



## Effect of Organic Chromium on Performance, Physiological and Anti-oxidative Stress Indicators of Growing Japanese Quail under High Ambient Temperature



Waleed M. Dosoky<sup>1\*</sup>, Hassan S. Zeweil<sup>1</sup>, Soliman M. Zahran<sup>1</sup>, Tarek A. Ebeid<sup>2</sup>, Ayman M. Khalifah<sup>3</sup> and Walaa A. Kashyout<sup>11</sup>

*Department of Animal and Fish Production, Faculty of Agriculture (Saba Basha), Alexandria University,*

<sup>2</sup> *Department of Poultry Production, Faculty of Agriculture, Kafrelsheikh University, 33516 Kafr El-Sheikh,*

<sup>3</sup> *Department of Livestock Res., Arid Lands Cultivation Res. Instit., City of Scientific Res. and Technological Applications, New Borg El-Arab, P.O. Box 21934, Alexandria, Egypt*

**T**HIS STUDY was designed to determine the effect of Chromium methionine (CrMet) at different levels on growth parameters, blood constituents, immunity, and anti-oxidative properties of growing Japanese quail. A total of 150 at 7-days old unsexed Japanese quail chicks were randomly distributed to five dietary treatments of thirty birds to a treatment. Each treatment was replicated three times with ten birds to replicate. Five isocaloric and isonitrogenous diets were formulated. CrMet was added to the basal diet at five different levels being 0, 200, 400, 600, and 800 mg /kg diet, respectively. CrMet supplementation improved body weight (BW) at 6 weeks of age by 2.3% compared with those on diet 1 (control). Feed intake (FI) increased gradually by increasing CrMet levels in the diets compared with the control group and the group fed on 200 mg CrMet /kg diet. The best ( $P \leq 0.05$ ) value of feed conversion ratio (FCR) was noticed in group fed 600 mg CrMet /kg as compared with other experimental groups. CrMet improved ( $P \leq 0.01$ ) the thymus, heart and testes weights, white blood cell (WBC) counts, hemoglobin (Hb), packed cell volume (PCV%), monocytes, albumin/globulin ratio and aspartate aminotransferase (AST) of growing Japanese quail. While, albumin, total lipids, cholesterol, triglycerides, and lipid peroxide concentrations contents significantly ( $P \leq 0.01$ ) decreased. In summary, the inclusion of CrMet in growing quail diets may exert beneficial effects on growth parameters, blood constituents, immunity, and anti-oxidative properties.

**Keywords:** Chromium methionine, Growth performance, Blood, Antioxidative properties, Immune response, and Japanese quail.

### Introduction

High ambient temperature, especially when merged with high humidity, leads to severe stress which impaired the performance of birds. Many ways to reduce the negative effects of heat stress on productive of birds have been documented. Methods such as shelter, ventilation, and cooling methods are probably applicable (Armstrong et al. 1999). Effects of heat stress could be ameliorated by acclimation (Yalcin et al. 2001). Some of these

methods not applicable in some regions and farms for their impracticality and high cost. Instead, nutritional manipulation could be a suitable approach to poultry production (Shane, 1988).

Chromium is an important microelement that acts an essential role in nutrition of animals and human beings (Nattapon et al., 2012). The Cr in 2 distinct ways improves the bird's production for example egg and meat production (Tolimir et al., 2005). The Cr helps in the fat, carbohydrates,

\*Corresponding Author: Email: w-dosoky@alexu.edu.eg

DOI: 10.21608/jsas.2021.53399.1269

Received: 12/12/2020; Accepted: 4/1/2021

©2020 National Information and Documentation Center (NIDOC)

and protein metabolism in animals. The Cr is also known as “Glucose Tolerance Factor” as helps in potentiation of insulin metabolism. Insulin impacts lipid peroxidation (Cole *et al.*, 2008), proposing that Cr might also exert an antioxidant effect (Preuss *et al.*, 1997). Things that cause Cr depletion may include stress, high carbohydrate consumption, obesity, and intense exercise (Hayirli, 2005). Moreover, Cr in organic types is relatively more water soluble and absorbed to a much greater extent in the gastrointestinal tract than Cr in inorganic types (Anderson *et al.*, 2001). The Cr steady form is the trivalent state (III) and Cr also helps to reduce the cholesterol level of plasma, muscle, and egg yolk with the supplement of Cr in the diet (Skalicka *et al.*, 2008). The Cr is important trace element help in physiological and nutritional function (Aslanian *et al.*, 2011). The Cr also helps in excretion, more viability rate, and less growth rate (Kim *et al.*, 1997). Environment stresses influence the performance of the poultry but supplements of the micro minerals like Cr and manganese act as anti-stress components (Gleuktin *et al.*, 2009). The Cr affects the function of a digestive enzyme (Pacheco *et al.*, 2004). The Cr supplement can decrease the negative impact of environmental stress and decreased heat stress during yolk building (Nasiroleslami and Torki, 2011). The Cr resulted in a decrease of average fat and an increase in the muscling and it is a very essential organic trace mineral that improves the nutritive influences of poultry meat (Li *et al.*, 2013). Cr supplement has proven to be effective in reducing the adverse impacts of stress, decreasing cortisol levels, and enhancing immunity (Chang and Mowat, 1992; Kegley and Spears, 1995). Chromium relation with L-methionine is a recently available natural Cr form whose bioavailability and effects have not been earlier revealed in growing Japanese quail. Therefore, this study was designed to test the impacts of different doses of CrMet on productive, blood constituents, immunity, and anti-oxidative properties of growing Japanese quail.

## **Materials and Methods**

### *Experimental site, design, and animal management*

The experiment was carried out at the Poultry Research laboratory belonging to the Faculty of Agriculture (Saba Basha), Alexandria University, Alexandria, Egypt. The experimental design was completely randomized with total of one hundred and fifty-7-day old unsexed Japanese quail chicks were randomly distributed to 5 dietary treatments of 30 birds to a treatment of 3 replicates of 10 birds to a replicate. Cr was added in the form of Chromium-l-methionine complex (containing 1 g of Cr·kg<sup>-1</sup>CrMet) to the basal diet at five different levels being 0, 200, 400, 600, and 800 mg CrMet /kg diet, respectively. Treatments were applied for 5 weeks. Throughout the experimental period,

daily ambient temperature ranged between 30-33 °C and relative humidity ranged between 72-80%. The diets were formulated to meet the nutritional requirements for quail chicks according to NRC (1994) and shown in Table 1.

### *Organs weight, blood sampling and biochemical analysis*

Data were collected on daily feed intake and mortality while the weight gain of birds was taken weekly. Feed consumption was determined by subtracting the left over from feed given after removing every foreign material from the left over while the weekly weight gain was determined by subtracting the initial weight of birds from the final weight. Feed conversion ratio (FCR) was calculated as the ratio of feed consumed to weight gain. Six birds representing the average live weight in each treatment were selected and sacrificed to determine blood parameters, carcass traits, and the relative weight of lymphoid organs (spleen, bursa, and thymus).

Blood samples were divided into two equal parts. The first was collected on heparin as an anticoagulant (0.1 ml of heparin to 1 ml of blood) according to Hawk *et al.* (1965) to determine the blood hematological parameters. The second part was kept clotting and then centrifuged at 4000 rpm for 15 minutes to split up blood serum. The obtained serum was kept frozen at -18 °C then analyzed. All biochemical analyses (total protein, albumin, alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase, total lipids, cholesterol, height density lipoproteins (HDL), low density Lipoproteins (LDL), triglyceride, uric acid, creatinine, total antioxidant capacity, glutathione peroxidase and lipid peroxide were complete by using commercial kits produced by bio - diagnostic – Egypt ([www.bio-diagnostic.com](http://www.bio-diagnostic.com)).

### *Determination of cellular immunity*

Foot web index (FWI) was used as an index of the cell-mediated immune response. At 6 weeks of age, 3 separate chicks from each treatment were chosen. The right foot web area was then injected intradermal with 0.25 mg of phytohemagglutinin (PHA; Sigma L-8754, St. Louis, MO) dissolved in 0.05 mL of PBS. Sterile physiological solution (PBS) (0.05 mL) was injected into the left foot web and served as a control group. A micrometer was used to determine changes in the thickness of the right and left foot webs with an accuracy of 0.01 mm. The Measurement was made at 0 and 24 h after the injection, as described by the method of Cheng and Lamont (1988) and Smits *et al.* (1999). A stimulation index was calculated as the difference in the change in thickness of the right PHA-injected foot web from the change in thickness of the left PBS-injected foot web.

**TABLE 1. Feed composition and calculated analysis of the diets for quail chickens**

Ingredients	%
Yellow corn	53.300
Soybean meal (44 %)	33.000
Concentrate (50 %) *	10.000
Di-calcium phosphate	0.200
Limestone	1.700
Sunflower oil	0.800
Vit. and min. mix. **	0.500
Salt (NaCl)	0.500
Total	100.00
<b>Calculated analyses<sup>1</sup>:</b>	
Crude protein, %	24.05
ME (Kcal/ Kg diet)	2907.10
Ether extract, %	2.44
Crude fiber, %	3.63
Methionine, %	0.76
Methionine +Cystine, %	0.88
Lysine, %	1.42
Calcium, %	1.11
Av. Phosphorus	0.39

\* Concentrate: ME (K cal/kg) 2870, Crude protein 50%, Crude fiber 1.51%, Crude fat 1.54%, Calcium 4.29%, Phosphorus 2.39%, NaCl 0.8%, Methionine 4.6%, Methionine & Cystine 5.38%, Lysine 3.90%.

\*\* Each kg of Vit. and min. mix. contained: Vit. A, 4,000,000 IU; Vit. D<sub>3</sub>, 500,000 IU; Vit. E, 16.7 g., Vit. K, 0.67 g., Vit. B<sub>1</sub> 0.67 g., Vit. B<sub>2</sub>, 2 g., Vit. B<sub>6</sub>, .67 g., Vit. B<sub>12</sub>, 0.004 g., Nicotinic acid, 16.7 g., Pantothenic acid, 6.67 g., Biotin, 0.07 g., Folic acid, 1.67 g., Choline chloride, 400 g., Zn, 23.3 g., Mn, 10 g., Fe, 25 g., Cu, 1.67 g., I, 0.25 g., Se, 0.033 g. and, Mg, 133.4 g.<sup>1</sup> According to NRC (1994).

### Statistical analysis

Data collected on performance, carcass, organs, blood profile and serum chemistry were subjected to one-way analysis of variance using General Linear Model (Windows Version of SPSS (2007), release 16), while differences in means were identified were separated using (Duncan,1955) option of the software.

The model used was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

where:  $Y_{ij}$  = An observation treatment.

$\mu$  = Overall mean.

$T_i$  = the treatment effect (I=1---- 5).

$e_{ij}$  = The random error.

### Results and Discussion

#### *Body weight, body weight gain, feed consumption and feed conversion ratio*

The effects of CrMet supplementation on the productive rate at six weeks of age are shown in Fig. 1 to 5. Groups fed diets containing different levels of CrMet had significantly heavier body weights than control group, except the group fed on 200 mg CrMet/kg diet (Fig. 2). The highest ( $P \leq 0.05$ ) value was observed in quail fed on 600 mg/kg as related to the other trial groups. This group surpassed the control one by 2.3%. Impact of CrMet supplementations on live body weight gain (BWG) of growing Japanese quail had the same trend that observed on body weight (figure3). The current results also showed that FI increased with increasing CrMet levels (figure4). The best ( $P \leq 0.05$ ) value of FCR was noticed in group fed 600 mg CrMet /kg as compared with other experimental groups (Fig.5).

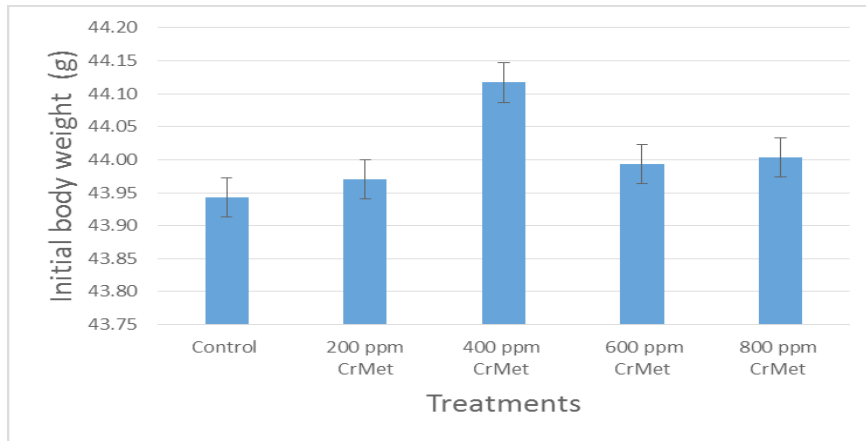


Fig. 1. Effect of Chromium methionine (CrMet) on initial body weight (g) of growing Japanese quail at one week of age.

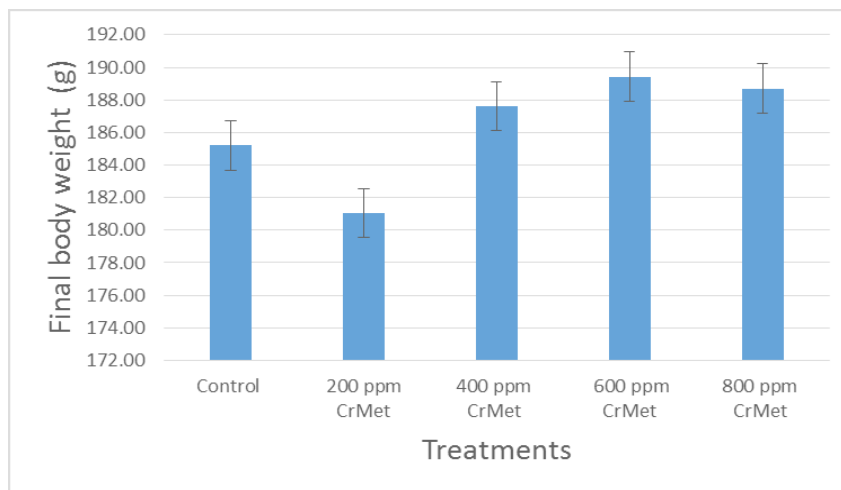


Fig. 2. Effect of Chromium methionine (CrMet) on final body weight (g) of growing Japanese quail at 6 weeks of age.

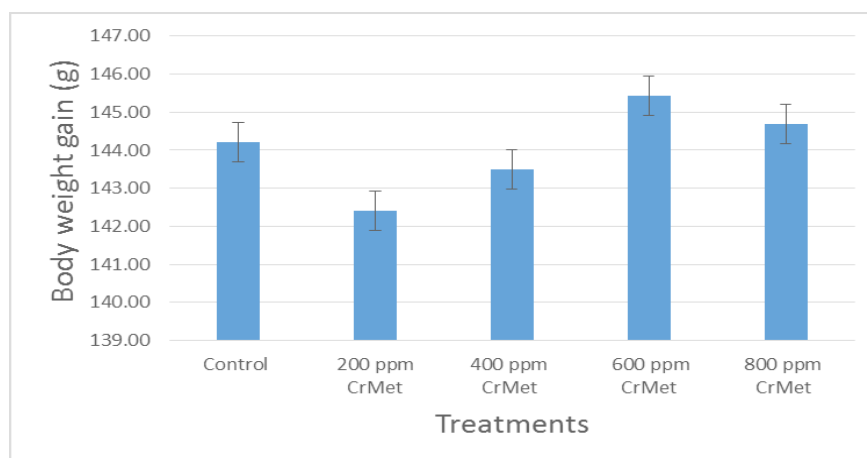


Fig. 3. Effect of Chromium methionine (CrMet) on body weight gain (g) of growing Japanese quail from 1- 6 weeks of age.

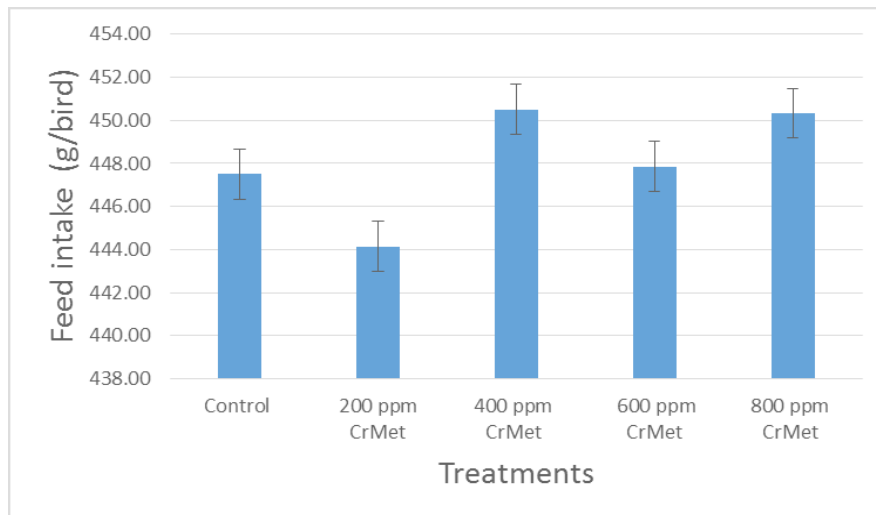


Fig. 4. Effect of Chromium methionine (CrMet) on feed intake (g/bird) of growing Japanese quail from 1-6 week of age

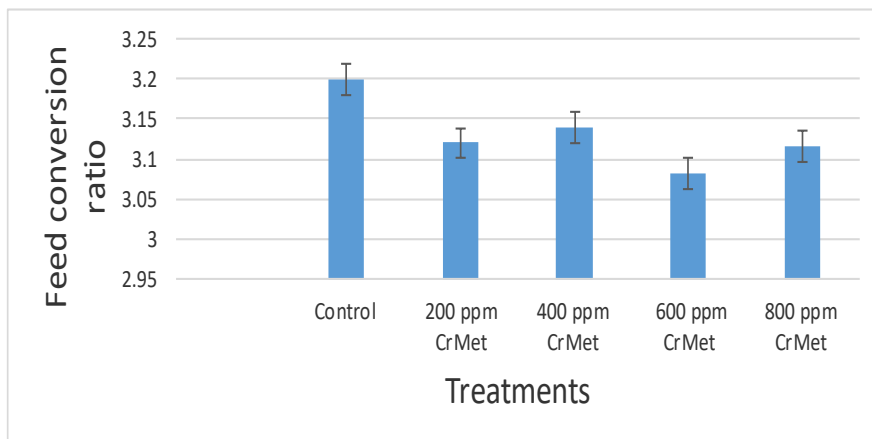


Fig. 5. Effect of Chromium methionine (CrMet) on feed conversion ratio of growing Japanese quail from 1-6 weeks of age

This observation is in the same line with the results of El-Kelawy (2019) who approved that chromium yeast (Cr-Yeast) supplementation improved BWG, and FCR of growing Japanese quail. Also, Abdelhady et al. (2017) found that Cr supplement significantly ( $P < 0.05$ ) improved the BWG, total FI, improved FCR and decreased the mortality rate when compared with heat-stressed quails. Ebrahimzadeh et al. (2013) found that BW and FI of the chickens supplemented by CrMet enhanced at 800-ppb concentrations of Cr ( $P < 0.05$ ). The FCR was not influenced by different amounts of additional CrMet in the chickens ( $P > 0.05$ ). Also, Aslanian et al. (2011) mentioned that, male broiler fed organic Cr had higher BW than control diet during the finishing (21-42d) phase. In earlier reports applying various sources of Cr like Cr picolinate (Sahin et al., 2002), and Cr yeast

(Hossain et al., 1998, Kroliczewska et al., 2004), enhancements in the FCR were stated. However, that nutritional supplement with Cr picolinate in heat-stressed chicks did not affect the FCR (Toghyani et al., 2006). In contrast, Sahin et al. (2003) demonstrated that a decrease BWG and FE in chicks raised under heat stress is alleviated by nutritional Cr and ascorbic acid supplementation. It is clear that performance rates worsen when the ambient temperature exceeds the thermo neutral zone (Ensminger et al., 1999) and that a reduced in growth level is partly the result of a reduction in FI (Hurwitz et al., 1980). Also, heat stress increases the secretion of chromium (Anderson, 1994) and thus may increase Cr requirements. In the current study, CrMet administration improved the performance rates of Japanese quail variables by increased BWG, FI, improved FCR.

This result is well recognized since Cr stimulates glucose metabolic rate via potentiates insulin hormone act (Jeebhoy *et al.*, 1977). Supplementation of organic Cr in quail diets decreased glucose level in the blood (Abdelhady *et al.* 2017) which agrees with (Sahin *et al.*, 2002; El-Hommosany, 2008) who stated that Cr is important for glucose metabolism and configure glucose tolerance factor, which works with insulin to transfer glucose to cells and increase the use of glucose, therefore, an improvement was found in BWG, FCR and carcass qualities. In addition, Chromium supplement enhances the amino acid acceptance by tissues and muscle cells, improves protein retention, and usually improves BW (Mertz, 1992).

#### *Organ weights*

The relative weights of carcass, liver, gizzard, spleen, bursa, and ovary were nonsignificant affected by CrMet supplementation, except relative weight of heart, thymus, abdominal fat, and testes were significantly ( $P \leq 0.001$  or  $0.01$ ) affected by CrMet treatments (Table 2). In this respect, El-Kelawy (2019) found that Cr-organic administration significantly decreased abdominal fat and increases carcass percentage. However, no significant impacts of different Cr sources on inner body organs including such as liver, gizzard, heart, spleen, pancreas, proventriculus, intestine length and intestine weight. Also, chicks supplemented with Cr-Pic (Sahin *et al.*, 2002 and 2003) and Cr-Yeast (Debski *et al.*, 2004) had higher carcass and lower abdominal fat than control. Also, Sands and Smith (1999) reported that Cr-Pic supplementation under HS or thermoneutral condition enhances live performance and percentage yield of carcass. Also, Norain *et al.* (2013) found that broiler chickens fed organic Cr had significantly higher carcass dressing percentage than those fed control diet. Suksombat and Kanchanatawee (2005) reported that organic Cr (Cr-Yeast or Cr-Pic) improved the carcass percentage of broilers. El-Kelawy (2019) showed that no significant impacts of Cr on relative weights of Thymus and Bursa. Similar results were observed by El-Hommosany (2008) and Al-Bandr *et al.* (2010).

#### *Hematological parameters*

Among the hematological variables, the white blood cells count, hemoglobin concentration, packed cell volume, and monocytes were significantly ( $P \leq 0.05$ ) influenced by CrMet supplementation. These variables increased in

quail chickens fed CrMet supplemented diets compared with those on the diet 1 (Table 3). However, red blood cells count, MCV, MCH, MCHC, lymphocytes (L), heterophils (H), H/L ratio, and eosinophils were not significantly affected by different treatments. It was observed that the group received 200 mg CrMet had the highest red blood cells counts as compared to other groups.

El-Kelawy (2019) referred that Cr supplementation significantly increased lymphocytes and decreased heterophile /lymphocytes ratio than the untreated one. In addition, there was no significant effect of the different sources of Cr supplementation on the hematological criteria and white blood cells. Like results were reported by Uyanik *et al.* (2002) who found that heterophil/lymphocyte ratio was reduced, and lymphocyte counts was increased by Cr supplementation. In addition, Toghyani *et al.* (2007) stated that H/L ratios decreased in boilers fed 1000 and 1500 ppb supplemental Cr. Moreover, Norain *et al.* (2013) found that Cr supplementation resulted in increased lymphocytes and decrease the heterophil/lymphocyte ratio of heat-stressed chickens. Also, Javed *et al.* (2003) indicated that non-significant differences between treatments and control groups in Hgb concentration and RBCs were obtained.

#### *Immunity assay*

Insignificant differences between treatments on foot web index and the best value was logged in the group given 400 and 600 ppm CrMet /kg diet followed by the group received 200 ppm and then the group received 800 ppm CrMet /kg diet (Table 3). In fact, the thymus, and bursa of Fabricius are "central lymphoid organs" in poultry and are important to the ontogenetic enhancement of adaptive immunity in birds. The T- and B-cell concept entered the vocabulary of immunology only after basic study with the chicken model showed an immunological function for the bursa of Fabricius (Warner *et al.*, 1962 and Cooper *et al.*, 1966) and the birds thymus (Cooper *et al.*, 1966) which involved in regulating the humoral- and cellular- mediated immunity.

#### *Serum biochemical profile*

The data obtained on serum biochemical estimates in quails as affected by CrMet are shown in Table 4. Serum total protein and globulin concentrations were not significantly different in all groups. Also, results showed that albumen was significantly ( $P \leq 0.05$ ) increased in all treated groups. Also, albumin / globulin ratio was significantly ( $P \leq 0.05$ ) affected by different treatments. The highest value was obtained in the group received 400 mg CrMet /kg diet.

The different levels of CrMet did not significantly ( $P \leq 0.05$ ) influence the serum alkaline phosphatase (ALP) and ALT of growing quail, while serum AST was significantly ( $P \leq 0.05$ ) increased in the quail fed on 400, 600 and 800 mg CrMet/kg diet in comparison with control. Serum total lipids, cholesterol, triglycerides concentrations were significantly ( $P \leq 0.05$ ) reduced due to addition of different doses of CrMet as compared with T1; However, LDL and HDL concentrations were statistically equal to the control group. Serum creatinine and uric acid were significantly ( $P \leq 0.05$ ) reduced by different levels of CrMet. The lowest values of uric acid and creatinine concentrations recorded in the groups fed 400 and 800 mg CrMet/kg diet, respectively.

These data are not similar with those found by Al-Bandr et al. (2010) and Al-Mashhadani et al. (2010). The high total protein levels in plasma may be because improved protein production and greatly growth rate in the tissues of the organic Cr supplemented groups (Cr-Yeast and Cr-Pic) compared to un-supplemented groups, where anabolism Overridden catabolism of the protein (Sahin et al., 2002). No significant effects of Cr on plasma albumin. These data are like those found by Al-Bandr et al. (2010). El-Kelawy (2019) found that Cr administration significantly reduced triglycerides, cholesterol, and LDL and increased HDL. Similarly, Aslanian et al. (2011) observed that the addition of Cr organic decreased the cholesterol and LDL levels, whereas HDL levels were increased in blood. Addition of Cr decreased total cholesterol, LDL and triglycerides, and increased HDL (Suksombat and Kanchanatawee, 2005 Abdelhady et al., 2017). Our data are like those found by Mustafa (2007) and Al-Bandr et al. (2010) who revealed that no significant effects

of Cr on either plasma uric acid or creatinine levels. Guo et al. (1999) revealed that chickens fed on 0.4, 2.0, or 10 ppm of Cr from 3 - 6 wk of age, any in the forms of CrCl<sub>3</sub> or Cr- yeast, did not have changed in ALP activity.

#### *Liver antioxidant profile*

Serum TAC was significantly ( $P \leq 0.05$ ) increased with increased CrMet levels in the diet as compared to the control group, while serum lipid peroxide concentration was significantly ( $P \leq 0.01$ ) decreased by increasing CrMet levels in the diets (except the group had 200 mg CrMet was significantly equal to T1 group). In contrast, serum glutathione peroxidase activity was numerically increased with increased CrMet levels in the diet as compared to the control group (Table 4).

Our results have confirmed that adding CrMet can increase antioxidant properties of birds and reduce oxidative destruction affected by HS. In this respect, Li et al. (2018) found that at fourteen-day dietary supplementation of Cr can significantly reduce serum MDA degree compared with HS group. At twenty-one-day, SOD levels in Cr-Pic group were significantly greater than those in HS group. Moreover, at thirty – five day, inserting Cr-Pic inclined to alleviate the reduction of serum T-AOC levels affected by HS. Likewise, chromium picolinate (Cr-Pic) would remarkably enhance SOD levels in serum compared to the control. Supplementation of Cr enhanced the actions of antioxidant enzymes (GSHPx, and GSH Rx), revealing that Cr addition gradually decreased oxidative stress with an increase in its levels in feed of broiler (Rao et al., 2012).

Results are in harmony with the results shown in Table 2 and confirmed that thymus was more developed due to dietary CrMet supplementation in growing Japanese quail which, in turn, translated into elevating the relative weight of it.

**TABLE 2. Effect of Chromium methionine (CrMet) on relative weight of carcass and lymphoid organs of growing Japanese quail at six weeks of age**

Treatments	Carcass	Liver	Gizzard	Abdominal fat	Heart	Spleen	Bursa	Thymus	Ovary	Testis
Control (T 1)	71.606	2.250	2.074	0.699 <sup>a</sup>	1.100 <sup>a</sup>	0.050	0.272 <sup>a</sup>	0.151	0.840	2.054 <sup>a</sup>
Control+200 ppm CrMet/kg diet	71.231	2.252	1.968	0.641 <sup>ab</sup>	1.040 <sup>a</sup>	0.055	0.137 <sup>b</sup>	0.183	1.178	1.142 <sup>b</sup>
Control+400 ppm CrMet/kg diet	69.897	2.229	2.062	0.626 <sup>ab</sup>	1.057 <sup>a</sup>	0.070	0.152 <sup>ab</sup>	0.174	0.775	2.549 <sup>a</sup>
Control+ 600 ppm CrMet/kg diet	70.640	2.302	2.122	0.410 <sup>b</sup>	1.104 <sup>a</sup>	0.061	0.123 <sup>b</sup>	0.149	0.887	1.276 <sup>b</sup>
Control+800 ppm CrMet/kg diet	69.220	1.932	2.009	0.406 <sup>b</sup>	0.873 <sup>b</sup>	0.077	0.133 <sup>b</sup>	0.185	0.288	1.837 <sup>ab</sup>
MSE	0.366	0.085	0.035	0.040	0.022	0.014	0.020	0.009	0.172	0.150
P Value	0.229	0.685	0.707	0.033	0.001	0.461	0.007	0.542	0.759	0.006

<sup>a-b</sup> Means with different superscript in the same row are significantly different ( $p < 0.05$ ).

**TABLE 3. Effect of Chromium methionine (CrMet) on some hematological and immunological parameters of growing quail at six weeks of age**

Items	Treatments*					MSE	P value
	T1	T2	T3	T4	T5		
<u>Hematological parameters</u>							
Red blood cells (RBCs 10 <sup>6</sup> /mm <sup>3</sup> )	4.133	4.600	4.213	4.293	4.232	0.159	0.926
Hemoglobin (Hb g/dl)	11.233 <sup>b</sup>	12.067 <sup>ab</sup>	12.568 <sup>a</sup>	12.200 <sup>ab</sup>	12.233 <sup>ab</sup>	0.162	0.050
Packed cell volume (PCV %)	35.500 <sup>b</sup>	37.532 <sup>a</sup>	39.233 <sup>a</sup>	38.867 <sup>a</sup>	38.233 <sup>a</sup>	0.371	0.002
MCV	0.890	0.823	0.990	0.953	0.996	0.037	0.705
MCH	28.590	26.263	31.550	29.803	29.080	26.655	0.735
MCHC	31.738	32.207	32.018	31.390	32.037	0.414	0.982
White blood cells (WBCs 10 <sup>3</sup> /mm <sup>3</sup> )	20.900 <sup>a</sup>	18.833 <sup>b</sup>	20.533 <sup>a</sup>	20.400 <sup>a</sup>	20.733 <sup>a</sup>	0.213	0.003
Lymphocytes	64.668	63.667 <sup>57</sup>	66.333	63.000	64.667	0.492	0.273
Heterophils	30.667	31.667	29.333	32.000	30.668	0.487	0.489
H/L ratio	0.473	0.498	0.443	0.510	0.477	0.019	0.398
Monocytes	3.332 <sup>b</sup>	4.000 <sup>a</sup>	3.000 <sup>b</sup>	3.333 <sup>b</sup>	3.333 <sup>b</sup>	0.104	0.021
Eosinophils	1.333	0.667	1.332	1.667	1.332	0.158	0.397
<u>Immunological parameter</u>							
Foot Web Index (mm)	0.243	0.261	0.263	0.257	0.260	0.005	0.743

\*T<sub>1</sub> (Control) - T<sub>2</sub> (Control+200 ppm CrMet /kg diet) - T<sub>3</sub> (Control+400 ppm CrMet /kg diet) - T<sub>4</sub> (Control+600 ppm CrMet /kg diet) - T<sub>5</sub> (Control+800 ppm CrMet /kg diet).

<sup>a-b</sup> Means with different superscript in the same row are significantly different (p < 0.05).

**TABLE 4. Effect of Chromium methionine (CrMet) on some blood serum constituents of growing quail at six weeks of age.**

Items	Treatments*					MSE	P value
	T1	T2	T3	T4	T5		
<u>Blood serum metabolites</u>							
Total Protein (g/dl)	4.069	4.233	4.571	4.273	4.297	0.077	0.364
Albumin (g/dl)	2.406 <sup>b</sup>	2.510 <sup>b</sup>	3.006 <sup>a</sup>	2.708 <sup>ab</sup>	2.813 <sup>ab</sup>	0.075	0.049
Globulin (g/dl)	1.663	1.723	1.566	1.566	1.483	0.058	0.730
Albumin /Globulin ratio	1.587 <sup>ab</sup>	1.458 <sup>b</sup>	2.271 <sup>a</sup>	1.784 <sup>ab</sup>	2.052 <sup>ab</sup>	0.106	0.035
Alkaline phosphatase (IU/L)	92.555	92.777	90.667	93.556	93.666	0.862	0.828
Alanine aminotransferase (U/L)	11.222	11.556	11.667	11.556	11.222	0.133	0.759
Aspartate aminotransferase (U/L)	8.111 <sup>b</sup>	8.889 <sup>ab</sup>	9.444 <sup>a</sup>	9.556 <sup>a</sup>	9.667 <sup>a</sup>	0.147	0.002
Total lipids (mg/dl)	475.780 <sup>a</sup>	433.560 <sup>b</sup>	434.670 <sup>b</sup>	420.220 <sup>b</sup>	448.670 <sup>ab</sup>	5.649	0.018
Total Cholesterol (mg/l)	114.560 <sup>a</sup>	111.110 <sup>a</sup>	110.110 <sup>a</sup>	100.220 <sup>b</sup>	98.222 <sup>b</sup>	1.151	0.001
Triglycerides(mg/dl)	103.000 <sup>a</sup>	92.444 <sup>c</sup>	101.890 <sup>ab</sup>	97.889 <sup>b</sup>	101.000 <sup>ab</sup>	0.880	0.001
Low density lipoprotein (mg/l)	35.333	35.444	32.222	32.333	33.000	0.496	0.073
High density lipoprotein (mg/l)	50.792	52.469	47.828	55.484	52.592	1.105	0.277
Uric acid (mg/dl)	5.316 <sup>a</sup>	4.439 <sup>cd</sup>	4.101 <sup>d</sup>	4.723 <sup>bc</sup>	4.899 <sup>b</sup>	0.086	0.001
Creatinine (mg/dl)	0.733 <sup>a</sup>	0.611 <sup>b</sup>	0.622 <sup>b</sup>	0.711 <sup>a</sup>	0.600 <sup>b</sup>	0.141	0.002
<u>Antioxidant profile</u>							
Glutathione peroxidase (mu/ml)	32.978	33.826	34.402	34.520	34.576	0.141	0.408
Malondialdehyde MDA (nmol/ml)	10.997 <sup>a</sup>	10.429 <sup>ab</sup>	9.893 <sup>b</sup>	9.999 <sup>b</sup>	9.749 <sup>b</sup>	0.299	0.029
total antioxidant capacity(mg/dl)	0.600 <sup>b</sup>	0.676 <sup>a</sup>	0.699 <sup>a</sup>	0.719 <sup>a</sup>	0.750 <sup>a</sup>	0.013	0.003

\*T<sub>1</sub> (Control) - T<sub>2</sub> (Control+(200PPM CrMet /kg diet) - T<sub>3</sub> (T3Control+(400PPM CrMet /kg diet) - T<sub>4</sub> (T4Control+(600PPM CrMet /kg diet) - T<sub>5</sub> (T5Control+(800PPM CrMet /kg diet).

<sup>a - c</sup> Means with different superscript in the same row are significantly different (p < 0.05)..



## Conclusions

Data obtained from this study indicated that dietary supplementation with 600 mg CrMet /kg diet resulted in improved performance, serum constituents and hematology, immunity, and anti-oxidative properties without compromising the health status of the birds under high ambient temperature.

## References

- Abdelhady, D.H, Moshira, A. El-Abasy, M.A., Atta, E.W. Ghazy, T.K. Abuzed and El-Moslemany, A.M. (2017) Synergistic Ameliorative Effects of Organic Chromium and Selenium Against Heat Stress in Japanese Quails: Performance, Immunological, Hematological, Biochemical and Antioxidant Studies. *AJVS*, **55** (2),113-123.
- Al-Bandr, L.K., D.K. Ibrahim, and E.H. Al-Mashhadani (2010) Effect of supplementing different sources of chromium to diet on some physiological traits of broiler chickens. *Egypt. Poult. Sci.* Vol (30) (II): 397-413.
- Al-Mashhadani E.H.I.; Ibrahim D.K. and Al-Bandr L.K. (2010) Effect of Supplementing Different Levels of Chromium Yeast to Diet on Broiler Chickens Performance. *Int. J. Poult. Sci.*, **9** (4): 376-381.
- Anderson, R.A. (1994) Stress effects on chromium nutrition of humans and farm animals. Pages 267–274 in *Biotechnology in Feed Industry*. T. P. Lyons and K. A. Jacques, Ed. Univ. Press, Nothingam, England.
- Anderson, R.A., A.M. Roussel, N. Zouari, S.J. Mahjoub, J.M. Matheau, and A.K. Abdelhamid (2001) Potential antioxidant effects of zinc and chromium supplementation in people with type 2 diabetes mellitus. *J. Am. Coll. Nutr.* **20**, 212–218.
- Armstrong, D. V., P. E. Hillman, M. J. Meyer, J. F. Smith, S. R. Stokes and J. P. Harner, (1999) Heat stress management in freestall barns in the western U. S. Pages 87–98 in *Proc. West. Dairy Manage. Conf., Las Vegas, NV*. Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan.
- Aslanian, A., K. Noori, A. D. Abolfazl, A. S. Habib, R. Shahnaz, M. S. Naser (2011) Evaluate the effect of Cr methionine on performance and serum metabolite in growing-finishing male broiler. *J Basic Appl Sci Res.* **1**(11), 2442-2448
- Chang, X. and D. N. Mowat (1992) Supplemental chromium for stressed and growing feeder calves. *J. Anim. Sci.* **70**, 559.
- Cheng, S. and S. J. Lamont (1988) Genetic analysis of immunocompetence measure in White Leghorn chicken line. *Pout. Sci.* **59**, 989–995.
- Cole, N.W., K.R.Weaver, B.N. Walcher, Z.F. Adams, R.R. Miller (2008) Hyperglycemia-induced membrane lipid peroxidation and elevated homocysteine levels are poorly attenuated by exogenous folate in embryonic chick brains. *Comp. Biochem. Physiol. B* **150**, 338-343.
- Cooper M. D., R. D. Peterson, M. A. South and R. A. Good, (1966) The functions of the thymus system and bursa system in the chicken. *The Journal of Experimental Medicine*, **123**, 75-106.
- Debski,B., W. Zalewski, M.A. Gralak, and T. Kolsa (2004) Chromium yeast supplementation of broilers in an industrial farming system. *J. Trace Elem. Med. Biol.* **18**, 47-51.
- Duncan D. B. (1955) The multiple range and F-tests. *Biometrics*, **11**, 1-42.
- Ebrahimzadeh, S., P. Farhoomand, and K. Noori, (2013) Effects of chromium methionine supplementation on performance, carcass traits, and the Ca and P metabolism of broiler chickens under heat-stress conditions. *J. Appl. Poult. Res.* **22**, 382-387.
- El- Hommosany, Y.M. (2008) study of the physiological changes in blood chemistry, Humoral immune response and performance of quail chicks feed supplemental chromium. *Int. J. of Poultry. Sci.* **7** (1), 40-44.
- El-Kelawy, M. I. (2019) Effect of different sources of chromium on productive performance of Japanese quail under heat stress conditions. *Egypt. Poult. Sci.* Vol. (39)(I): (99-115).
- Ensminger, M.E., J.E. Oldfield, and W. Heinemann (1999) *Feeds and Nutrition*. The Ensminger Publ. Co., Clovis, CA.
- Gleuktin, M., F. Uyanik, , B. K. Guclu, and M. Eren (2009) Effects of Cr and manganese on performance, egg quality and serum lipid levels of Japanese quail exposed to heat stress. *Book Proceedings of 2<sup>nd</sup>.Mediterranean Summit of WPSA, Turkey* **9**, 117-121.
- Guo, Y. L., X. G. Luo, Z. L. Hao, B. Liu, J. L. Chen, F. S. Gao, and S. X. Yu. (1999) Effect of chromium on growth performance, serum biochemical traits, immune function and carcass quality of broiler chickens. *Scientia Agric. Sinica* **32**, 79-86.
- Hawk P. B., B. L. Oscar and W. Summerson, (1965) Hawk's [physiological chemistry]. London J., and A. Churchill Ltd. 14<sup>th</sup> ed.

- Hayirli, A. (2005) Chromium nutrition of livestock species. *Nutr. Abs. Rev. Ser. B: Livestock Feeds Feed.* **75**, 1N–14N.
- Hossain, S. M., S. L. Barreto, and C. G. Silva. (1998) Growth performance and carcass composition of broiler fed supplemental chromium from chromium yeast. *J. Anim. Feed. Sci. Tech.* **71**, 217–228.
- Hurwitz, S., M. Weiselberg, U. Eisner, I. Bartov, G. Riesenfeld, M. Sharvit, A. Niv, and S. Bornstein (1980) The energy requirements and performance of growing chickens and turkeys, as affected by environmental temperature. *Poult. Sci.* **59**, 2290-2299.
- Javed, M.T., F. Ahmad, N.Z. Rafique, and M. Bashir (2003) Effects of higher levels of chromium and copper on some haematological parameters and serum proteins in broilers. *Pakistan Vet. J.* **23** (1), 31-35.
- Jeejebhoy, K.N., R.C. Chu, E.B. Marliss, G.R. Greenberg, and A. Bruce – Robertson. (1977) chromium deficiency, glucose intolerance, and neuropathy reversed by chromium supplementation, in a patient receiving long-term total parenteral nutrition. *Am. J. Clin. Nutr.* **30**, 531-538.
- Kegley, E. B. and J. W. Spears (1995) Immune response, glucose metabolism, and performance of stressed feeder calves fed inorganic or organic chromium. *J. Anim. Sci.* **73**, 2721-2726.
- Kim, J. D., I. K. Han, B. J. Chae, J. H. Lee, J. H. Park, and C. J. Yang (1997) Effect of dietary Cr picolinate on performance, egg quality, serum trait and mortality rate of brown layer. *Asian Aus J Anim Sci.* **10**(1), 1-7.
- Kroliczewska, B., W. Zawadzki, Z. Dobrzanski, and A. Kaczmarek-Oliwa. (2004) Change in selected serum parameters of broiler chicken fed supplemental chromium. *J. Anim. Physiol. Nutr.* **88**, 393-400.
- Li, R., Y. Zhou, Y. Li, L. Guo, Y. Zhang, and Z. Qi (2018). Effects of chromium picolinate supplementation on growth performance, small intestine morphology and antioxidant status in ducks under heat stress conditions. *Int. J. Morphol.*, **36** (1):226-234.
- Li, Y. S., N. H. Zhu, P. P. Niu, F. X. Shi, C. L. Hughes, G. X. Tian, and R. H. Huang, (2013) Effects of dietary Cr methionine on growth performance, carcass composition, meat colour and expression of the colour-related gene myoglobin of growing finishing pigs. *Asian Australas J Anim Sci.* **26** (7): 1021- 1029.
- Mertz, W. (1992). Chromium: History and nutritional importance. *Biol. Trace Elem. Res.* **32**:3–8.
- Mustafa, N.M. (2007). Effect of organic and inorganic selenium or chromium on productive performance and immunity of broilers, *M. V. Sc. Thesis*, Fac. Vet. Med; Cairo Uni.
- Nasiroleslami, M. and M. Toriki, (2011). Egg quality characteristics and productive performance of laying hens fed diets supplemented by Echinacea purpurea extract, immunizing and vitamin E. *Glob Veterin* **7** (3): 270- 275.
- National Research Council (NRC), 1994. Nutritional requirements of Poultry. Ninth revised edition, National press Washington. D. C
- Nattapon, S., L. Jin-Jenn, T. Alex and Tu-Fa Lien (2012). Effect of different level of nanoparticles of Cr picolinate supplementation on performance, egg quality, retention and tissue mineral accumulation in layers. *J. Agr Sci.* **5** (2): 150-159.
- Norain, T.M., I.B. Ismail, K.A. Abdoun, and A.A. Al-Haidary ( 2013). Dietary Inclusion of Chromium to Improve Growth Performance and Immune-Competence of Broilers Under Heat Stress, *ITAL. J. ANIM. SCI.*, **12**:4, e92.
- Pacheco, P. D. G., A. C. Stradiotti, E. V. Siloto, P. V. A. Alvarenga, T. C. Putarov, D. R. S. Sartori, J. R. Sartori, M. L. M. Vicentini-Paulino, A. Piccinin and D. F. Pinherio (2004) Effect of organic Cr supplementation and energy levels on digestive enzyme activities in laying hens. *Poult Sci.* **91**; 433.
- Preuss, H.G, P. L. Grojec, S. Lieberman, R.A. Anderson (1997). Effects of different chromium compounds on blood pressure and lipid peroxidation in spontaneously hypertensive rats. *Clin Nephrol.* **47**:325–330.
- Rao, S.V., M.V. Raju, A.K. Panda, N.S. Poonam, O.K. Murthy, and G.S. Sunder, (2012). Effect of dietary supplementation of organic chromium on performance, carcass traits, oxidative parameters, and immune responses in commercial broiler chickens. *Biol. Trace Elem. Res.*, **147** (1-3), 135-41.
- Sahin, K., N. Sahin, and O. Kucuk (2003) Effects of chromium, and ascorbic acid supplementation on growth, carcass traits, serum metabolites, and antioxidant status of broiler chickens reared at a high ambient temperature. *Nutr. Res.* **23**, 225-238.
- Sahin, K., N. Sahin, M. Onderci, F. Gursu, and G. Cikim (2002) Optimal dietary concentration of chromium for alleviating the effect of heat stress on growth,

- carcass qualities and some serum metabolites of broiler chickens. *Biol. Trace Elem. Res.*, **89**, 53-64.
- Sands, J.S. and M.O. Smith, (1999) Broilers in heat stress conditions: Effects of dietary manganese proteinate or chromium picolinate supplementation. *J. Appl. Poultry Res.* **8**, 280-287.
- Shane, S. M. (1988) Factors influencing health and performance of poultry in hot climates. *Crit. Rev. Poult. Biol.*, **1**, 247-267.
- Skalicka, M., B. Korenekova, P. Nad, and J. Saly (2008) Influence of Cr and cadmium addition on quality of Japanese quail eggs. *Acta Vet Brno* **77**,503-508.
- Smits, J. E., G.R. Bortolotti, and J.L. Tella, (1999) Simplifying the phytohaemagglutinin skin-testing technique in studies of avian immunocompetence. *Funct. Ecol.* **13**, 567-572.
- SPSS, (2007) SPSS for Windows Release 16.0, SPSS. Inc.
- Suksombat, W. and S. Kanchanatawee (2005) Effects of Various Sources and Levels of Chromium on Performance of Broilers. *Asian-Aust. J. Anim. Sci.* **18**, 11, 1628-1633.
- Toghyani, M., M. Shivazad, A. A. Gheisari, and S. H. Zarkesh. (2006) Performance, carcass traits and hematological parameters of heat-stressed broiler chicks in response to dietary levels of chromium picolinate. *Int. J. Poult. Sci.* **5**, 65-69.
- Toghyani, M., S.H. Zarkesh, M.Shivazad, and A.A. Gheisari (2007) Immune responses of broiler chicks fed chromium picolinate in heat-stressed condition. *J. Poult. Sci.* **44**, 330-334.
- Tolimir, N., P. Zalatica, V. Koljajic, S. Mtrovic, and N. Anokic, (2005) The effect of different sources and Cr level in ration in broiler breast musculature. *Biotechnol Animal Husb.* **21** (5-6), 153-158.
- Uyanik,F., A. Atasever, S. Ozdmar, and F. Aydin (2002) Effects of dietary chromium chloride supplementation on performance, some serum parameters, and immune response in broilers. *Biol. Trace Elem. Res.* **90**, 99-115.
- Warner N. L., A. J. Szenberg and F. M. Burnet (1962) The immunological role of different lymphoid organs in the chicken. I. Dissociation of immunological responsiveness. *The Australian Journal of Experimental Biology and Medical Science*, **40**, 373-388.
- Yalcin, S., S., Ozkan, L. Turkmur and P. B. Siegel (2001) Responses to heat stress in commercial and local broiler stocks. 1. *Performance traits. Br. Poult. Sci.* **42**, 149-152.

## تأثير الكروميوم العضوي على الاداء الإنتاجي والفسولوجي وتقليل الاجهاد التأكسدي في السمان الياباني النامي والمربي تحت درجات الحرارة المرتفعة

وليد مصطفى دسوقي<sup>١</sup> - حسن صابر زويل<sup>١</sup> - سليمان محمد زهران<sup>١</sup> - طارق امين عبيد<sup>٢</sup> - ايمن معوض خليفة<sup>٣</sup> - ولاء قشيوط<sup>١</sup>

<sup>١</sup> قسم الانتاج الحيواني والسمكي - كلية الزراعة ساجا باشا- جامعة الإسكندرية- مصر

<sup>٢</sup> قسم انتاج الدواجن - كلية الزراعة - جامعة كفر الشيخ- مصر

<sup>٣</sup> قسم بحوث الحيوانات المزرعية - معهد بحوث زراعه الأراضي القاحلة - مدينه الأبحاث العلمية والتطبيقات التكنولوجية - مدينه برج العرب - مصر

تم تقسيم عدد ١٥٠ كتكوت سمان غير مجنس عمر ٧ أيام عشوائياً الى ٥ مجموعات تجريبية. احتوت كل مجموعة على ٣٠ كتكوت، احتوت كل مجموعة على ٣ مكررات بكل مكررة ١٠ طيور في تصميم عشوائي كامل. وكانت المعاملات التجريبية خلال فترة النمو من عمر أسبوع وحتى ستة أسابيع كالتالي: المعاملة الأولى غذيت الطيور على عليقة أساسية بدون أي إضافات واستخدمت كمجموعة مقارنة. المعاملة الثانية والثالثة والرابعة والخامسة غذيت الطيور على عليقة أساسية مضاف لها الكروميوم ميثايونين بمعدل ٢٠٠ و ٤٠٠ و ٦٠٠ و ٨٠٠ ملليجرام كروميوم ميثايونين / كجم عليقة على التوالي. اظهرت النتائج ان إضافة الكروميوم ميثايونين أدت الي زيادة الوزن بمعدل 2.3% عند الأسبوع السادس من العمر مقارنة بالطيور المغذاه على العليقة الكنترول. كما ان معدل استهلاك العلف زاد تدريجياً بزيادة مستويات الكروميوم ميثايونين في العليقة بالمقارنة بالعليقة الكنترول وأيضا العليقة المضاف اليها ٢٠٠ ملليجرام كروميوم ميثايونين. سجلت أفضل قيمة معنويه لمعدل التحويل الغذائي في المجموعة المغذاه على ٦٠٠ ملليجرام كروميوم ميثايونين / كجم عليقة بالمقارنة بجميع المعاملات التجريبية الأخرى. تحسن معنويا الوزن النسبي لكلا من الغدة التيموسية والقلب والخصيتين وأيضا تحسنت معنويا صفات الدم الهيماتولوجية (عدد كرات الدم البيضاء والهيموجلوبين وحجم كرات الدم المضغوطة والنسبة المئوية لعدد الخلايا الأحادية و aspartate aminotransferase و نسبة الالبومين الي الجلوبيولين للسمان الياباني النامي بينما انخفض معنويا كلا من الليبيدات الكلية و الكوليسترول والجلسريدات الثلاثية وتركيز بيروكسيد الدهون. وخلاصه الدراسة ان إضافة الكروميوم ميثايونين في علائق السمان الياباني النامي بمستوى 600 ملليجرام / كجم عليقة كان له تأثير مفيد على مقاييس النمو ومكونات الدم البيوكيميائية والهيماتولوجية والاستجابة المناعية والخصائص المضادة للأكسدة.