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The Effect of Chromium Picolinate On Lipid Profile and Antioxidants Enzymes in The Male Rats.

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ABSTRACT

This study designed to demonstrate the effect of chromium picolinate on the lipid profile parameters and antioxidant enzymes in the male rats. Albino rats were divided into three groups each group have ten rats. The first group received standard diet and distilled water as control group, the second group received chromium picolinate at dose 3 mg/kg, the third group received chromium picolinate at dose 6 mg/kg after six weeks half number of rats from each group were sacrificed while the remainder rats were sacrificed after eight weeks. The results show no significant change ($p>0.05$) in the lipid profile parameters in the rats treated with chromium picolinate for six and eight weeks but the results recorded significant decrease ($p<0.05$) in the SOD, GPX while significant increase ($p<0.05$) in MDA level in the rats treated with chromium picolinate for six and eight weeks. These results proposed no significant effect of chromium picolinate in the lipid profile parameters in the same time it has toxic effect in the antioxidant enzymes on healthy rats.

Keywords: chromium picolinate, TC, HDL, TG, SOD, GPX, MDA, male rats.

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INTRODUCTION

The trace elements are essential for proper functioning of biochemical reactions especially as enzyme cofactors and regulation of glucose metabolism or in hormonal control, especially insulin [1]. Chromium is a mineral which is required in little amounts for human health and widely used as supplements. Chromium has extensively been area of concern since long for its probable connection to various health conditions [2].

Among the most active areas, chromium is used in supplement form to treat diabetes, lower blood lipid levels, promote weight loss, and improve body composition [3]. Chromium is act mainly to enhance the effective of insulin by increasing insulin binding with receptor, phosphorylation, and protein kinase activity and finally results in decreased insulin resistance and has therefore been recommended that might help to control Type 2 diabetes or the glucose and insulin responses in personsat high risk of developing the disease [5,6]. The present study is proposed to evaluate of the different doses of chromium supplementation (3/6 mg/kg of chromium picolinate) at different time intervals on lipid profile and antioxidant enzymes in rats.

MATERIALS AND METHODS

Chromium picolinate (Crp) is purchased from the Chromax company, U.S.A.

Determination of lipid profile activity

Total cholesterol kit for quantitative determination of total cholesterol in serum was supplied by Biolabo SA, France.[6].

Serum HDL-Cholesterol level was measured by HDL-Cholesterol phosphotungstic acid (PTA) precipitant kit (Biolabo, France) [6].

Very low density lipoprotein (VLDL) were measured by using the following formula: VLDL = TG (mg/dl) / 5 [6].

Low density lipoprotein (LDL) were measured by using the next formula: LDL=TC(mmol/l)-VLDL(mmol/l)-HDL(mmol/l).[6].

Triglycerides Kit was supplied by Biolabo, France. foe measureable of triglycerides in human serum [7].

Determination of antioxidant enzymes

Measurment of SOD activity by ELISA Kit (Elabscience, U.S.A.) (www.elabscience.com).

The quantitativedetermination of GPX concentration in serum through the enzyme linked immunosorbant assay using ELISA kit (Elabscience, U.S.A.) (www.elabscience.com).

Measurmentof MDA activity by ELISA Kit (Elabscience, U.S.A.) is an enzyme immunoassay (www.elabscience.com).

Experimental Design

Thirty male albino rats strain (*Rattusnorvegicus*) weighting (225-250g) obtained from the animal house in the science faculty/Kufa university. The rats kept under observation for one week before starting the experiment for acclimatization. fed on standard diet and distilled water *ad libitum* .Then animals were divided intothree groups each group have ten rats. The first group received standard diet and distilled water as control group, the second group received chromium picolinate at dose 3 mg/kg, the third group received chromium picolinate at dose 6 mg/kg after six weeks half number of rats from each group were sacrificed while the remainder rats were sacrificed after eight weeks by Ketamine and xylazine and blood samples have collected by heart puncture and put into serum tubes in the room temperature for several minutes and were centrifuged for 20 minutes at 3000 rpm. At the end of experiment (8 weeks) the remainder groups of rats also anaesthetized by the same method and the blood samples were saved.

Statistical Analysis: Data were expressed as mean ± S.E. and Statistical Analysis was carried using computerized SPSS program version (21) with one way ANOVA [8].

RESULTS AND DISCUSSION

The current results in table (1) and (2) are appeared no significant reduction ($p>0.05$) in TC,TG,LDL,VLDL and no significant change ($p>0.05$) in HDL in the serum of rats treated with chromium picolinate for six, eight weeks. These results are accepted with Sahin[9] andAly[10] are recorded in their researches.

Chromium picolinate is believed to reduce serum total cholesterol, TG, LDL and VLDL and improve HDL levels in experimental animals [11,12] when used as therapeutic doses for short period but the adverse effects occur when used in long period. So that, the results are highly variable, contradictory and depend on the chromium compound and its dose, chromium bioavailability, duration of experiment, animal model and species researchers used.

For instance, Lai [13]called that supplemental chromium yeast (600 mg/kg/day) administration to diabetic type 1 male wister rats had diminished the plasma cholesterol, TG, LDL, VLDL levels as compared to control.

Cefalu[14] observed lower plasma total cholesterol, TG, LDL, VLDL and more HDL levels in obese rats supplemented for three months with 80 mg Cr/day as CrPic demonstrated that the chromium propionate complex (injected intravenously at the dose of 10-20 mg/kg) significantly lowered plasma Total cholesterol, TG, LDL, VLDL and higher levels of HDL after 24 weeks of supplementation in healthy rats [15].

Also, the results in table (3) and (4) are noticed in the animals after oral administration of chromium picolinate for six and eight weeks in contrast with control group. Trivalent chromium supplements such as chromium picolinate and niacin-bound chromium, Cr(III) is consumed by the general population through its presence in many foods. In addition, there is widespread consumption of Cr(III) present in dietary supplements, such as CrPic, that are marketed primarily for weight loss and antidiabetic effects. Humans typically ingest 20 to 45 µgCr(III) per day in the diet [16], while typical daily doses of supplements may contain 200 to 1000 µg Cr(III) [17]. It is known that Cr(III) can accumulate in the body. Ingestion of CrPic supplements is found to produce serum levels of chromium that were equivalent to serum levels measured in workers occupationally exposed to chromium, and to produce urinary chromium levels higher than those in the people environmentally exposed to chromium. Chromium has also been shown to accumulate in rat liver, kidneys, spleen, lungs, legs, testes and heart after ingestion of CrPic in the diet. The structure and coordination chemistry of CrPic may make it more toxic than other forms of Cr(III) [18].

Reactive oxygen species are produced by the electron leakage outside the electron transfer chain [19]. Oxidative damage induced by reactive oxygen species (ROS) causes tissue damage by a variety of mechanisms including DNA damage, lipid peroxidation (LPO), impaired membrane function, decreased membrane fluidity, altered structural integrity, inactivation of several membrane bound enzymes and depletion of thiols[20].

Mahboob[21] reported an increase in lipid peroxidation levels in tissues are observed in all chromium picolinate-treated rats. SOD and GPX levels in the tissues are decreased in all the treated groups.

However, low dose chromium treatment showed no significant alteration in LPO when compared with their respective controls. Enhanced LPO in response to chromium exposure leads to cellular degeneration. Normally produced reactive oxygen species are neutralized by cellular antioxidant defense mechanism, which includes the antioxidative enzyme superoxide dismutase and glutathione peroxidase. Decline in the SOD and catalase activities after high dosage of chromium exposure indicate increased production of reactive species beyond the physiological limit [22].

Biological systems, under normal physiological conditions are protected from oxidative damage of the reactive oxygen species by the antioxidant defense systems, including enzymatic and non-enzymatic scavengers. Free radical scavenging enzymes such as SOD, CAT and GPX are the first line of cellular defense

against the toxic effects of reactive oxygen species and they are widely used as biomarkers of oxidative stress [23].

The results of the current study suggested no toxic effects of chromium picolinate on lipid profile parameters on healthy rats while it has toxic effects on the antioxidant enzymes.

Table (1) Effect of chromiumpicolinate in the blood parameters in the rats treated for six weeks.

Doses of CrP	TC (mg/dl)	TG (mg/dl)	HDL (mg/dl)	VLDL (mg/dl)	LDL (mg/dl)
3 mg/kg	52.33±19.56	22.33±2.51	30.00±15.62	4.47±0.50	15.87±2.80
6 mg/kg	49.33±8.08	20.67±3.05	38.33±8.73	4.27±0.72	6.53±5.40
control	52.33±5.85	26.33±11.06	35.33±6.42	7.33±1.15	8.00±5.19
L.S.D. 0.05	9.367	6.966	12.207	1.028	8.646

Number of animals = 5 for each group
Each value represents mean ± S.E.
CrP : chromium picolinate

Table (2) Effect of chromiumpicolinate in the blood parameters in the rats treated for eight weeks.

Doses of CrP	TC (mg/dl)	TG (mg/dl)	HDL (mg/dl)	VLDL (mg/dl)	LDL (mg/dl)
3 mg/kg	45.00±3.00	20.33±0.57	35.33±3.78	4.07±0.11	5.60±4.61
6 mg/kg	41.33±2.31	20.00±0.21	35.67±1.15	4.00±0.31	2.33±2.31
control	51.00±3.61	25.00±5.00	36.67±7.63	5.00±1.00	9.33±4.50
L.S.D. 0.05	9.367	6.966	12.207	1.028	8.646

Number of animals = 5 for each group
Each value represents mean ± S.E.
CrP : chromium picolinate

Table (3) Effect of chromiumpicolinate in the antioxidant enzymes in the rats treated for six weeks.

Doses of CrP	MDA (ng/ml)	SOD (ng/ml)	GPX (pg/ml)
3 mg/kg	45.67±26.11	0.15±0.04	64.28±7.84
6 mg/kg	47.92±5.53	0.10±0.03	77.05±12.99
control	44.86±25.08	0.17±0.06	75.90±26.25
L.S.D. 0.05	15.465	0.045	20.513

Number of animals = 5 for each group
Each value represents mean ± S.E.
CrP : chromium picolinate

Table (4) Effect of chromiumpicolinate in the antioxidant enzymes in the rats treated for eight weeks.

Doses of CrP	MDA (ng/ml)	SOD (ng/ml)	GPX (pg/ml)
3 mg/kg	41.00±12.55	0.18±0.08	26.39±20.34
6 mg/kg	42.54±25.57	0.14±0.02	36.30±34.54
control	44.21±21.62	0.18±0.01	74.17±22.63
L.S.D. 0.05	15.465	0.045	20.513

Number of animals = 5 for each group

Each value represents mean ± S.E.
CrP : chromium picolinate

REFERRENCES

[1] Wiernsperger, N. and Rapin, J. Trace elements in glucometabolic disorders: an update. Diabetol. Metab. Syndr., 19(2): 2010, pp. 70.

[2] Vincent, J. Chromium: celebrating 50 years as an essential element?. Dalton Transactions (Royal Society of Chemistry) 39: 2010, pp. 3787-3794.

[3] Albarracin, C.; Fuqua, B.; Evans, J. and Goldfine, I. Chromium picolinate and biotin combination improves glucose metabolism in treated, uncontrolled overweight to obese patients with Type 2 diabetes. Diabetes Metab. Res. Rev., 24(1): 2008, pp. 41-51.

[4] Cefalu, H. Role of Chromium in Human Health and in Diabetic Care, 27(11): 2004, pp. 2741-2751.

[5] Yazaki, Y.; Faridi, Y.; Ali, M.; Northrup, V.; Njike, Y.; Liberti, L. and Katz, D. A Pilot Study of Chromium Picolinate for Weight Loss. J. Altern. Compliment. Med., 16(3): 2009, pp. 291-299.

[6] Tietz, N. Text book of clinical chemistry, 3rd Ed., C.A. Burtis, E.R. Ashwood, W.B. Saunders . 1999, pp. 703-1699.

[7] Tietz, N. Clinical guide to laboratory test 4th Ed., 2006, pp. 1074-1077.

[8] Al-Rawi, K. Entrance to the Statistics. Second edition. Faculty of Agriculture and Forestry, University of Mosul. 2000.

[9] Sahin, K.; Onderci, M.; Tuzcu, M.; Ustandag, B.; Cikim, G.; Ozercan, I.; Sriramoju, V.; Juturu, V. and Komorowski, J. Effect of chromium on carbohydrate and lipid metabolism in rat model of type 2 diabetes mellitus: the fat fed streptozotocin treated rat. Metabolism 56: 2007, pp. 1233-1240.

[10] Aly, R.; Abdel-moenin, A.; El-megeid, A.; Ebtesam, M.; Yasmeen, F. Abd El-moneim, S.; Dalia, M. and Sonia, S. To investigate effects of a shifting high fat diet to normal fat diet supplemented with magnesium, zinc and chromium on biochemical parameters in rats with diabetes. Agricultura 8: 2011, pp. 23-32 .

[11] roliczewska, B.; Zawadzki, W.; Dobrzanski, Z. and Kaczmarek-Oliwa, A. Changes in selected serum parameters of broiler chicken fed supplemental chromium. J. Anim. Physiol. Anim. Nutr. 88: 2004, pp. 393-400.

[12] Yang, X.; Li, S.; Dong, F.; Ren, J. and Sreejayan, N. Insulin-sensitizing and cholesterol-lowering effects of chromium (D-Phenylalanine) 3. J. Inorg. Biochem. 100: 2006, pp. 1187-1193.

[13] Lai, M.; Chen, Y. and Cheng, H. Chromium yeast supplementation improves fasting plasma glucose and LDL-cholesterol in streptozotozin induced diabetic rats. Int. J. Vitam. Nutr. Res. 76: 2006, pp. 391-397.

[14] Cefalu, W.; Wang, Z.; Zheng, X.; Baldar, L. and Russel, J. Oral chromium picolinate improves carbohydrate metabolism and enhances skeletal muscle Glut4 translocation in obese, hyperinsulinemic (JCR-LA corpulent) rats. J. Nutr. 132: 2002, pp. 1107-1114.

[15] Sun, Y.; Clodfelder, B.; Shute, A.; Irvin, T. and Vincent, J. The biomimetic (Cr3O(O2CCH2CH3)6(H2O)3]+decreases plasma insulin, cholesterol, and triglycerides in healthy and type II diabetic rats but not in type I diabetic rats. J. Biol. Inorg. Chem. 7: 2002, pp. 852-862.

[16] IOM (Institute of Medicine). Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Food and Nutrition Board, Institute of Medicine. National Academy Press, Washington, DC.2001.

[17] Komorowski, J.; Greenberg, D. and Juturu, V. Chromium picolinate does not produce chromosome damage. Toxicol. In vitro 22: 2008, pp. 819-826.

[18] Stearns, D.; Silveira, S.; Wolf, K. and Luke, A. Chromium(III) tris(picolinate) is mutagenic at the hypoxanthine (guanine) phosphoribosyltransferase locus in Chinese hamster ovary cells. Mutat. Res. 513: 2002, pp. 135-142.

[19] Hanukoglu, I.; Rapoport, R.; Weiner, L. and Sklan, D. Electron leakage from mytochondrial NADPH-adrenodoxinreductaseadrenodoxinreductaseadrenodoxin P450 scc (cholesterol side chain cleavage) system. Arch. Biochem. Biophys. 305: 1993, pp. 489-498.

[20] Gutteridge, J. and Halliwell, B. Free radicals and antioxidants, a historical look to the future. Ann. NY. Acad. Sci. 899: 2000, pp. 136-147.

[21] Mahboob, L.; Mcneil, L.; Tolliver, T. and Ogden, L. Effects of chromium picolinate on antioxidant enzyme levels in rats. Toxicol. Sci. 66: 2002, pp. 32-35.

[22] Murugesan, P.; Muthusamy, T.; Balasubramanian, K. and Arunakaran, J. Studies on the protective role of vitamin C and E against polychlorinated biphenyl (Aroclor 1254)-induced oxidative damage in Leydig cells. Free Radic. Res. 39(11): 2005, pp. 1259-1272.

[23] Ahmad, N.; Fazal, H.; Abbasi, B. and Iqbal, M. *In vitro* larvicidal potential against Anopheles stephensi and antioxidative enzyme activities of *Ginkgo biloba, Stevia rebaudiana*and *Partheniumhysterophorous*. Asian Pacific Journal of Tropical Medicine, 4: 2011, pp. 169-175.