitamin C in the body, as the essential active antioxidants in the cell membrane and cytoplasm, respectively (Allen, 1997). In other words, there is a strong connection between vitamin E and most bodies' biological activities, preventing many deficiency diseases in most animal species (Erf & Bottje 1996; Jiang *et al*., 2013; Habibian *et al*., 2014). Vitamin E is likely to interfere with vitamin C production by simulating coenzyme Q (Leeson & Summers, 2001).

In higher environmental temperatures, e.g., more than 32°C, chickens do not consume enough water to fulfill their metabolic needs. This causes the reduction of growth performance and egg production (May & Lott, 1992). Belay and Titer (1993) showed a noticeable variation in water excretion in response to

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environmental temperature. They revealed that birds exposed to 35°C showed 133 percent more water excretion compared to those at 32°C, while water consumption increased only 78% during this period. Birds do not have sweat glands in their skin, so they lose their body heat through evaporation from the respiratory system. Feed intake is higher while the birds have access to water since the presence of enough water is necessary for digestion and nutrient absorption (Lepkovsky *et al*., 1960; Cooper & Washburn, 1998).

Watermelon (*Citrullus Lanatus thanb)* is a nutritious fruit containing various vitamins and minerals like thiamin, niacin, riboflavin, ascorbic acid, calcium, phosphorous, ferrous, and potassium, and also other compounds with antioxidant properties such as beta carotene, citron, and lycopene (Ko *et al*., 2005; Sogi *et al.,* 2010). Lycopene in watermelon is around 40 percent more than tomato (Holden *et al*., 1999). Figueroa *et al*. (2011) investigated the effect of watermelon' consumption on aortal blood pressure, especially on individuals with high blood pressure. This study showed that consumption of watermelon supplements for six weeks reduced brachial pulse pressure and aortic wave reflection. The citrulline in watermelon is converted to L-arginine which can regulate blood pressure. Previous studies have investigated the effectiveness of antioxidants to mitigate the adverse effect of heat stress on bird's performance (McKee & Harrison, 1995; Borges *et al*., 2004; Ko *et al*., 2005; Shakeri *et al*., 2020). Therefore, watermelon juice, as a natural source of antioxidants, along with vitamin C and Vitamin E-selenium are selected in the current study to assess their effects on growth performance, internal organs' weight, and prececal nutrient digestibility of broilers reared under heat stress condition.

Materials and Methods

This study applied 250 mixed male and female day-old broiler chickens of the commercial Hubbard strain in a completely randomized design with five treatments. Each treatment had five replicates, and each replicate included ten broiler chickens. Chickens were in one group for the first 11 days to adapt to the experiment environment. At the beginning of the 12th day, the chicks were weighed and randomly assigned to 25 one-square-meter pens made by plastic tubes and meshes. One bell drinker and one feeder were installed in each pen, and birds had free access to water and feed. The PVC isolation wall separated the experiment's place into two sections to prepare the thermoneutral and heat stress conditions after 11 days. In a thermoneutral state, the temperature was designed based on the management guide of Hubbard strain (Hubbard F15 Manual, 2015). Chickens in heat stress conditions were exposed to heat stress from day 12 onward. Birds were under heat stress in three stages every day (De Basilio *et al*., 2001). In stage one, from 11 to 12 o'clock, the hall temperature raised to 32°C. In stage two, from 12 to 19 o'clock, the hall temperature remained at 32°C. In stage three, from 19 to 20 o'clock, the hall temperature gradually reduced to the average temperature according to the age based on the management guidelines of the Hubbard strain.

For this study, diets were prepared based on corn and soybean meal as mash feed and formulated according to the commercial Hubbard strain's standard requirements (Hubbard F15 Manual, 2015) and WUFFDA software (Table 1). Chickens received the starter diet until their 11th day, the grower diet from the 12th day to the 33rd day, and the finisher diet from the 34th to 42nd day of age. The energy and protein density of the diets were the same for all treatments in each period. The Birds vaccinated against infectious bronchitis, Newcastle disease, and infectious bursal disease. Chickens followed the lighting program of Hubbard strain commercial recommendations.

Treatments were as follows. The birds in the control treatment did not receive any supplement in drinking water and reared in thermoneutral temperature. Four other treatments were the birds under heat stress conditions and received watermelon juice at 60% or 30%, vitamin C at 50 mg/L, or vitamin E-Selenium at 1 mL/L in drinking water based on manufactured company advice every other day. Each litter of E-Selen® solution (C-Vet 50®, Daroupakhsh Distribution Vet. Company, Iran) contained 100 g vitamin E and 0.5 g sodium selenite. Each kg of C-Vet 50® (E-Selen®, Afagh Pharmaceutical Company, Iran) contained 500 g L-ascorbic acid. Treatments with 60 and 30 percent watermelon juice had 100 and 50 percent of vitamin C content that was included in the vitamin C Treatment. Vitamin C content in watermelon juice was considered around 80 mg/L based on USDA (2018) food composition databases.

Bird's performance parameters, including daily body weight gain, final average body weight, daily feed intake, feed conversion ratio, dressing percentage, and prececal nutrient digestibility, were measured. The mean body weight of birds and mean feed intake in each pen were recorded at the first and the end of each week. Water consumption in heat stress and thermoneutral conditions was recorded daily. In heat stress conditions, a water supplement was administrated every other day. Therefore, water consumption recorded separately for the days supplemented or the day not supplemented. The feed conversion ratio was calculated by dividing daily feed intake by daily body weight gain. At the end of the experiment, each pen's chickens were weighed and slaughtered, and one male bird from each pen was considered for carcass traits measurements. After killing, the weight of gizzard, intestine (from

Meckel's diverticulum up to 2 cm before the junction of the intestine to the cecum), pancreas, carcass, and so on and the length of the intestine from Meckel's diverticulum up to 2 cm before the cecum were measured. Intestine pooled digesta samples of nine birds in each pen were collected. Digesta was kept at -20°C to perform the proximate analysis of nutrients afterward.

Table 1. Composition of starter, grower, and finisher diets

Ingredients	Starter (1-11 day)	Grower (12-33 day)	Finisher (34-42 day)
Corn Grain (8.8% CP)	55.73	57.49	59.50
Soybean meal (44% CP)	35.68	33.75	30.97
Soybean oil	3.71	4.22	5.38
Di Calcium Phosphate	1.92	1.67	1.44
Calcium Carbonate	1.16	1.32	1.21
D L Methionine	0.34	0.30	0.26
L-Lysine HCl	0.31	0.15	0.13
L-Threonine	0.11	0.07	0.06
Vitamin Premix [1]	0.25	0.25	0.25
Mineral Premix [2]	0.25	0.25	0.25
Salt	0.15	0.20	0.15
Sodium Bicarbonate	0.34	0.28	0.35
Anti-Coccidiosis	0.05	0.05	0.05
Nutrient composition			
ME (Kcal/kg)	3000	3050	3150
Crude protein (%)	21.00	20.10	18.99
Lysine digest (%)	1.23	1.06	0.98
Methionine + Cystine digest (%)	0.90	0.85	0.78
Threonine digest (%)	0.78	0.72	0.67
Calcium (%)	1.00	1.00	00.9
Available Phosphorus (%)	0.50	0.45	0.40
Sodium (%)	0.16	0.17	0.17
Chloride (%)	0.15	0.19	0.15
Potassium (%)	0.85	0.85	0.80

[1]Each g of vitamin premix contain: Vitamin A, 7500 IU; Vitamin D3, 3000 IU; Vitamin E, 10 IU; Vitamin K, 2 mg; Vitamin B12, 12.5 µg; folic acid, 0.5 mg; pantothenic acid, 8 mg; pyridoxine 1.8 mg; riboflavin, 5.3 mg; thiamine, 2 mg; biotin, 0.15 mg; choline, 350 mg. [2]Each g of mineral premix contain: iodine; 1 mg. ; selenium, 0.15 mg; niacin, 24 mg; copper; 6 mg; iron, 30 mg; zinc, 50 mg; manganese, 80 mg.

To calculate prececal nutrient digestibility, the nutrient content of feed and ileal samples were analyzed by proximate analysis method (AOAC, 2006). Acid Insoluble Ash (AIA) as an internal marker was measured in feed and digesta samples to calculate the prececal nutrient digestibility (De Coca-Sinova *et al.*, 2011). The prececal nutrient digestibility (Pc D) of dietary nutrients was calculated based on equation 1 (Scott & Hall, 1998).

(Equation 1)

$$\text{Pc D} = 100 - (100 \times ((\text{diet nutrient} / \text{ileal nutrient}) \times (\text{ileal AIA} / \text{diet AIA}))$$

Statistical analysis

For all parameters, except prececal nutrient digestibility and weight of the internal organs, birds' weight at the first of the experiment (12^{th} d of age) was considered as a covariate. Statistical analysis of data was performed using the GLM procedure of SAS software version 9.4 (SAS, 2013), and mean least squares of treatments were compared at a 5% probability level. All data were analyzed for statistical normality using the Shapiro-Wilk test before statistical analysis. The mathematical of the statistical design was as follow:

$$y_{ijk} = \mu + T_i + \beta\,(Wij - \overline{W}) + e_{ijk} \qquad \text{(Equation 2)}$$

Where: y_{ijk} = y^{th} observation in the i^{th} level of treatment and j^{th} level of replication, μ = overall mean, T_i = effect of i^{th} level of treatment, β = regression coefficient of the studied traits on body weight at 12^{th} d, w_{ij} = body weight of i^{th} level of treatment and j^{th} level of replicate, $\overline{W}$= average body weight of birds at 12 d and e_{ij} = residual effect with mean 0 and normal distribution.

Results

The effect of treatments on daily body weight gain (BWG), daily feed intake (FI), feed conversation ratio (FCR), and final live body weight (BW) of broilers in grower and finisher and total rearing stages are shown in Table 2. According to the results, birds in the control treatment (without stress condition) showed the highest BWG in grower and total stages, highest FI in the finisher and total stages, and the highest BW at the end of the experiment significantly ($P < 0.01$). It is important to mention that the second-highest level of BWG and FI during these stages was related to watermelon 60% treatment. The final body weight in this treatment was as high as the control treatment. It showed that almost the highest performance of birds was related to watermelon 60% among heat stress treatments. The feed conversion ratio was the same among all treatments.

Table 2. Productive parameters of broilers received watermelon juice, vitamin E-selenium, and vitamin C under heat stress conditions

Treatment	daily weight gain (g/d)			daily Feed intake (g/d)			FCR			Final Body weight (g)
	Grower	Finisher	Total	Grower	Finisher	Total	Grower	Finisher	Total	
Control	69.30^{a}	100.82	77.18^{a}	92.68	164.37^{a}	110.60^{a}	1.33	1.64	1.43	2547^{a}
Watermelon 60%	66.61^{b}	87.27	71.77^{b}	90.32	155.04^{b}	106.50^{ab}	1.35	1.81	1.48	2471^{ab}
Watermelon 30%	64.53^{bc}	79.46	68.27^{c}	87.20	142.15^{c}	100.94^{b}	1.35	1.79	1.47	2359^{c}
Vitamin C	62.33^{c}	83.17	67.54^{c}	87.13	143.95^{c}	101.34^{b}	1.39	1.75	1.50	2341^{c}
Vit E-Selenium	64.08^{bc}	81.86	68.52^{bc}	88.69	144.29^{c}	102.52^{b}	1.38	1.81	1.49	2367^{b}
SEM	2.444	10.654	2.266	4.150	5.606	3.766	0.054	0.238	0.060	73.3
P-value	0.0042	0.0689	≤.0001	0.1886	≤.0001	0.0043	0.5643	0.8257	0.5872	0.0001

The chickens received the starter diet until their 11th day, the grower feeds were fed from the 12th day to the 33rd day and the finisher from the 34th day to the 42nd day of age.

$^{a,b\ c}$ Means within a column that do not have a common superscript are significantly different ($P < 0.05$).

Results of prececal nutrient digestibility were only significant for prececal dry matter digestibility ($P < 0.05$). Birds in sixty percent of watermelon treatment had significantly higher prececal dry matter digestibility than those in the vitamin C and control treatments (Table 3).

Table 3. Prececal nutrient digestibility of birds received watermelon juice, vitamin E-selenium and vitamin C under heat stress conditions

Treatment	Prececal nutrient digestibility			
	Dry Matter	Crude Protein	Etheric Extract	Ash
Control	56.84^{b}	43.83	73.90	27.45
Watermelon 60%	64.99^{a}	50.41	80.86	33.60
Watermelon 30%	57.57^{ab}	45.78	78.40	25.89
Vitamin C	51.07^{b}	47.03	75.29	32.84
Vit E-Selenium	58.57^{ab}	50.70	59.34	42.49
SEM	5.844	14.364	8.615	11.952
P-value	0.0288	0.9415	0.2289	0.2877

$^{a,\ b,\ c}$ Means within a column that do not have a common superscript are significantly different ($P < 0.05$).

Table 4. Carcass parameters of birds received watermelon juice, vitamin E-selenium and vitamin C under heat stress condition

Treatment	Carcass parameters (percent of live body weight)										
	Gizzard	Liver	Gallbladder	Pancreas	Intestine Length (cm)	Intestine Weight	Proventriculus	Heart	spleen	Bours	Cecum
Control	1.72	1.80	0.08	0.11	87.50^{b}	2.63	0.30^{b}	0.44	0.10	0.05	0.46
Watermelon 60%	1.99	1.73	0.09	0.11	95.00^{a}	2.68	0.41^{a}	0.52	0.09	0.08	0.53
Watermelon 30%	1.93	1.23	0.08	0.20	74.00^{b}	2.70	0.37^{ab}	0.45	0.09	0.07	0.62
Vit C	1.88	1.68	0.09	0.15	79.40^{b}	2.77	0.35^{ab}	0.42	0.08	0.10	0.50
Vit E-Selenium	2.01	1.61	0.06	0.13	86.06^{ab}	2.94	0.32^{b}	0.42	0.09	0.05	0.57
SEM	0.208	0.336	0.026	0.040	10.002	0.512	0.042	0.088	0.018	0.021	0.100
P-value	0.2779	0.3062	0.5242	0.0641	0.0385	0.9372	0.043	0.5363	0.9255	0.2073	0.2231

$^{a,\ b,\ c}$ Means within a column that do not have a common superscript are significantly different ($P < 0.05$).

The effect of experimental treatments on carcass parameters of broiler chickens on slaughtering day is reported in Table 4. The treatments had a significant impact on the length of the intestine and proventriculus weight. The results showed that 60% watermelon treatment had the highest and watermelon 30%, and vitamin C the lowest intestine length. Besides, the watermelon 60 % treatment had the highest proventriculus relative weight and the control, and vitamin E-Selenium treatments the lowest one.

Because the supplements were added to the water every other day, the effects of experimental treatments on daily water intake (WI) and feed intake (FI) of broilers were investigated in the following three stages (Tables 5): 1- Non- heat stress hours without supplements. 2- Heat stress hours without supplements and 3- Heat stress hours with supplements.

The results showed that under heat stress conditions, the WI of birds was significantly affected by treatments ($P < 0.05$). The presence of supplements significantly changed the WI of broilers under heat stress conditions. The water intake of broilers that received 60% of watermelon was significantly lower compared to control and other treatments. However, a comparison of means when the birds were in a heat stress condition and without supplementation showed that the control treatment consumed the least WI. According to the results, the supplementation of vitamin E-Selenium or vitamin C to the bird's water in heat stress conditions could not prevent their water's increasing demand. The highest amount of WI was in these treatments.

Table 5. Daily water intake of broilers in one hour (mL/h) in three stages of non-heat stress, heat stress without water supplements, and heat stress condition with water supplements

Treatment	Average daily water intake (mL/h)		
	No Stress – No Supplements	Stress – No Supplements	Stress – Supplements
Control	11.66	12.41^{c}	12.14^{b}
Watermelon 60%	12.58	12.63^{bc}	10.57^{c}
Watermelon 30%	12.28	13.43^{ab}	12.55^{b}
Vit C	12.27	12.66^{bc}	13.58^{a}
Vit E-Selenium	11.88	13.50^{a}	14.11^{a}
SEM	0.842	0.556	0.708
P-value	0.5817	0.0142	≤.0001

$^{a, b, c}$ Means within a column that do not have a common superscript are significantly different ($P < 0.05$).

Paired t-tests for water and feed intake in heat stress conditions were compared between the days birds received and the days not received oral supplementations (Table 6). As mentioned previously, the water-soluble treatments administrated every other day. These tests showed that birds' WI in 60% watermelon, 30% watermelon, vitamin C, and vitamin E-selenium treatments were significantly different in the supplemented vs. non-supplemented days. In contrast to vitamin C and vitamin E-Selenium treatments, watermelon treatments' WI was lower on the days that birds received the treatment compared to the days they did not receive it. T-test results of feed intake shown in Table 6 also demonstrated that watermelon supplements or vitamin C could improve the adverse effects of heat stress on feed intake. Still, this effect for vitamin E-Selenium was not relevant.

Table 6. T-test comparison of water intake (mL/h) and feed intake (g/d) of broilers during heat stress condition with soluble supplements and without soluble supplements.

Treatment	Average Water intake in Stress hours (mL/h)		*SEM*	*P*-value	Average Feed intake in Stress hours (g/d)		*SEM*	*P*-value
	T-test				T-test			
	Without Supplements	With Supplements			Without Supplements	With Supplements		
Watermelon 60%	12.60 ^{a}	10.57 ^{b}	0.970	0.0106	107.51 ^{b}	109.6 ^{a}	4.832	0.0447
Watermelon 30%	13.43 ^{a}	12.55 ^{b}	0.325	0.0145	104.43 ^{b}	106.3 ^{a}	2.624	0.0252
Vit C	12.66 ^{b}	13.58 ^{a}	0.695	0.0071	104.42 ^{b}	107.3 ^{a}	3.753	0.0368
Vit E-Selenium	13.50	14.11	1.371	0.1000	102.53	108.9	4.527	0.0631

$^{a, b}$ Means within a row that does not have a common superscript are significantly different ($P < 0.05$)

Discussion

According to this experiment's results, birds' average final body weight was at the maximum level in the control and 60 % watermelon treatments. Probably 60% watermelon treatment had this superior performance due to its benefits, including ideal nutrients and electrolytes (Ko *et al.*, 2005; Sogi *et al.*, 2010; Tarazona-Diaz *et al.*, 2011). The birds in this treatment under heat stress were able to gain total body weight similar to the control treatment reared in thermoneutral conditions. Mitigation of the adverse effect of heat stress by watermelon supplement was also reported in previous reports (Bottje & Harrison, 1985). Teeter & Smith (1986) reported that heat stress caused electrolyte imbalance and alkalosis by increasing blood pH which subsequently leads to reduced feed intake, growth and nutrition efficiency, and increasing mortality. McKee & Harrison, (1995) reported that ascorbic acid, particularly at 150 ppm, enhances the performance of broiler chicks exposed to multiple concurrent environmental stressors. Shakeri *et al.*, (2020) showed that the synergistic effects of selenium and vitamins E and C enhance growth performance in broiler chickens challenged with acute heat stress, employing multiple mechanisms. Emerging literature revealed that selenium and vitamins E and C have close interactions to protect proteins and lipids from oxidative damage and a combination of them can be considered as an important solution to cope with heat stress (Erf & Bottje, 1996; McKee & Harrison, 2014; Habibian *et al*., 2014; McKee & Harrison, 1995; Borges *et al*., 2004; Ko *et al*., 2005; Shakeri *et al*., 2020). Both vitamins C and E play an important role in the body, for example: scavenging oxygen radicals and improving the function of the immune system. Furthermore, vitamin C regenerates vitamin E by reducing the radicals formed (Shakeri *et al*., 2020). Meanwhile, selenium is involved in the glutathione pathway, which is a part of the ascorbate cycle (Shakeri *et al*., 2020). This synergic effect among nutrients in watermelon juice may be the reason for better performance in watermelon juice 60% treatment.

Total daily feed intake in 60% watermelon was similar to control treatment and significantly higher than the other treatments. The reason for this increase in feed intake in 60% watermelon treatment could be the higher potassium concentration and better electrolyte balance in watermelon treatment (Sogi *et al*., 2010). This result is consistent with research by Borges *et al*. (2004) that reported the addition of electrolyte supplements such as sodium bicarbonate and potassium chloride to drinking water or feed increased feed intake and thus improved broiler growth in hot climates.

The feed conversion ratio for treatments under heat stress was the same as the control treatment in thermoneutral conditions. Birds could counteract the adverse effect of high temperature by consuming dietary antioxidants such as vitamin C and E, beta-carotene, citrulline, Lycopene, and L arginine (McKee & Harrison, 1995; Ko *et al*., 2005; Figueroa *et al*., 2011). Researchers showed that free radicals released during heat stress have many drastic adverse effects on feed conversion ratio (Bottje & Wideman, 1995; Bottje *et al*., 1997). Indeed, the presence of antioxidants in water or feed can counteract the harmful effects of free radicals produced in birds reared under heat stress (Nockels, 1973; McKee & Harrison, 1995; Allen, 1997). Ascorbic acid can reduce the heat load by reducing body heat production or increasing heat loss by affecting the heat exchange between the environment and body (Kutlu & Forbes, 1993).

Prececal dry matter digestibility in 60% watermelon treatment was higher than in the other treatments. This better dry matter digestibility may be due to the enhancement of the gastrointestinal tract's efficiency, consistent with carcass parameters like intestine length and proventriculus. Since heat stress has adverse effects on digestibility (Hurwitz *et al*., 1980), feed intake, and retention of some nutrients (Bonnet *et al*., 1997), watermelon supplementation was able to counteract these adverse effects. Interestingly, in birds that received 60% watermelon level; the prececal nutrient digestibility was better than control treatment without any stress.

Comparing water intake among heat stress treatments showed significant differences due to the different consuming water quality. The lowest water intake was in 60% watermelon treatment under heat stress conditions. Birds in vitamin C and vitamin E-selenium supplemented treatments consumed more water than watermelon treatments. The changes can be related to different water quality, especially potassium contents of treatments (Huston, 1978; Smith & Teeter, 1987; Deyhim & Teeter, 1991; Ait-Boulahsen *et al*., 1992; Ait-Boulahsen *et al*., 1995).

The T-test results for feed intake showed that in all treatments except vitamin E-selenium, feed intake was significantly higher in the presence than in the absence of the supplement treatment. Researchers showed that vitamin C supplementation could positively affect birds' feed intake and performance when the flock exposes to various stressors (van Niekerk *et al*., 1989). Controversy in watermelon and vitamin C supplemented treatment; water intake was lower in supplemented hours than non-supplemented ones. It reveals that only these treatments could compensate for heat stress's negative effect without increasing water intake. Some researchers showed the negative impact of higher water intake on prececal nutrient digestibility during heat stress conditions (Hurwitz *et al*., 1980; Bonnet *et al*., 1997). The birds with 60% watermelon supplementation under heat stress conditions could restore their water and feed intake records. Sixty percent watermelon juice treatment could induce better prececal dry matter digestibility and carcass parameters in birds under heat stress and finally improved the bird's performance.

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