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Chromium in various food items as regulators of different metabolic activities

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Abstract: Chromium plays a vital role in metabolism of carbohydrates and potentiates the action of insulin, and its deficiency leads to diabetes in human body. In Pakistan majority of people use vegetables, fruits and cereal as daily food stuff. This paper represents a study for chromium contents by atomic absorption spectrophotometer (dry method) in different vegetables, fruits and cereals which are commonly used in our daily routine life. Maximum chromium content was found in Jaman pulp (0.4575 mg/100 gm) where as rice contain minimum amount (0.01759 mg/100gm) on dry basis. This is an effort to introduce chromium rich food items for diabetic and high blood lipid patients.

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INTRODUCTION

Chromium mineral is found in all living creatures; man, animal, and plant. In nature Chromium is present in the both trivalent and hexavalent oxidation states. Trivalent is nontoxic and present in living organism while hexavalent is toxic and mostly used in industry. Chromium (Cr) is an essential element required in trace amount for normal carbohydrate and lipid metabolism[1].heavy metals are present in food in a very minute quantity for their role in body metabolism. It has been established that whatever is taken as food might cause metabolic disturbance if it does not contain the permissible and lower limits of heavy metals. Thus, both deficiency and excess of essential micro-nutrients (zinc, iron, chromium, nickel, etc) may produce undesirable effects[2,3].

The clinical studies showed that chromium improve human body glucose intolerance. It also has anti-atherogenic effect through glucose regulatory mechanism[4,5]. A recent study has found that giving chromium picolinate to older people experiencing early memory decline boosts brain power. MRI scans showed that in older adults given 1,000mcg chromium picolinate per day, there was greater activation of certain parts of the brain during challenging mental tasks. Lead researcher Robert Krikorian said "these brain imaging results suggest that chromium picolinate may be beneficial for older adults with early memory decline and metabolic irregularities – factors that substantially increase the risk for dementia".Chromium (Cr) is an essential element required for normal carbohydrate and lipid metabolism[1,6].

The beneficial effects of chromium on cardiovascular diseases were first hypothesized by Schroeder and coworkers after their observation of reduced chromium concentration in the aortas of people dying from heart disease compared with those killed by accidents. This is consistent with their observation of increased occurrence of aortic plaques and elevated blood lipids of rats kept in a strictly controlled, low chromium environment[7].

Chromium plays a vital role in diabetes too. It is generally presumed that chromium supplementation is of no benefit to people with Type I diabetes, since their problem is insulin insufficiency. Although this is the case, sometimes Type I is combined with Type II, and chromium supplementation helps the patient overall. For example, blood glucose and glycosylated hemoglobin concentrations fell in a 28-year-old woman with an 18-year history of Type I diabetes during a three-month period in which she took 200 mcg chromium picolinate twice daily[8].

For adults daily chromium concentration was recommended 10 mg to 20mg[9].The estimated safe and adequate daily dietary intake (ESADDI) [10] for Cr is shown in Table 2.The ESADDI for infants of 10 mg to 40 mg is based upon breast milk Cr concentrations obtained before 1980 that were often 10-fold higher than presently accepted values. Based on the present ESADDI of 10 mg to 40 mg for children, children would need to consume more than 55.6 liters of breast milk daily to obtain the minimum suggested daily intake of 10 mg. Although breast milk is likely to have a higher Cr bioavailability than other sources, this has not been document. The most readily observed benefit reported in the majority of the studies was improved blood sugar. Not only is the amount of Cr consumed daily important, but specific foods may negatively affect Cr status as well. For example, foods high in simple sugars are not only usually low in Cr but enhance Cr losses. Chromium intakes of 30 mg to 40 mg per day would likely be adequate if well balanced diets low in simple sugars and high in fresh fruits and vegetables were consumed[11].

The concentration of chromium in human tissues varies greatly in different part of the world, depending on dietary habits and on the amount of

chromium in supplies. There is evidence that human tissue chromium decline with advancing age[10].The literature indicates that Vegetable oils and unrefined sugars have relatively high chromium Concentration while spices (like black pepper, thyme, and cloves), fruit and vegetables, fish and meat (except liver and kidney) are low in chromium, and human milk generally contains more chromium than cow's milk[12].

In this view there is a dire need to estimate chromium content in different fruits, cereals, vegetables, crops etc that the normal people in Pakistan usually take in their daily life and also search for chromium rich food. The present research work was carried out at Pakistan Council of scientific and industrial research (PCSIR). The objective was to estimate the chromium concentration in different fruits and vegetables which have suitable chromium concentration.

MATERIALS AND METHODS

Collection of sample

All glass apparatus used in this research were Pyrex made and all the chemicals are analytical reagent grade. Samples were collected from local market of Lahore city.

Calculation of moisture content

The weighed samples were de-moisturized in oven then were charred on flame following dry ashing method. All the samples of fruits, vegetables and cereals are dried in oven at 105^{o}C and calculated the moisture contents.

Sample preparation for chromium analysis

Then weighed amount of each sample was charred on flame. After charring, the samples were subjected to ashing in carbolite CWF 1200 furnace on 500^{o}C. After cooling the ash were dissolved in 10 ml of concentrated HNO_3 and allow to stand over night then heat carefully on hot plate until production of red NO_2 fumes seased, cool and solution was added to 2-4ml 70% $HCLO_4$, heat it again and made up to 100 ml after filtration. The concentration of chromium in different samples was analyzed on atomic absorption spectrometer, analyst 800(Perkin Elmer) for chromium contents.

RESULTS AND DISCUSSION

It is well known fact from scientific research that chromium deficiency in human body first disturbs its carbohydrate metabolism and then leads to the diabetic condition[13].Nature has provided chromium in different fruits, vegetables and cereals in order to keep carbohydrate metabolism in order.

The result of Table 2 showed the chromium contents in different daily consumable food items. If we compare chromium contents in oven dried sample as shown in Fig-1 and originally dried sample as shown in Figure 2, the maximum chromium was found in jaman pulp (0.4575 mg/100 gm) as it has 90.99 % moisture but if we look at original form of sample, maximum chromium was found in whole biterground (0.5191 mg/100 gm). Kalongi seeds, meethi methi leaves and seed also have high chromium contant in dried form 0.1311, 0.1951 and 0.1399 mg/ 100gm respectively.

Table 1: Estimated safe and adequate daily dietary intakes for chromium

Age groups	Recommended Cr dose (mg)
7 years to adults	5-200
4-6 years	30-120
1-3 years	20-80
0.5 months-1 year	20-60
Infants<6 months	10-40

In oven dried sample pulp of Jaman had 0.4574 mg/100 gm and in bitter ground 0.5 inches peet got 0.252 mg/100gm of dried sample and in potato, its 3mm peel got 0.2069 mg/100 gm of sample. In three cereals, rice, wheat and barley amount of chromium is 0.0175, 0.0377 and 0.1369 mg/100gm respectively.

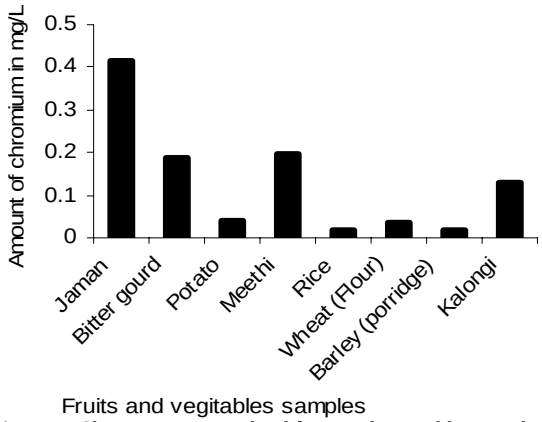

Figure 1: Chromium in oven dried fruits and vegetables samples.

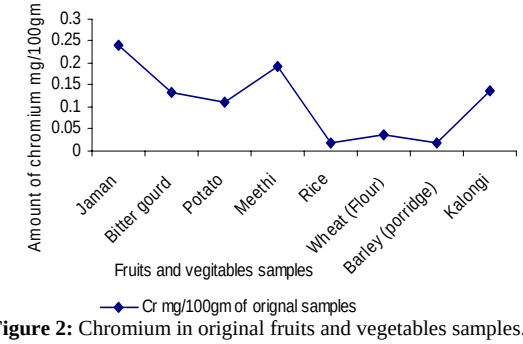

Figure 2: Chromium in original fruits and vegetables samples.

Table 2: Amount of chromium contents (mean values of triplicate samples of fruits and vegetables)

Sample	Botanical name		Moisture %	Ash %	Cr in demonstrated oven dried samples mg/100gm	Cr mg/100gm of ash	Cr mg/100gm of original samples
Jaman	Syzygium jumbolana	Seed	20.427	93.35	0.1395	13.9376	0.1156
		Pulp	90.99	95.42	0.4575	-	0.2395
		Whole	79.577	94.285	0.04157	8.6956	0.0232
Bitter gourd	Charatium memerdica	Peel	90.91	94.30	0.252	13.695	0.1319
		Seeds	77.85	84.40	0.155	-	0.087
		Whole	92.618	86.26	0.188	21.840	0.5191
Potato	Solanum tuberosum	Peel	85.33	86.1027	0.2069	22.489	0.11
		Inner	96.132	96.132	0.0256	2.876	
		Whole	95.40	95.40	0.0396	2.2628	0.02159
Meethi	Trigonella	Leaves	0.4	18.90	0.1951	4.1059	0.1924
		Seeds	0.1	75.66	0.1399	13.038	0.0322
Rice	Oriza stiva	Whole	0.02	2.94	0.01759	2.019	0.01757
Wheat (Flour)	Triticum sativa	Whole	0.01	1.61535	0.0379	11.28	0.0377
Barley (porridge)	Herdeum vulgare	Whole	0.01	1.728	0.01741	4.6176	0.01739
Kalongi	Nigella saliva	Whole	0.001	93.54	0.1311	6.909	0.1369

Table 3: Amount of chromium in different vegetables on dry basis.

Sr #	Vegetables	Chromium contents on dry bases. mg/100gm	Sr #	Vegetables	Chromium contents on dry bases
1	Bitter ground	0.458	11	Berseem	0.191
2	Beens	0.317	12	Maize	0.351
3	Wheat	0.353	13	Chilli (Green)	0.194
4	Radish	0.219	14	Sorghum	0.500
5	Cauliflower	0.383	15	Sugar beat	0.202
6	Sugarcane	0.160	16	Garlic	0.433
7	Turnijs	0.445	17	Potato	0.182
8	Mastand	0.228	18	Spinach	0.319
9	Carrot	0.242	19	Mint	0.297
10	Tomato	0.319	20	Barley	0.210

Table 3 shows the amount of chromium as mg/100 gm of different vegetables which were demoisturized and oven dried, grown in Punjab province, reported by different researcher of Pakistan[14]. As these mentioned vegetables and fruits are seasonal, we can use these in medicines and in herb formulations in dried powder form other than season as chromium supplement which has been frequently reported to improve glucose tolerance in malnourished children and elderly diabetic patients.

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