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RESEARCH ARTICLE

EFFECT OF SUBLETHAL CONCENTRATION OF HEXAVALENT CHROMIUM ON THE CARBOHYDRATE METABOLISM OF ALBINO RABBIT *ORYCTOLAGUS CUNICULUS*

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ABSTRACT

Chromium is present in trace in all organic matter and seems to be an essential mineral. Chromium plays an important role in the metabolism of carbohydrate and fats. It works with insulin in the metabolism of sugar. It seems to increase the effectiveness of insulin, thereby facilitating the transport of glucose in to the cells and not allowing the blood glucose levels to rise. It helps to take protein where it is needed and also an aid in growth. Chromium has been found beneficial in the prevention and also an aid in growth .Chromium has been found beneficial in the prevention and treatment of high blood pressure. In spite of its uses it also causes severe impairments in animals including man. It is available in excess ie., above the normal level. Hence, in the present study the impact of sub lethal concentration of hexavalent chromium compound (Potassium dichromate) on total carbohydrate ,glycogen and total free sugar was estimated in the tissues such as brain, liver, kidney and muscle of Newzealand white rabbit exposed to 1,5 and 9 months duration was carried out. The results shows the total carbohydrates, total free sugars and glucose increased when compared to the normal rabbit. The glycogen gradually decreased. The results are discussed, the values are statistically significant.

INTRODUCTION

Chromium (Cr) is an essential trace element required for the normal insulin function in order to maintain glucose homeostasis and regulate carbohydrate, protein and lipid metabolism. Carbohydrate metabolism begins with digestion in the small intestine where monosaccharide is absorbed in to the blood stream. Blood sugar concentration is controlled by hormones, such as insulin, glucgen and epinephrine. If the concentration of glucose in the blood is too high, insulin is secreted by the pancreas. Insulin stimulates the transfer of glucose in to the cells, especially in the liver and muscles, although other organs are also able to metabolise glucose. Chromium is an active component of glucose tolerance factor (GTF) and thus is essential for the maintenance of normal metabolism of carbohydrates and lipids. In humans and laboratory animals, severe Cr deficiency may result in insulin resistance and impaired tolerance of glucose. Mertz.,1981 and Mertz., W. 1969 focused on feed intake, body weight gain and immune response of stressed cattle. Initial research with feeder calves demonstrated that dietary supplementation with Cr markedly improved growth rate chromium increase insulin binding to cells, insulin sensitivity. Additional studies are urgently needed to elucidate the mechanism of chromium and its role in the prevention and control of diabetes Anderson (1981). Chromium III has limited toxicological properties whereas other Cr are considered to be human carcinogen and toxic to flora and fauna (Roe and Carter, 1969).

Hence in the present investigation the effect of hexavalent chromium, Potassium dichromate on carbohydrate metabolism of rabbit *Oryctologus cuniculus* was under taken.

MATERIALS AND METHODS

The white rabbits *Oryctologus cuniculus* weighing 1Kg to 1.2Kg were used for the experiment. They were maintained on commercial diet supplied by "Hindustan Lever Limited" Bombay, marketed under the trade name "Gold Mohur Feeds", water was provided adlibitum. The LD_{50} for potassium dichromate was determined as per standard methods Finney, D.J. (1964). Rabbit of similar sex (male) were selected with equal weight and divided in to six groups. In each groups six individuals were kept. No food was given to animals for 24 hr prior to experimentation. The LD_{50} value was recorded as 240mg/Kg body weight. 1/3 of LD_{50} value as sublethal concentration was calculated. The sublethal dose (80mg/Kg body weight) of potassium dichromate was administered in rabbit. The rabbit were allowed to drink chromium containing water i.e.,80mg/Kg body weight. The animals were sacrificed after 1, 5 and 9 months and various scientific works were carried out. The carbohydrate and glycogen were estimated as per the method of Carrol *et al.* (1956).The total free sugar was estimated as per the method of Roe (1954).The blood glucose was estimated by glucose oxidase method of Trinder (1969). The values were statistically treated as per method of Pillai and Sinha (1968).

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RESULTS AND DISCUSSION

The manifestation of disease results due to various changes at molecular level and at organ level. It would be worthwhile attempt to understand the biochemical mechanisms underlying during manifestation of disease.

Table 1. Total carbohydrate content (mg/gm wet wt) in selected tissues of Rabbit (*Oryctolagus cuniculus*) exposed to sub lethal concentration (8 mg/100 gm body weight) of potassium dichromate

Tissue	Normal Animal (Control)	Experimental Aniaml			F Value	Probability Value
		1-month exposed	5-months exposed	9-months exposed		
Brain	5.0±0.25	6.6±0.21 (32.00)	10.0±0.36 (100.00)	13.5±0.42 (170.00)	132.5325	0.0000
Liver	11.5±0.22	11.6±0.21 (0.86)	11.8±0.16 (2.60)	15.5±0.34 (34.78)	61.8217	0.0000
Kidney	6.16±0.16	7.16±0.16 (16.23)	10.66±0.33 (73.05)	18.0±0.25 (192.20)	492.3810	0.0000
Muscle	4.50±0.22	6.83±0.16 (51.77)	9.50±0.34 (111.00)	14.83±0.16 (229.55)	355.1667	0.0000

Values ±SE of six individual observations; Values in parenthesis indicates % change over control

Table 2. Total Free Sugar content (mg/gm wet wt) in selected tissues of Rabbit (*Oryctolagus cuniculus*) exposed to sub lethal concentration (8 mg/100 gm body weight) of potassium dichromate

Tissue	Normal Animal (Control)	Experimental Aniaml			F Value	Probability Value
		1-month exposed	5-months exposed	9-months exposed		
Brain	4.66±0.55	6.16±0.79 (103.86)	9.50±0.76 (132.00)	11.16±0.94 (139.48)	14.7241	0.0000
Liver	10.5±0.42	11.16±0.03 (6.28)	11.83±0.74 (12.66)	13.33±0.98 (26.95)	3.236	0.0000
Kidney	6.00±0.51	7.16±0.60 (19.33)	9.50±0.99 (58.33)	12.0±0.85 (100.00)	12.0379	0.0000
Muscle	3.50±0.50	60.66±0.49 (90.28)	9.66±0.84 (176.00)	13.0±0.57 (271.42)	43.0024	0.0000

Values ±SE of six individual observations; Values in parenthesis indicates % change over control

Table 3. Total Glycogen content (mg/gm wet wt) in selected tissues of Rabbit (*Oryctolagus cuniculus*) exposed to sub lethal concentration (8 mg/100 gm body weight) of potassium dichromate

Tissue	Normal Animal (Control)	Experimental Animal			F Value	Probability Value
		1-month exposed	5-months exposed	9-months exposed		
Brain	9.00±0.36	8.00±0.51 (-11.11)	7.66±0.49 (-14.88)	5.00±0.36 (-44.44)	15.0000	0.0000
Liver	35.50±0.67	30.50±0.50 (-14.08)	26.00±0.68 (-26.76)	20.83±0.83 (-42.32)	84.3134	0.0000
Kidney	36.16±0.54	33.16±0.70 (-8.29)	29.16±0.47 (-19.35)	17.50±0.42 (-51.60)	223.333	0.0000
Muscle	13.66±0.66	11.66±0.66 (-14.64)	9.16±0.47 (-32.94)	8.50±0.42 (-37.77)	17.3504	0.0000

Values ±SE of six individual observations; Values in parenthesis indicates % change over control

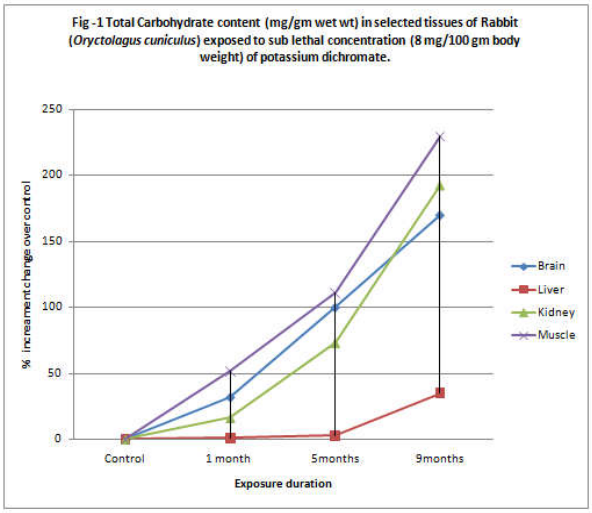
Which occurs due to the toxic action of some chemical compounds. Hence in the present investigation an attempt has been made to understand certain biochemical changes in mammalian tissues which occur due to toxic action of chromium compounds. It nearly gives the possible physiological changes in humans. The amount of total carbohydrates, total free sugars and glycogen of brain, kidney, liver and muscle tissues and blood glucose of rabbit exposed to sublethal concentration of potassium dichromate and normal rabbit are shown in the Table 1. The percent increment of carbohydrate recorded. In the brain tissue the percent increment was 32.18, 103.86 and 139.48; in liver 6.28, 12.66 and 26.95; in kidney 19.33, 58.33 and 100; in muscle 90.28,176 and 271.42; in 1, 5 and 9 months exposure respectively. Maximum increment was recorded in long term exposure (9months) in all tissues.

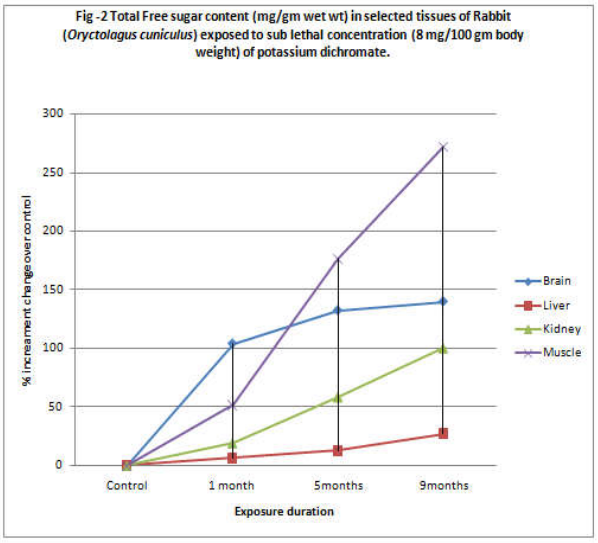
The Table 2 Shows the results obtained for total free sugars. The percent increment in brain tissues was 32.00,100.00 and 170.00;in liver 0.86,2.60 and 34.78;in kidney 16.23,73.05 and 19.20;in muscle 51.77,111.00 and 229.55; in 1,5 and 9 months exposure respectively. The Table 3 shows the results obtained for glycogen, the percent decrement of glycogen recorded in brain tissue was -11.11,-14.88 and -44.44;in liver -14.08,-26.76 and -42.32;in kidney -8.29, -19.35 and -51.60;in muscle -14.64,-32.94 and -37.77 in 1,5 and 9 months exposure

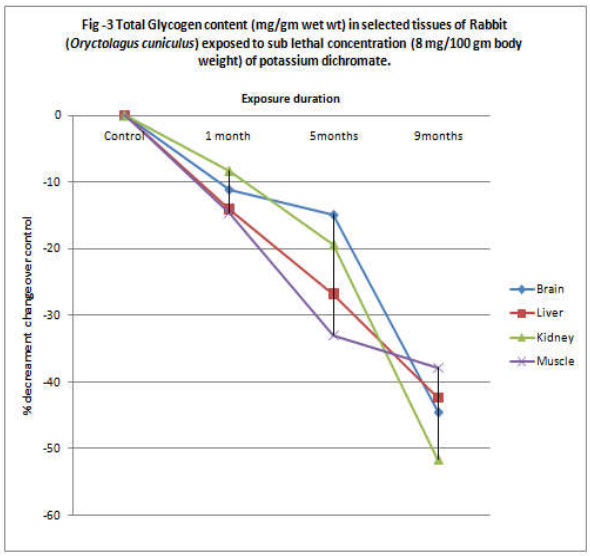
Table 4. Effect of sub lethal concentration of potassium dichromate on blood glucose of Rabbit *Oryctolagus cuniculus*

Co - Factors	Control	Experimental 9 months exposure
Glucose	93.2 mg/L±2.15	823 mg/L ±2.41

Values ±SE of six individual observations; Values are significant at p<0.001







respectively. The Table 4 represents the amount of blood glucose in control and experimental rabbits. In the present investigation the hexavalent chromium, potassium dichromate has manifested its toxic effects by significantly altering the carbohydrate metabolism of male albino rabbit *Oryctolagus cuniculus*. The impairment of carbohydrate metabolism has occurred. Due to this impairment, abnormal increase of total free sugars in tissues has been taken place. Moreover the conversion of glucose in to glycogen (glycogenesis) in liver tissue was also affected in the animal. The glucose was more in blood (hyperglycemia). This may be due to the fact that the activity of pancreatic hormone involved in carbohydrate metabolism i.e. insulin was severly affected. Because of impairment of insulin, glucose accumulated in the blood. The activity of glucogen was not impaired and hence conversion of glycogen to glucose (glycolysis) has been taken place in the liver tissue which increased the level of blood glucose and decrement of glycogen content in the liver tissue.

In conclusion, the administration of potassium dichromate caused changes in the carbohydrate metabolism. The changes were very much proven in the liver. This obviously affects the liver metabolism and liver function. Hence, there was an unusual deposit of carbohydrate and fat in the liver. The values of the administration of potassium dichromate showed an increase over control and manifested its toxic effects by altering the carbohydrate metabolic process in the tissues such as liver, kidney and muscle and blood sugar of male albino rabbit, *Oryctolagus cuniculus*. The results obtained for total free sugar are substantiated with the work of Sharma (1984)**.** Who observed the effect of mercury on carbohydrate metabolism of fish *Channapunctatus*. Carbohydrate, protein and lipid contents in tissues of *Catla* are depleted under the sublethal stress of chromium Vincent *et al*. (1995). Abnormal increase of glucose in blood, carbohydrates and free sugars in tissues shows the condition of diabetes in rabbit. Hence it is presumed that the chromate workers also may have possibilities to get diabetes.

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