J. Agric. Sci. Mansoura Univ., 33 (7): 4927 - 4936, 2008

EFFECT OF ADDING CHROMIUM PICOLONATE INTO BROILER DIETS ON THEIR PERFORMANCE AND DIGESTIVE ENZYME

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ABSTRACT

An experiment was conducted to investigate the effect of different graded levels of chromium picolonate on performance of broiler chicks, some digestive enzymes activity, carcass yield and some blood constituents. For this purpose three hundred day old Cubb broiler chicks were allocated into five treatment groups. For five weeks experimental period, four groups of birds were fed on corn soy-basal diets supplemented with 0.25mg, 0.5mg, 0.75mg or 1mg/kg diet chromium of chromium picolonate whereas the fifth group was the control.

Average body weight improved due to feeding supplemental chromium diets. The group of birds fed 0.5mg chromium picolonate recorded the highest body weight (1888g) followed by those fed 0.75mg Cr (1872g) compared with (1788g) for control. Feed consumption values were not affected by treatments for the entire experimental period. Feed conversation (g feed/g gain) improved as a result of feeding dietary chromium. The beneficial effects of chromium supplementation may be related to its effect on stimulating digestive enzymes activity and immune response. Amylase enzyme activity was significantly elevated in jejunum and ileum due to feeding chromium enriched-diets, while lipase enzyme was slightly increased due to treatment in jejunum only. Trypsine and chemotrypsine enzymes were not affected by treatments. Dressed carcass and breast meat yield percentages were increased due to adding chromium into diets while; thigh, drumstick or back percentages were not affected.

Supplemental organic chromium significantly increased plasma concentration of glucose, total lipids, cholesterol and triglycerides while plasma high density lipoprotein cholesterol (H.D.L.) was not affected. Plasma total protein and globulin increased significantly due to treatments while, plasma albumin was not affected. Albumin to globulin ratio decreased by inclusion of chromium into broiler diets that may indicate enhancement in immune response of birds.

INTRODUCTION

Trivalent chromium is well known as an essential trace element for nutrients metabolism in human and animals (Mertz 1992).

The primary role of chromium in nutrients metabolism is to potentiate the action of insulin through its presence in an organometallic molecule, called the glucose tolerance factor (GTF) (Anderson 1987; Sahin *et al.* 2001). Insulin has been shown to increase the glucose and amino acids uptake into muscle cells to regulate energy production, muscle tissue deposition, fat metabolism and cholesterol utilization. (Moat, 1994; Olin *et al.* 1994) chromium has been included in poultry researches as an inorganic compounds like chromium chloride (crcl3) or organic complex such as chromium picolonate, nicotine and high chromium yeast (Toghyani *et al.*; 2006).

However, chromium picolonate is the most common chromium in the poultry diets due to its high absorbability and low toxicity (Line *et al.* 1999).

Dietary supplementation of chromium picolonate could result in improved body gain, and feed conversion ratio of broiler chicks (Lien *et al.*, 1999; Toghyani *et al.*, 2006; Anandhi *et al.*, 2006). In addition it increases carcass weight breast meat yield and reduces carcass fat (Hossain *et al.*, 1998; Toghyani *et al.*, 2006). Furthermore it increases digestive enzymes activity (Karam *et al.* 2007). As well, reduces blood cholesterol, total lipids and glucose (Lien *et al.*, 1999; Sahin *et al.*, 2002).

It seemly that, the favorable action of chromium picolonate may be is related to its level in broiler diet. Ward *et al.*, (1995) and Lien *et al.* (1993) showed that, enriched broiler diets with 100, to 400mg chromium picolonate /kg did not affect their growth or carcass composition.

Therefore, the objectives of this study were to evaluate the effects of different graded levels of chromium picolonate on performance, carcass traits, hematological parameters and digestive enzyme activity in broiler chicks.

MATERIALS AND METHODS

This experiment was conducted at ″Broiler Nutrition Unit″ Faculty of Agric., Ain Shams Univ. Three hundred one-day Cubb broiler chicks were allocated randomly into fife treatment groups of 60 birds and divided into three replicates with 20 birds each. Four experimental groups of birds were fed on a corn-soybean basal diet supplemented with 0.25 mg, 0.5 mg, 0.75mg or 1 mg/kg of chromium picolonate whereas the fifth group was control.

Two basal diets were formulated (Table1) to meet the nutrients requirements of chicks during the starter (0-3 wk) and grower (3-5 wk) periods according to NRC (1994). The chicks were housed in floor pens with wood-shaving litter. Electrical heaters were used to obtain suitable environmental temperature and artificial lighting was provided constantly. Water and mach feed was provided ad lib. Individual body weights were recorded weekly for each chick and the average body weight and body weight gain was calculated for each group based on the two experimental periods (0-3 & 0-5 week). Feed conversion ratio was calculated as gram feed /gram gain in the same manner.

Digestive enzymes and Carcass traits. At the end of experiment 6 birds were chosen to represent the three replicate of each treatment. The birds were slaughtered in a horizontal position to reduce the anti peristaltic movement of the intestinal segments. The slaughtered birds allowed to bleed, defeathered and internal organs were separated.

For digestive enzymes activity the content of jejunum and ileum were collected, weighed and kept in equal volumes of buffer saline solution. The contents were then individually centrifuged (6000 rpm for ten min.) and the supernatant fluids were decanted and used for the determination of some digestive enzymes activity. Amylase activity was determined using the method described by Pinshasov and Noy. (1994), lipase activity according to Skalan, *et al.* (1975) and both Trypsine and Chemotrypsine according to Skalan and Helevy (1985).The enzymes were assayed in four chicks of slaughtered birds.

Table (1): Composition of experimental basal diets

Ingredients	Starter (0-3 wks)	Grower (3-5 wks)
Yellow corn	55.8	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. & min. premix*	0.25	0.25
DL. Methionine	0.18	0.18
Total	100	100
Calculated composition		
Crude protein%	22.00	20.00
M.E. Kcal/kg	3000	3100
% Calcium	0.97	0.91
%Available phosphours	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 contain: 12000000 IU vitamin A; 2000000 IU D3; 10g E ; 1g K ; 1 g B1 ; 5g B2; 1500mg B6 ; 10mg B12 ;10g Pantothenic acid ; 20g Nicotinic acid ; 1g Folic acid ; 50mg Biotin ; 500 g choline chloride ;4 g copper ; 300 mg iodine ; 30g iron ;60 g Manganese; 50g Zinc; and 100mg selenium

For carcass traits Bursa, Spleen and Thymus were weighted. Head and Leg were separated and dressed carcass was weighed and calculated as percentage of live body weight. The dressed carcass was divided into breast, thigh, drumstick, two wings, back and neck which were weighed and calculated as percentage of dressed carcass weight.

Blood constituents. Blood samples were collected in heparin-zed tubes and centrifuged immediately for 15 minutes to separate plasma that was decanted and frozen up to chemical analysis.

Plasma total protein was determined according to Biuret method described by Henery (1964) and albumin according to Doumas *et al.* (1971). Plasma globulin was obtained by subtracting albumin from total protein values. Plasma total lipid was determined according to Knight *et al.* (1972) and total cholesterol according to Watson (1960). High density lipoprotein cholesterol (H.D.L.) and triglyceride was assayed by using kits of Diamond Diagnostics Company. Plasma concentration of Glucose was determined immediately before plasma frozen by using kit of Spectrum diagnostic company.

Statistical Analysis. Statistical analysis was computerized by statistical program SAS (1994), with using Duncan's multiple range tests to separate means.

RESULTS AND DISSCUSION

Performance aspects*.* Body weight of broiler chicks (Table 2) were positively affected by adding chromium picolonate into their diets either at 3 or 5 week of age. The level of 0.5mg/kg diet of cr pico was the most effective in increasing body weight which was followed by 0.75 mg/kg. This result is in agreement with those obtained by Kim *et al.* (1996) and Bhuvensh *et al.* (2004) who observed an increase in body weight of broiler chicks fed chromium-supplemented diets.

Table(2):Effect of chromium picolonate on performance of broiler hicks.

Items	Control	Cr Pico 0.25 mg	Cr Pico 0.50 mg	Cr Pico 0.75 mg	Cr Pico 1 mg
			At: 0-3 weeks		
Body wt. (g)	710.3^{b}±15.7	706.5^{b}±13.9	758.9^{a}±13.1	744.8^{ab}±15.6	731.2^{ab}±13.4
Feed intake (g)	1350^{ab}±28.2	1282.5^{b}±25.6	1368.5^{a}±25.7	1351^{ab}±25.9	1302^{ab}±28.8
Feed conversion g feed/g gain	2.02±0.08 (100)*	1.93±0.01 (105)	1.87±0.03 (108)	1.92±0.01 (105)	1.89±0.06 (107)
			At:0-5 weeks		
Body wt. (g)	1788.5^{b}±30.2	1814^{ab}±26.5	1888.3^{a}±30.4	1872.7^{ab}±30.1	1824.6^{ab}±18.9
Feed intake (g)	3735.7^{a}±76	3578.0^{a}±28.3	3850.5^{a}±95	3619.5^{a}±70.2	3697.3±116
Feed conversion g feed/g gain	2.14^{a}±0.02 (100)*	2.02^{ab}±0.01 (106)	2.09^{ab}±0.03 (102)	1.97^{b}±0.04 (109)	2.07^{ab} ±0.08 (103)

a-b differences within rows, means with no common superscripts differ significantly ($p \geq 0.05$)
( )* values as percentage to control.

Feed consumption values were not affected by feeding diets enriched with chromium picolonate at the 5 or 3 week of age. Anandhi *et al.* (2006) and Motozona *et al.* (1998) did not record any effect on feed consumption of broiler chicks fed excessive chromium diets.

Feed conversation ratios (g feed/g gain) were enhancing by enriching Cr picolonate into broiler diets, this improvements were related as percentage to control and ranged between 5% to 8% at 3 week of age and from 2% to 9% at 5 week of age. Kim *et al.* (1995) and Uyanik *et al.* (2002) reported that supplementation of organic chromium significantly improved feed conversion ratio of broiler chicks.

Generally, the beneficial effects of Cr picolonate supplementation may be obtained since most broiler diets are primarily composed of ingredients from plant origin which are usually low in chromium content (Anandhi *et al.* 2006).

In addition, many illustration have been introduced to reveal the beneficial action of organic chromium on performance of broiler chicks, Evans and Bowman (1992) and Linderman *et al.* (1995) demonstrated that, Cr picolonate increase amino acids and glucose uptake by muscle cells that may enhance protein and energy utilization, consequently improve performance characteristics. Karam *et al.* (2007) and Kornegay *et al.* (1997) related the beneficial action of Cr supplementation to increase digestive enzyme activity and nutrients utilization. Furthermore; supplemental chromium may enhance the immune response (Uyanik *et al.* 2002) and ameliorate the negative effect of environmental stress (Sahin *et al.* 2002).

In the current experiment Cr inclusion increase the digestive enzyme activity (Table 3). Consequently increase nutrients utilization and improve performance aspects.

Table (3): Effect of chromium picolonate on Amylase, Lipase, Trypsine and chemotrypsine in jejunum and ileum

parameters	Control	Cr Pico 0.25 mg	Cr Pico 0.50 mg	Cr Pico 0.75 mg	Cr Pico 1 mg
			In Jejunum		
Amylase (mg/dl)	1.78±0.285	2.07±0.398	2.55±0.081	2.14±0.098	2.36±0.165
Lipase (mg/dl)	10.36±0.727	12.20±1.80	13.31±0.707	10.73±0.999	12.10±1.65
Trypsine (mg/dl)	21.42±2.75	21.09±3.33	26.83±1.30	22.11±3.27	21.91±4.17
Chemotrypsine (mg/dl)	14.78±1.16	15.56±3.72	15.85±1.02	16.92±1.62	14.56±2.07
			In Ileam		
Amylase (mg/dl)	1.86±0.146	2.00±0.182	2.08±0.112	2.10±0.140	1.85±0.113
Lipase (mg/dl)	9.40±0.512	8.66±1.26	9.25±0.689	8.57±0.574	8.71±0.833
Trypsine (mg/dl)	7.66±0.542	9.01±0.389	7.32±0.774	8.52±0.348	7.68±0.254
Chemotrypsine (mg/dl)	8.27^{a}±1.09	7.78^{ab}±0.479	6.19^{b}±0.066	6.65^{ab}±0.151	7.52^{ab}±0.634

a-b within rows, means with no common superscripts differ significantly ($p \geq 0.05$)

Digestive enzymes activity Amylase activity was elevated in jejunum and ileum due to enriching broiler diets with chromium picolonate, however the increment lacked significant. This result is in accordance with those obtained by Karam *et al.* (2007) who observed an increase in amylase enzyme in digestive tract of broiler chicks fed diets enriched with chromium chloride. It could be suggested that the excessive chromium supplementation may potentate insulin activity and increase cell uptake of glucose which incorporated into glycogen (Wayne *et al.* 1989). This process may stimulate amylase enzyme activity to breakdown more starch into glucose for compensating the ratio of glucose used up by high insulin activity. Hossain *et al.* (1998) reported that, chromium is an integral component of glucose tolerance factor, which regulate energy production.

There was a non slight significant increase in lipase enzyme activity of jejunum by feeding chromium supplemented-diets. It may be assumed that, supplemental chromium could stimulate lipid metabolism throughout its effect on lipase enzyme (Karam *et al.* 2007; Steele and Rasebrough 1981). Trypsine and chemotrypsine enzymes were not affected by chromium addition, and their values have not a proper symmetric trend. This result is in harmony with those of Karam *et al.* (2007) who did not observe any effect on Trypsine or chemotrypsine enzymes in broiler chicks, due to feeding Cr chloride supplemented-diets. It is likely that, the beneficial effect of chromium supplementation is more related to carbohydrates and lipid metabolism via its interference with insulin secretion, since chromium influence on digestive-protein enzymes (Trypsine, chemotrypsine) was not obvious.

Carcass traits. Dressed carcass percentages were increased due to adding chromium picolonate into diets, beyond that, the increment was significant at levels of 0.5mg, 0.75mg and 1 mg Cr picolonate (Table 4). As well, breast yield percentages were increased significantly due to adding 0.75 mg Cr picolonate into broiler diets while the increment in other treatments lacked significance. Both of thigh and drumstick were not affected by treatments. There were a reduction in wings and neck percentage due to feeding chromium diets while; back portion percentage was not affected clearly.

Table (4): Effect of chromium picolonate on carcass yield percentage and some immunity and internal organs

Items	Control	Cr Pico 0.25 mg	Cr Pico 0.50 mg	Cr Pico 0.75 mg	Cr Pico 1 mg
Dressed carcass% *	68.7^{b}± 1.14	70.98^{ab}±0.28	72.72^{a}±0.54	71.99^{a}±0.57	71.88^{a}±1.29
Thighs % **	16.85±0.57	16.15±0.44	15.33±0.126	14.78±1.11	16.16±0.436
Drumstick % **	12.56±0.42	12.35±0.15	12.74±0.36	12.31±0.37	11.82±0.09
Breast % **	26.55[لا]±0.87	27.24^{b}±1.08	26.73^{b}±0.47	32.75^{a}±2.04	28.06^{b}±1.05
Neck % **	6.29[ش]±0.69	5.48^{ab}±0.26	5.37^{ab}±0.79	4.24^{b}±0.36	5.39^{ab}±0.62
Wings % **	12.73±0.74	12.01±0.34	11.89±1.17	10.74±0.34	11.01±0.52
Back % **	24.39^{c}±0.33	25.53^{bc}±0.54	27.18^{ab}±0.46	23.58^{c}±1.53	28.32^{a}±0.68
Bursa**	0.26±0.018	0.21±0.03	0.24±0.05	0.17±0.03	0.18±0.02
Thymus**	0.553±0.061	0.515^{ab}±0.114	0.46±0.072	0.49±0.038	0.63±0.074
Spleen**	0.183^{a}±0.024	0.128^{b}±0.016	0.123^{b}±0.009	0.135^{b}±0.005	0.123^{b}±0.003

a-b-c within rows, means with no common superscripts differ significantly ($p \geq 0.05$)
*** % percentage of live body weight**
**** % percentage of dressed carcass weight**

The present results are in a good agreement with the finding of Toghyani *et al.* (2006) and Sahin *et al.* (2002) who observed an increase in carcass yield of broilers fed supplemental Cr picolonate. As well, Hossain *et al.* (1998) reported that carcass percentage and breast meat yield was significantly influenced by Cr yeast supplementation.

The beneficial effect of feeding supplemental chromium on carcass and breast meat yield may be related to its role in increasing amino acids uptake, incorporation and utilization (Hossain *et al.* 1998), ultimately increase protein deposition, muscles synthesis and meat yield (Sahin *et al.* 2002).

Neither bursa nor thymus weight was affected by treatments whereas spleen weight significantly dcreased due to feeding Cr picolonate supplemented diets. El-Hommosany (2008) did not find any effect on bursa or spleen weight due to adding Cr chloride into quail diets.

Blood constituents*.* Glucose concentration in plasma reduced as a result of feeding dietary chromium (Table 5). This result is well accepted since chromium stimulates glucose metabolism via potentiates insulin hormone action. Sahin *et al.* (2002) found that, supplementation of Cr picolonate into broiler diet, decrease plasma glucose and increase plasma insulin concentration.

Lipid derivatives. There were reductions in plasma total lipid, triglycerides and cholesterol due to feeding excessive chromium picolonate (Table 5). This reduction was significant in total lipid and lacked significance in cholesterol and triglycerides values while H.D.L. cholesterol was not affected. This result confirms the finding of Abraham *et al.* (1982 a, b) that, chromium is essential for lipid metabolism Uyanik *et al.* (2002) observed a reduction in plasma total cholesterol, triglycerides of quails fed supplemental chromium and illustrated that, the decrease in lipid parameters could result from the increasing activity of insulin that depressing the fatty acid synthesis by increasing glycogen build up.

Table (5): Effect of chromium picolonate on some blood constituents

Items	Control	Cr Pico 0.25 mg	Cr Pico 0.50 mg	Cr Pico 0.75 mg	Cr Pico 1 mg
Glucose mg/dl	239.75^{a}±13.29	197.25^{b}±2.66	210.0^{b}±3.83	213.33^{b}±5.46	205.2^{b}±10.82
Cholesterol mg/dl	149.50±3.48	124.25±12.11	137.0±13.65	128.33±13.98	120.75±9.61
HDL mg/dl	88.75±5.62	79.0±6.63	92.0±2.65	87.67±1.76	88.75±4.27
Total lipid mg/dl	4.78^{a}±0.35	3.58^{b}±0.29	4.67^{a}±0.43	3.33^{b}±0.13	3.38^{b}±0.33
Triglycerides mg/dl	174.0±8.91	144.25±13.59	164.0±17.21	124.0±14.76	146.0±23.09
Total protein g/dl	2.43^{c}±0.12	2.74^{bc}±0.04	2.80^{bc}±0.08	3.03^{b}±0.26	3.60^{a}±0.10
Albumin	1.39±0.14	1.49±0.07	1.48±0.04	1.26±0.09	1.48±0.16
Globulin g/dl	1.04^{c}±0.19	1.26^{bc}±0.10	1.33^{bc}±0.09	1.77^{ab}±0.34	2.12^{a}±0.24
Alb. / glob. ratio	1.52^{a}±0.35	1.22^{ab}±0.16	1.14^{ab}±0.11	0.83^{b}±0.21	0.75^{b}±0.17

a-b-c within rows, means with no common superscripts differ significantly ($p \geq 0.05$)

Blood protein and immunity. Plasma proteins (Table 5) increased significantly due to inclusion of Cr picolonate into broiler diets. 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 by treatments and were parallel to the total protein values. This result confirms the finding of Sahin *et al.* (2002) who observed an increase in blood total protein with feeding supplemental chromium. A lack of chromium effect on plasma albumin was also reported by Karam *et al.* (2007) and Ibrahim *et al.* (2005). The high concentration of globulin inherent with low ratios of albumin to globulin (A/g) may indicate an enhancement in immune function of birds fed dietary chromium. Uyanik *et al.* (2002), observed an increase in immunoglobulin levels and antibody titers of broiler fed diets supplemented with chromium.

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تأثير إضافة بيكولونات الكروم إلى علائق كتاكيت اللحم على الاداء الانتاجى ونشاط الانزيمات الهاضمه

لمى خالد بندر ، نجلاء كمال سليمان و سنبل جاسم الحمودى
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أجريت هذه التجربه لدراسة تأثير المستويات المختلفه من بيكلونات الكروم على الاداء الانتاجى لكتاكيت التسمين وبعض صفات الذبيحه ونشاط الانزيمات الهاضمه.

استخدمت الدراسه عدد ٣٠٠ كتكوت تسمين عمر يوم من سلاله (كب) تم توزيعها عشوائيا بالتساوى على خمس معاملات بواقع ٦٠ كتكوت بكل معامله، غذيت الطيور على عليقه قاعديه من الذرة وفول الصويا حيث أضيف لها اربع مستويات من بيكلونات الكروم وهى. ٢٥ و٠,٥٠و٠,٧٥ و١ مجم/كجم علف والمعامله الخامسه كانت الكنترول.

أشارت النتائج الى تحسن فى وزن الجسم نتيجه لاضافة الكروم للعلائق وسجلت الكتاكيت المغذاة على ٠,٥مجم كروم بيكلونات أعلى معدل لوزن الجسم (١٨٨٨,٣جم) تلاها تلك المغذاة على ٠,٧٥مجم كروم بيكلونات (١٨٧٢,٧جم) مقارنة ب ١٧٨٨,٥ جم للكنترول. الاستهلاك الغذائى لكامل فترة التجربه لم يتأثر بالمعامله. معدلات التحويل الغذائى تحسنت بمعدل ٢٪ الى ٩٪ نتيجة التغذيه على علائق الكروم وربما يرجع هذا التحسن فى الاداء الانتاجى لتأثير الكروم المنشط للإنزيمات الهاضمه المحفز للمناعه مما يؤدى لتحسن الاستفادة من العلائق.

لم يتأثر كل من نشاط انزيم الاميليز و الليبيزو التربسين أو الكيموتربسين فى كل من اللفائفى أو الصائم نتيجه التغذيه على علائق الكروم,.

كان هناك زيادة معنويه فى النسبه المئويه للذبيحه ولحم الصدر نتيجه لاضافة الكروم للعلائق كذلك تأثرت النسبه المئويه للاجزاء الخلفيه للذبيحه بالمعامله.

أضافة الكروم للعلائق أدى لانخفاض مستوى الجلكوز والليبيدات الكليه ببلازما الدم بينما لم يتأثر مستوى الكوليستيرول أو الكولستيرول عالى الكثافه (H.D.L) وكذلك الجلسريدات الثلاثيه بالمعامله.

أرتفع مستوى البروتينات الكليه والجلوبيولين بالدم بينما لم يتأثر مستوى الالبيومين وذلك ربما يشير الى وجود تحسن فى مناعة الطيور نتيجة المعامله.