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Effect of Supplementing Different Levels of Chromium Yeast to Diet on Broiler Chickens on Some Physiological Traits

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Abstract: The experiment was conducted at the faculty of agriculture University of Ain Shams-Egypt, from January to March 2008, to study the effect of different levels of chromium yeast (cr-yeast) on broiler chickens on some physiological traits. A total of 450, one-day old unsexed chickens (Cobb) strain were used. The birds were randomly allocated to five treatments with 3 replicates each. The treatments were control (T_1), without supplementation, T_2, T_3, T_4 and T_5 which were supplemented with 0.5, 1, 1.5 and 2 mg cr-yeast/kg diet respectively. Chromium yeast supplementation treatments caused a significant ($p \leq 0.05$) increase in plasma glucose levels, while supplemented Cr-yeast at levels of 1 (T_3), 1.5 (T_4), 2 (T_5) mg/kg diet resulted in a significant ($p \leq 0.05$) increase in total protein and globulin as compared to control group. Also supplemented 0.5 (T_2) or 2 (T_5) mg Cr-yeast resulted in a significant ($p \leq 0.05$) reduction in total lipid in plasma, whereas cholesterol levels which were significantly ($p \leq 0.05$) decreased when Cr-yeast was supplemented at levels of 1 (T_3), 1.5 (T_4) and 2 (T_5) mg/kg diet. Although LDL was significantly ($p \leq 0.05$) decreased when 1.5 (T_4) or 2 (T_5) mg Cr-yeast was supplemented to the diet. Lymphoid organs percentage which was not affected by dietary supplementation of Cr-yeast except spleen percentage that was significantly ($p \leq 0.05$) higher in the group that was supplemented with Cr yeast .Chromium level increased in liver, muscle and plasma as levels of supplementation was increased. Protein percentage in the breast and thigh increased significantly ($p \leq 0.05$) in all chromium supplementation groups as compared to the control group, while fat percentage in the breast and thigh decrease significantly ($p \leq 0.05$) when chromium level increased from 1-2 mg/kg diet. It can be concluded that Cr-yeast had a beneficial effect on some of the physiological measurements of broilers under such experimental conditions.

Key words: Broiler chicken, chromium, chromium yeast, broiler performance

INTRODUCTION

The first suggestion that chromium participates in carbohydrate metabolism in animals was mentioned by Schwartz and Mertz (1957). They observed that glucose tolerance factor GTF, which was shown later to contain chromium, was deficient in animals with impaired glucose tolerance and that supplemental chromium improved glucose tolerance (Mertz, 1993).

Chromium is a co-factor of insulin, promoting insulin activity (McCary *et al*., 1988), enhancing amino acid uptake, promoting lipogenesis from glucose and lipid storage in the liver and adipose tissues (Steele and Rosebrough, 1979) dietary chromium can increase lipoprotein lipase activity and eventually decrease the contents of triglycerides rich lipoproteins (Garfinkel *et al*., 1976; Howard *et al*., 1993) also can increase liver LDL receptors there by reducing the LDL content and concomitantly the HDL proportion is increased (Brindley and Salter, 1991; Lien *et al*., 1999). The rate limiting enzyme in cholesterol synthesis is 3-hydroxyl-3-methylglutaryl Co enzyme A HMG-CoA reductase (Merlin, 1998). The mechanism whereby chromium alters cholesterol levels and fractions is not fairly understood. Chromium is also considered as antistress factor (Kegley and Spears, 1995) and increases immune capability (Uyanik *et al*., 2002).Chromium excretion may increase 10 to 300 fold in stress situations. This also becomes nutritionally important because in such condition it is necessary to increase the trace element concentration in the diet. However, an appropriate recommendation on the chromium requirement for poultry has not been made NRC (1994) and most poultry diets are basically composed of plant origin ingredients which have usually a low content of chromium (Giri *et al*., 1990).

Inorganic chromium such as chromic chloride and Cr oxide are poorly absorbed in animals, absorption ranges from 0.4 to 3% or less, regardless of dose and dietary Cr status (Anderson, 1987; Underwood and Suttle, 1999). There are six known sources of organic Cr compounds (Zinpro, 2003). Chromium-L-methionine, Chromium Nicotinate, Chromium Chelate, Chromium Proteinate, chromium picolinate (Cr Pic) and Cr yeast. Researches on animals have confirmed that Cr from organic complex is absorbed more efficiently, about 25-30% more than inorganic compounds (Mowat, 1997; Olin *et al*., 1994).

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Chromium yeast (Cr yeast): Brewer's yeast is an example of natural chromium yeast. Typically it contains approximately 2 ppm of organic chromium. The actual chemical structure of chromium compound in brewer's yeast is unknown, because of its low chromium content, manufacturers often raise the content of chromium in yeast by the following methods: Yeast-bound chromium is produced by introducing an inorganic chromium source such as chromic chloride into live yeast culture. As the brewer's yeast cells grow and multiply chromium is taken up into the yeast cells, increasing the chromium content of the yeast. Some yeast-bound chromium products also contain the culture from which the live yeast cells were grown. It is difficult to know the actual amount of organic chromium in the yeast cells in these products (Zinpro, 2003). Chromium Fortified yeast: Brewer's yeast or yeast culture is blended with inorganic chromium salt, such as chromic chloride or organic chromium to form a mixture. This mixture is sold as chromium yeast (Zinpro, 2003).

The objective of the present work was to investigate the effects different levels of dietary chromium yeast supplementation to broiler chickens on some physiological traits.

MATERIALS AND METHODS

The experiment were conducted at Broiler Nutrition Unit, Faculty of Agriculture Ain Shams University during the period from January to March 2008. This study aimed to investigate the effects of adding different levels chromium yeast (Cr yeast), to the broiler chickens diets on, blood constituents and physiological characters.

Birds were raised from day-old to 5 weeks of age. Cobb broiler chickens were randomly allocated to floor pens. Electrical heaters were used to maintain room temperature at 34°C during the first week of age and then the temperature was being decreased gradually to 26°C during the 3rd week of age. Artificial lighting was provided constantly during the experimental period. Water and mash feed were provided *ad lib* through the 35 days experimental period. All chickens were vaccinated against avian influenza at one day old and Newcastle disease at 6, 18 days old.

Four hundred and fifty, one-day old Cobb broiler chickens were allocated randomly into five treatment groups of 90 birds and divided into three replicates with 30 birds each.

The chickens were received starter diet from one to 21 day of age and then switched to grower diet from 22 to 35 days of age, as shown in Table 1. The diets were formulated according to NRC (1994).

In this experiment, five different dietary treatments were used as follows:

Treatment 1 (Control) T_1: The diet without chromium yeast supplementation, treatment 2 (T_2): The diet + 0.5 mg Cr yeast/kg diet, treatment 3 (T_3): The diet + 1 mg Cr yeast/kg diet, Treatment 4 (T_4): The diet + 1.5 mg Cr yeast/kg diet, Treatment 5 (T_5): The diet + 2 mg Cr yeast/kg diet.

Table 1: Composition and calculated analysis of the experimental diets

Ingredient (%)	Starter (0-3 wks)	Grower (3-5 wks)
Yellow corn	55.80	59.71
Soybean meal (44%)	34.32	30.00
Corn gluten	3.33	2.80
Vegetable oil	2.79	4.00
Dicalcium phosphate	1.94	1.67
Limestone	1.14	1.14
Common salt	0.25	0.25
Vit and min. premix*	0.25	0.25
DL. methionine	0.18	0.18
Total	100.00	100.00
Calculated composition**		
Crude protein (%)	22.00	20.00
ME. kcal/kg kcal ME/kg	3000.00	3100.00
Calcium (%)	0.97	0.91
Available Phosphorus (%)	0.50	0.45
Methionine + Cystein (%)	0.91	0.78
Lysine (%)	1.10	1.10

*Composition of vitamin and minerals premix. Each 3 kg of vitamin and minerals mixture contatin: 12000000 IU vitamin A; 2000000 IU D3; 10 gE; 1gk; 1 g Bl; 5 g B2 1500 mg B6; 10 mg B12; 10 g pantothenic acid; 20 g Nicotinic acid, 1 g Folic acid; 50 mg Biotin, 500 g choline chloride; 4 g copper; 300 mg iodine; 30 g iron; 60 g manganese; 50 g zinc and 100 mg selenium.
**According to NRC (1994)

Blood samples were collected at 35 days of age, 45 chickens where the number of chickens per treatment was 9. These chickens were slaughtered and blood samples were collected in centrifuge tubes with EDTA. The tubes were stoppered and centrifuged immediately (4000 rpm) for 15 min to separate plasma which was decanted into sterilized glass vials which were stoppered tightly and stored in a deep freezer until test. Plasma glucose was determined according to Trinder (1969) using commercial kits of (spectrum Co.). Plasma total proteins were determined by using colorimetric method according to Henery (1964) using commercial kits of (Biodiagnostic Co.). Plasma Albumin was determined using colorimetric method according to Doumas *et al.* (1971) using commercial kits of (Biodiagnostic Co.). The concentration of plasma globulins was obtained by subtracting the albumin value from the value of total protein for each plasma sample. Plasma total lipids were determined according to Knight *et al.* (1972) using commercial kits of (Biocon Co.) Plasma triglycerides were determined by triglycerides kits according Sidney and Barnard (1973) using commercial kits of (Biocon Co.). Plasma total cholesterol and HDL cholesterol was determined by cholesterol kits according to Richmond (1973) using commercial kits of (Biocon CO.). LDL cholesterol was determined according to Bergmenyer (1985) by calculation LDL = total cholesterol - HDL - TG/5 Plasma calcium and phosphorus were determined by using commercial kits of (Giesse Diagnostics company). According to Gindler and King (1972). T3 and T4 were analyzed by using radio immune assay kits as described by Sharp *et al.* (1987).

Uric acid was determined by enzymatic colorimetric test to Arliss and Entvistle (1981), using commercial kits (Biodiagnostic CO.). Plasma creatinine was determined by using spectrophotometer to Husdan and Rapaport (1968), using commercial kits (Biodiagnostic CO.). AST was determined according to Reitman and Frankel, (1957) using commercial kits (Biodiagnostic CO.). ALT was determined according to Reitman and Frankel, (1957) using commercial kits (Biodiagnostic CO.).

At the end of the experiment (5 weeks), three chickens from each replicate were chosen randomly and slaughtered, then internal organs (liver, Gizzard and heart) and lymphois organs (bursa, thymus and spleen) were removed, weighted and calculated as percentage of carcass weight.

Plasma chromium levels were analyzed by using atomic absorption spectrophotometer as described by Perkin, (1982). Five gram add justly weighed of selected tissue (liver, muscles, plasma) which were ashes in a muffle at 600^{0}C for 3 h. The ash was solved in concentrated hydrochloric acid at first, the washed in a limit quantity of hydrochloric acid 1 molar concentration and filtrate using ashless filtering papers. The filtrate was diluted properly and flam photometer was used for chromium determining (AOAC, 1980). The Cr was measured using Atomic Absorption (Spectrophotometer).

Meat samples were taken from breast and thigh to measure the biochemical analysis Ether Extract (EE), protein, Moisture and Ash, according to AOAC (1980).

Completely Randomized Design (CRD) was used to study the effect of difference treatment in all traits. Duncan (1955) multiple range test was used to compare the significant differences between means. Data were analyzed using statistical analysis system (SAS, 2001) by assuming the following model.

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

Where:

Y_{ij} = The value of observation of traits
μ = The overall mean of traits
T_i = The effect of treatments, control (T_1), (T_2), (T_3), (T_4) and (T_5).
e_{ij} = Random error assumed to be mean equal to zero and variance is σ^2e (N ~ 0, σ^2e)

RESULTS AND DISCUSSION

Figure 1 shows the effect of chromium yeast supplementation on glucose of chickens in different experimental groups. Analysis of data on plasma glucose concentration showed a significant ($p \leq 0.05$) difference between control and all Cr yeast supplemented groups. However there was no difference among Cr yeast groups. Glucose concentration in plasma was reduced as a result of feeding dietary Cr yeast at level 0.5, 1, 1.5, 2 mg, the values were 204.5, 202.4, 210, 201 mg/dl, respectively compared to control group 246.33 mg/dl.

Plasma total protein (Table 2) increased significantly ($p \leq 0.05$) due to inclusion Cr yeast into chickens diet in T_3, T_4 and T_5 and values were 2.55, 2.93, 3.13, 3.27, 3.54 g/dl for control T_2, T_3, T_4, T_5 groups, respectively. Plasma total protein value in 0.5 mg Cr yeast group (T_2) did not differ from the value of control (T_1), T_3 and T_4 group. Simultaneously plasma albumin values were not affected by treatments so that the elevation in plasma total protein was reflected as an increment in plasma globulin values which were affected significantly ($p \leq 0.05$) by treatments and were parallel to the total protein and the values were 1.16, 1.42, 1.94, 1.79, 2.07 g/dl for control, T_1, T_2, T_3, T_4, T_5 respectively.

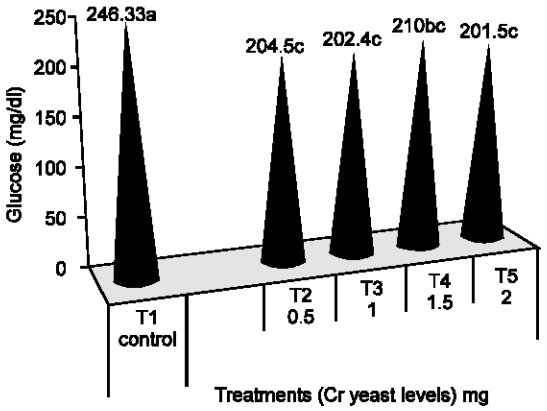

Fig. 1: Effect of Cr yeast levels on plasma glucose concentration in broiler chickens at 5 weeks. Means having different letters are significantly different ($p \leq 0.05$)

Table 2: Effect of Cr yeast levels on plasma total protein, albumin, globulin, total lipid, triglycerides and HDL in broiler chickens at 5 weeks

	Treatments (Cr yeast levels) mg				
Characters	T_1 (Control)	T_2 (0.5)	T_3 (1)	T_4 (1.5)	T_5 (2)
Total protein g/dl	2.55^{c}	2.93^{bc}	3.13^{ab}	3.27^{ab}	3.54^{a}
Albumin g/dl	1.39	1.51	1.19	1.48	1.48
Globulin g/dl	1.16^{c}	1.42^{bc}	1.94^{ab}	1.79^{ab}	2.07^{a}
Total lipid (g/dl)	4.86^{a}	3.86^{b}	4.30^{ab}	4.24^{ab}	3.72^{b}
Triglycerides (mg/dl)	165.33	158.00	138.00	157.33	143.00
HDL (mg/dl)	97.07	89.00	78.00	78.50	87.00

Means having different letters at the same row are significantly different ($p \leq 0.05$)

Table 2 shows the effect of chromium supplementation on lipid derivatives of broiler chickens. Plasma total lipid was significantly ($p \leq 0.05$) lower in T_2 and T_5 group ($p \leq 0.05$) as compared to the control group (T_1), T_2 and T_5 while there were no significant differences between T_1, T_5 and T_4. Significantly ($p \leq 0.05$) lowest total lipid levels of 3.72 and 3.86 g/dl were recorded for chickens supplemented 0.5, 2 mg chromium yeast/kg diet, respectively. The control group recorded the higher plasma total lipid 4.86 g/dl. while the other groups. T_3, T_4 recorded intermediate in total lipid level 4.3, 4.24 g/dl respectively with no significant ($p \leq 0.05$) difference compared to control as well as T_2, T_5 groups. There were reductions in plasma triglycerides due to feeding chromium yeast. This reduction lacked significance, triglyceride values 165.33, 158, 138, 157.3, 143 mg/dl for control, T_1, T_2, T_3, T_4 and T_5 respectively. The data indicated non significant ($p \leq 0.05$) difference between chromium yeast supplemented groups and the control group in plasma HDL.

Analysis of data on plasma total cholesterol showed significant ($p \leq 0.05$) differences between control (T_1) and chromium supplemented groups T_3, T_4 and T_5. However, there were no differences among chromium supplemented groups at all levels. Plasma total cholesterol was reduced as a result of adding chromium yeast into chick's diets. Furthermore, the reduction was significant at levels of 1, 1.5 and 2 mg Cr/kg diet and values were 128.3 130.3, 130.7, 146.66 mg/dl respectively compared to control group 168.06 mg/dl, but the cholesterol value in 0.5 mg Cr yeast group did not differ from the value observed in control group (Fig. 2).

The T_5 and T_4 group showed a significant decrease in LDL 14.7, 18.3 mg/dl respectively compared to control group 39.79 mg/dl. The LDL of chick fed T_2 and T_3 diet did not differ from the value recorded in control group T_1 as well as in T_4 and T_5 (Fig. 3).

The effect of chromium yeast on plasma calcium, phosphorus, T_3 and T_4 hormones are illustrated in Table 3. Blood calcium concentration was not affected significantly ($p \leq 0.05$) by adding different levels of chromium yeast into broiler diets. The calcium concentration were 4.25, 4.38, 4.23, 3.43, 4.67 mg/dl for control, T_1, T_2, T_3, T_4, T_5 group respectively. Also the plasma phosphorus concentration did not significantly ($p \leq 0.05$) differ among chromium yeast supplementation groups and control group. It is obvious that the phosphorus of chickens feed diet supplemented with chromium yeast was slightly lower than those fed control diet, the values were 5.94, 5, 5.46, 5.55, 5.5 mg/dl for control T_1, T_2, T_3, T_4, T_5 groups, respectively. Analysis of variance showed a non significant ($p \leq 0.05$) effect of the different levels of chromium yeast supplementation on the level of T_3, T_4 hormones.

Table 4 shows the effect of Cr yeast on some kidney function test of chickens in different experimental groups. The results showed that the dietary control and diet with 0.5, 1.5, 2 mg Cr yeast supplemented had no effect on plasma creatinine level and values were 0.82, 0.83, 0.77, 0.74, 0.64 mg/dl respectively. Plasma uric acid levels were not affected by feeding diet with Cr yeast and values were 3.45, 4, 3.79, 3.35, 3.55 mg/dl for control, T_1, T_2, T_3, T_4, T_5 groups respectively. The same Table 4 shows the effect of chromium yeast on some liver enzymes activity of chickens fed experimental diets. The present data showed that the blood concentration of ALT and AST enzyme was not affected significantly ($p \leq 0.05$) by adding Cr yeast into diets.

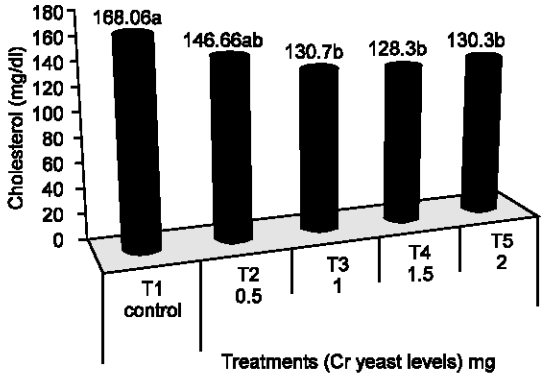

Fig. 2: Effect of Cr yeast levels on plasma cholesterol in broiler chickens at 5 weeks. Means having different letters are significantly different ($p \leq 0.05$)

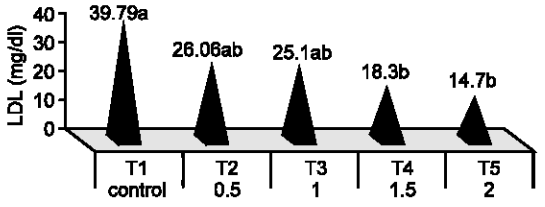

Fig. 3: Effect of Cr yeast levels on plasma LDL in broiler chickens at 5 weeks. Means having different letters are significantly different ($p \leq 0.05$)

Table 3: Effect of Cr yeast levels on plasma calcium, phosphorus, T3 and T4 level in blood plasma of broiler chickens at 5 weeks

	Treatments (Cr yeast levels) mg				
Characters	T_1 (Control)	T_2 (0.5)	T_3 (1)	T_4 (1.5)	T_5 (2)
Calcium (mg/dl)	4.25	4.38	4.23	3.43	4.67
Phosphorus (mg/dl)	5.94	5.00	5.46	5.55	5.50
T_3 (ng/ml)	3.95	3.77	3.42	3.78	3.91
T_4 (ng/ml)	12.95	12.52	13.05	12.73	13.55

Table 4: Effect of Cr yeast levels on plasma creatinine uric acid, ALT and AST in broiler chickens at 5 weeks of age

	Treatments (Cr yeast levels) mg				
Characters	T_1 (Control)	T_2 (0.5)	T_3 (1)	T_4 (1.5)	T_5 (2)
Creatinine (mg/dl)	0.82	0.83	0.77	0.74	0.64
Uric acid (mg/dl)	3.45	4.00	3.79	3.35	3.55
ALT (µ/L)	72.8	74.35	82.56	69.10	80.2
AST (µ/L)	10.15	10.89	11.19	9.89	11.29

Table 5: Effect of Cr yeast on internal organs percentage in broiler chickens at 5 weeks of age

	Treatments (Cr yeast levels) mg				
Characters (%)	T_1 (Control)	T_2 (0.5)	T_3 (1)	T_4 (1.5)	T_5 (2)
Liver	2.11	2.31	2.61	2.12	2.21
Gizzard	2.71	2.48	2.27	2.43	2.61
Heart	0.64	0.62	0.58	0.59	0.74

Table 6: Effect of Cr yeast levels on lymphoid organs percentage in broiler chickens at 5 weeks of age

	Treatments (Cr yeast levels) mg				
Characters (%)	T_1 (Control)	T_2 (0.5)	T_3 (1)	T_4 (1.5)	T_5 (2)
Bursa	0.264	0.192	0.191	0.170	0.186
Thymus	0.499	0.531	0.486	0.276	0.455
Spleen	0.110^{b}	0.115^{b}	0.158^{ab}	0.140^{ab}	0.173^{a}

Means having different letters in the same row are significantly different ($p \leq 0.05$)

The relative weights of the internal organs of chickens fed different experimental diets are shown in Table 5. Liver weight % was not affected by supplementing different levels of chromium yeast in the diet of chickens. The values of gizzard weight percentage were 2.71, 2.48, 2.27, 2.43 and 2.61 for control T_1, T_2, T_3, T_4, T_5 respectively which were not affected by dietary treatments. Heart weight percentage was not affected by using chromium yeast into diets. And average values were 0.64, 0.62, 0.58, 0.59 and 0.74 for treatment T_4, T_2, T_3, T_1 and T_5 respectively.

The relative weights of lymphoid organs are shown in Table 6. Neither bursa nor thymus percentage was affected by supplemented chromium yeast to chickens diets, whereas spleen relative weight significantly ($p \leq 0.05$) increased due to feeding Cr yeast (T_5). The spleen relative weight was significantly ($p \leq 0.05$) higher in chickens which received 2 mg Cr yeast (T_5) 0.173% as compared to control group (T_1) (0.11%) and T_2 group (0.115%). Both 1 mg Cr yeast (T_3) and 1.5 mg Cr yeast (T_4) groups (0.158%, 0.14%, respectively) did not differ from the 2 mg Cr yeast T_5 group, as well as from control and 0.5 mg cr yeast (T_2) groups.

The effects of chromium levels on tissue concentration is presented Table 7. Chromium levels for T_3, T_4 and T_5 were significantly ($p \leq 0.05$) higher than those the control group, while supplementing 0.5 mg chromium group did not differ significantly from all other supplemented groups and the control.

The values for liver chromium were 18.62, 20.70, 23.50, 25.12 and 25.53 (µg/100 mg) for the treatment T_1, T_2, T_3, T_4 and T_5 respectively.

Muscle chromium were significantly ($p \leq 0.05$) higher for T_4 and T_5 (1.5 mg and 2 mg chromium/kg diet), while chromium levels for T_3 (1 mg/kg diet) did not differ significantly than T_4, T_5 and the control group. Average values for muscle chromium level were 14.80, 16.32, 20.33, 22.21 and 22.00 for the T_1, T_2, T_3, T_4 and T_5 respectively.

Plasma chromium levels followed a similar trend as muscle chromium (Table 7). Plasma chromium levels for the groups that were supplemented with 1.5 mg and 2 mg/kg diet had significantly ($p \leq 0.05$) higher plasma chromium levels as compared to the control group while plasma chromium levels for T_3 (1 mg/kg diet) did not differ significantly than T_4 and T_5 (1.5 mg and 2 mg/kg diet) and the control group. Average values for plasma chromium were 4.05, 4.38, 5.25. 5.79 and 5.82 treatments T_1, T_2, T_3, T_4 and T_5 respectively.

Chemical composition of breast muscles is presented in Table 8. Protein percentage of the breast muscle was significantly ($p \leq 0.05$) higher in chickens which received 1, 1.5 and 2 mg Cr yeast (T_3, T_4 and T_5) followed by chickens which received 0.5 mg Cr yeast (T_2) compared to control group. The values were 25.9, 25.53, 25.52, 23.59 and 22.84% for treatments T_5, T_4, T_3, T_2 and T_1 respectively. The protein percentage in thigh muscle depicted a similar trend as the breast muscle the average values were 21.53, 21.47, 21.34, 20.28 and 19.4% for T_5, T_4, T_3, T_2 and control T_1 groups respectively. The use of Cr yeast in feeding of chickens caused the significant ($p \leq 0.05$) reduction in the breast muscles fat content in and the highest reduction was observed in T_3 group (6.52%) followed by T_5, T_4, T_2 group compared to control (T_1) group, 7.04, 7.1, 7.4 and 8.2% respectively. The thigh muscle fat percentage was significantly ($p \leq 0.05$) lower in chickens which received 2, 1.5, 1 mg Cr yeast compared to 0.5 cr yeast group and control group the values were 10, 10.9, 11.08, 12.5 and 13.09 respectively. The moisture and Ash content of breast and thigh muscle did not differ significantly ($p \leq 0.05$) between treatment groups.

Table 7: Effect of Cr yeast levels on liver, muscle, plasma, chromium level in broiler chickens at 5 weeks

Characters (chromium level)	Treatments (Cr yeast levels) mg				
	T_1 (Control)	T_2 (0.5)	T_3 (1)	T_4 (1.5)	T_5 (2)
Liver (µg/100 g)	18.62^{b}	20.70^{ab}	23.50^{a}	25.12^{a}	25.53^{a}
Muscle (µg/100 g)	14.80^{b}	16.32^{b}	20.33^{ab}	22.21^{a}	22.00^{a}
Plasma (µg/dl)	4.05^{b}	4.38^{b}	5.25^{ab}	5.79^{a}	5.82^{a}

Means having different letters in the same row are significantly different ($p \leq 0.05$)

Table 8: Effect of Cr yeast levels on chemical analysis of broiler breast and thigh muscles

Characters (%)	Treatments (Cr yeast levels) mg				
	T_1 (Control)	T_2 (0.5)	T_3 (1)	T_4 (1.5)	T_5 (2)
Muscle protein					
Breast	22.84^{c}	23.59^{b}	25.53^{a}	25.52^{a}	25.9^{a}
Thigh	19.40^{c}	20.28^{b}	21.34^{a}	21.47^{a}	21.53^{a}
Muscle fat					
Breast	8.20^{a}	7.40^{b}	6.52^{c}	7.10^{bc}	7.04^{bc}
Thigh	13.09^{a}	12.50^{a}	11.08^{bc}	10.90^{bc}	10.00^{c}
Muscle moisture					
Breast	67.71	67.79	66.59	66.00	65.63
Thigh	66.32	65.93	66.42	66.34	67.14
Muscle ash					
Breast	1.25	1.22	1.36	1.38	1.33
thigh	1.19	1.29	1.29	1.29	1.23

Means having different letters in the same row are significantly different ($p \leq 0.05$)

In this study there was a significant reduction in blood glucose level (Fig. 1) in chickens fed dietary Cr yeast. Ali (2006) found that organic Cr supplementation markedly decreased blood glucose level and this could be explained by supplementing chromium may increase glucose clearance rate which resulted in decrease plasma glucose and cholesterol in chickens fed 800 or 1.600 ug/kg of diet (Kim *et al*., 1996).

Plasma total protein (Table 2) increased significantly due to adding Cr yeast. This result confirmed the findings of Eshra (2005) who observed a linear increase in blood total proteins levels with increasing dietary supplementation of Cr yeast in chicken. In contrary to the present results. Chen *et al*. (2001) reported that dietary Cr at 1 to 3 mg/kg diet to male turkey diet did not significantly influence serum total proteins. Blood content of albumin was not affected significantly by Cr yeast levels. The same results were recorded by Ibrahim (2005). Plasma globulin values were affected significantly by Cr yeast supplementation.

The increase in plasma protein and Globulin in the chickens that were supplemented with 1, 1.5 and 2 mg/kg (T_3, T_4 and T_5) increased protein synrhesis in the supplemented group over the control group, which resulted in highly live body weight and weight gain, these group as compared to the control group. These results are in agreement with the findings of Roginiski and Mertz (1969) who reported that chromium supplementation increased amino acid incorporation into heart protein and amino acid uptake into tissues of rats.

There were a significant reduction in plasma total lipids, cholesterol, LDL due to feeding Cr yeast, this results confirms the finding of Abraham *et al*. (1982 a,b) that, Cr is essential for lipid metabolism. Also Uyanik *et al*. (2002), Ali (2006) observed a reduction in plasma total lipid, cholesterol by adding Cr and illustrated that, the decrease in lipid parameters could results from the increasing activity of insulin that depressed the fatty acid synthesis by increasing glycogen build up. Triglycerides and HDL cholesterol were did not affect these results is similar to finding of El-Afifi (2008).

Blood calcium and phosphorus (Table 3) were not affected significantly by adding Cr yeast into diets. This result is similar to that findings of Kalaycioglu *et al*. (1999).

The data (Table 3) showed a non significant effect of the Cr yeast supplementation on the level of T_3, T_4 hormones. The same result were recorded by Mostafa (2007).

The results (Table 4) showed that the dietary Cr yeast supplementation had no effect on plasma ALT, AST enzymes and indicated that Cr yeast had no deleterious effect on liver function. These results are in agreement with there obtained by (Karam *et al*., 2007; Mostafa 2007).

The results showed that the dietary Cr yeast had no effect on plasma uric acid plasma creatinine (Table 4) which may reveal that the Cr yeast levels used in the present study were safe for birds and had non deleterious effects on kidney function of treated chickens Mostafa (2007).

Bursa and Thymus percentage Table 6. were not affected by dietary supplementation of chromium yeast, while spleen percentage was only significantly ($p<0.05$)

in T_5 (2 mg Cr yeast) this could be an indicator to supplement Cr in levels lower than 2 mg/kg due the negative effect of this levels. These results are not in agreement with Mostafa (2007) who used Cr yeast a level of 4 mg/kg.

The Liver, muscle and Plasma chromium level (Table 7) increased significantly due to adding chromium yeast. This result confirmed the findings of Hossain *et al.* (1998), who observed a linear increase in blood, Muscle and liver, chromium levels with increasing dietary supplementation of Cr yeast.

This study showed that altering the dietary concentration of Cr yeast in broiler diets affected deposition of fat and protein (Table 8). The breast muscle protein percentage was significantly high in broiler received diet with 1, 1.5 and 2 mg Cr yeast. The protein percentage in thigh muscle depicted a similar trend as that of the breast muscle. These are in agreement with Anandhi *et al.* (2006) who concluded that the breast and thigh muscle protein levels significantly increased in 500 and 750 µg Cr yeast supplemented of broiler. But, Amatya *et al.* (2004) observed a non significant increase in protein accretion in broiler meat when Cr level was 0.2 mg/kg diet. Adding Cr yeast decreased carcass fat deposition in breast and thigh muscle. The same results were obtained by (Lien *et al.*, 1999; Choct *et al.*, 2000) who had recorded less fat content in muscle of broiler fed diet with Cr at different levels. Significant increase in muscle protein content may be attributed to the stimulating effect of protein synthesis by a supplement of Cr (Lien *et al.*, 1999). Chromium supplementation increased amino acids uptake into tissue (Chen *et al.*, 2001; Roginiski and Mertz, 1969).

IT can be concluded that using Cr yeast to broiler feeding had beneficial effects on some physiological traits.

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