CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

Available online at: http://www.iajps.com *Research Article*

HEAVY METAL AND TRACE ELEMENT CONTAMINATION IN LEGUMES CEREAL AND PRODUCT SOLD IN LOCAL MARKET OF QUETTA CITY

Huma Ayub*[1] , Mujeeb U R Rehman[2], Muhammad Ajmal[3], Khurum shezad[4].

[1]Scientific Officer, PCSIR Labs, Department of Pakistan Council of scientific and Industrial research center Quetta, P.O.Box 387, Mastung Road Near Mian Ghundi, Quetta.

[2]Chief Scientific Officer, PCSIR Labs, Department of Pakistan Council of scientific and Industrial research center Quetta, P.O.Box 387, Mastung Road Near Mian Ghundi, Quetta

[3]Experimental Officer, PCSIR Labs, Department of Pakistan Council of scientific and Industrial research center Quetta, P.O.Box 387, Mastung Road Near Mian Ghundi, Quetta

[4]Scientific Officer, PCSIR Labs, Department of Pakistan Council of scientific and Industrial research center Quetta, P.O.Box 387, Mastung Road Near Mian Ghundi, Quetta

.

Abstract:

Millet, wheat, rice, Barley, Biscuit, spaghetti, Noodle are mainly consumed as food in Quetta city. These samples were collected from Quetta city market for the analysis of heavy metals and trace elements by Atomic absorption spectrophotometer. The collected 35 samples of cereal, legumes and their product from local market of Quetta were analyzed by Atomic absorption spectrophotometer. After digestion with 10:3 $HNO_3/HCIO_4$ for assessment to four potentially hazardous heavy metals, copper, zinc, Lead, Cadmium.

Keywords: *Heavy Metal, Trace element, Food source.*

Corresponding author:

Huma Ayub,

Department of Pakistan Council of scientific and Industrial research center, Quetta,P.O.Box 387, Mastung Road,
Near Mian Ghundi, Quetta.
Phone: 081-2011769,
Chemist.huma@gmail.com

QR code

Please cite this article in press as Huma Ayub et al, ***Heavy Metal and Trace Element Contamination in Legumes Cereal and Product Sold in Local Market of Quetta City****, Indo Am. J. P. Sci, 2017; 4(06).*

INTRODUCTION:

The Chemical analysis of different food sample i.e. Legumes, Cereal and their products for evaluation of contamination of heavy and trace element. From few decades environment concerns in connection with human and animal health have promoted a renewed focus on trace and heavy metals including zinc, lead, copper, Iron, Manganese, and Cadmium are essential micro nutrient. The benefits of these elements are become direct when they are present in high concentration. Some of the heavy toxic are even at low concentration creating soil and environmental pollution as toxic pollutant.

Heavy metal is given special attention through out the world due to their toxic effects even at very low on concentration [1].

Several cases of human disease, disorders, malfunction and malformation of organs due to meta toxicity have been reported [14].

The level of heavy metal in food stuffs have been reported around the world: from east Asia[34], Sweden[16] ,USA[12], Egypt [8], China [35], .Nigeria [23] ,Italy[5],and Turkey[26].In many developing countries such data are not readily available..

Cadmium and Lead are among the most abundant heavy metals and are particularly toxic. The excessive content of this metal in food is associated with etiology. For a number of disease.[32],[33]. Cadmium are used as color pigments and in rechargeable nickel-cadmium batteries.it is also present as a pollutant in phosphate fertilizer.[14] pointed out that cadmium is present in food stuffs, but concentration very greatly .Cadmium exposure may cause kidney damage and/or skeleton damage [14],[32].

Air borne Lead can be deposited on soil, water and plants thus reaching human via the food chain. Lead is accumulated in the skeleton and cause renal tubular damage and may also give rise to kidney damage [33]. International Agency for research on cancer (IARC) classified cadmium and lead as human carcinogen [9]. On the other hand humanity facing one of the most fundamentals challenges to eliminated hunger and malnutrition and it is important to keep in mind that malnutrition and its associated disease can caused by improper diet or it caused to much lack necessary nutrient[21],[6].

Due to anthropogenic activities, improper waste management, the pollutants are accumulated in the edible items. This required an urgent need for proper documentation of different type of heavy and Trace elements which have an impact on human health .There fore the assessment of these elements are very necessary

The heavy metal concentration is concerned among the various environment objects that needs basic attention are the human health and cause the disease several researcher have published their works and views on environmental pollution by heavy metals

EXPERIMENTAL:

Collection of Sample of Cereal, Legumes and their products:

About 36 sample of legumes, Cereals and their products were collected from the local markets of Quetta city. These food items also imported from different countries. These samples are Barley, Rice, Bean, Millet, Biscuits, Spagetti, Noodles(Irani and Pakistani brand),Corn which have 4,3,4,6,2,4,5,5,2 varieties of each respectively.

Reagents and glass wear:

Atomic absorption standard solution for Cu, Zn, Pd, Cd were purchased from Merck .working solution were prepared by diluting the standard solution to stock solution. All solution were prepared with double distilled demonized water obtained by distillatory, Before and After used all glass wear were washed with double distilled water and put in the electric oven at about 70 0C for about 2 hrs. We used the (Iwaki Pyrex Asahi Techno glass made in Japan under LIC).

Apparatus and Calibration:

We used the Graphite furnace Atomic Absorption Spectrometer (GFAAS) model type M5 MK 2AA system. The sensitivity of AAS machine was tested and reported earlier.

Table 1: Shows the flame condition for the AAS measurement of Cu, Zn, Pd, Cd, elements

Element	Copper	Zinc	Lead	cadmium	Maganese	Nickle	Iron
Measurement Mode	Absorbance	Absorbance	Absorbance	Absorbance	Absorbance	Absorbance	Absorbance
Wave Length	324.8nm	213.9nm	217nm	228.8nm	279.5nm	232nm	248.9
Band pass	0.5nm	2nm	5nm	5nm	0.2nm	0.1nm	0.2nm
Lamp Current	100%	100%	100%	100%	75%	75%	100%
Measurement Time	4sec	4sec	4sec	4sec	4sec	4sec	4sec
Flame Parameter							
Flame type	Air-C_2H_2	Air-C_2H_2	Air-C_2H_2	Air-C_2H_2	Air-C_2H_2	Air-C_2H_2	Air-C_2H_2
Fuel Flow	0.9L/min	1L/min	1L/min	0.9L/min	1.0L/min	1.0L/min	1.0L/min
Nebulizer uptake	4sec	4sec	4sec	4sec	4sec	4sec	4sec
Burner height	5.4mm	6.4mm	6.9mm	13.4mm	8.4mm	12.5mm	3.9mm
Calibration Parameter(ppm)							
Standard1	0.25	0.25	0.5	0.5	0.50	0.25	0.25
Standard2	0.5	0.5	1	1	1.00	0.50	0.5
Standard3		1	9.4	3	2.6	1.00	1
Standard4		1.2				5.70	2

Sample Digestion and preparation of analyze solution for AAS:

Sorting of stones had been done after collection of sample and then washed with distilled water and then dried in oven at 400C.after that the sample was grinded by grinder.1 gm of grinded sample were soaked in10:3 ml HNO3/HClO4.(HNO3 65% Merck 6427/Darmstadt Germany and HClO4 70% Merck6427/ Darmstadt Germany) for full night then digest it for 3 hr at 120^0C until only 1 ml of solution remain than dilute it up to 50 ml distilled water when it cooled.

Before digestion the Ash (%) and Moisture (%) of the following sample have been done.

Table 2: in which Ash and moisture percentage are given.

S. No	Sample name	Ash (%)	Moisture (%)
1	Beans	94.86	5.434
2	Wheat	87.045	4.656
3	Barley	83.533	5.537
4	Corn	96.553	6.09
5	Pakistani Biscuits	92.052	3.372
6	Irani Biscuits	89.012	4.320
7	Spaghetti	87.330	9.517
8	Millet	94.440	8.65
9	Rice	86.412	8.073

RESULT AND DISCUSSION:

The values based on cereal, legumes are the mean of duplicate sample of their different varieties which are shown in table (2).

In this study 33 sample were collected from local market of Quetta City of different varieties. These samples were subject for studies to chemical analysis of heavy and trace element. The samples which are collected from different market are presented in Table 2. The values based on the mean of duplicated values and then their mean ±SD.

All 33 samples were analyzed and have detectable levels of Cu varying from 1.373mg/kg-25.973 mg/kg.while Pd, Zn values in these samples are also varying from 1.4075mg/kg-5.067mg/kg and 6.619mg/kg-71.723mg/kg respectively.

In our study highest value of Cu and Zn in cereal and its product were detected in Irani Biscuits (25.973mglkg) and Barley(71.723 mg/kg).

However our study shows that Copper is lower in Spaghetti ,Millet, Wheat while these products are within the range of permissible level .Bean ,Barley, Corn ,Pakistani Biscuits, Iran Biscuits. Over all the study show the level of Cu are below the safe limits.

The study show that Zn products are within the range which are Corn, Iran Biscuits, Beans, Wheat, Barley, Millet while the lower limits of Zn are Spaghetti , Rice, Pakistani Biscuits but the lead quantity is greater in all food products which is due to bio accumulation /bio magnification its higher than the permissible limits set by codex alimentarius commission.

In fact Cu and Zn have a lot of function in the body and they are essential elements to about 0.4mg/kg in almost all sample.

The mean detectable levels of Cu, Pb, Zn and Cadmium are ranged 1.373mglkg-17.505mglkg,6.619mglkg-710723mglkg,1.4075mglkg-5.067mglkg and0.212mglkg-0.911 mg/kg respectively.

Copper: The mean values for copper have been presented in table 2.Copper is an essential element for plants, fertilizer, pesticides industry and sewage sludge's are the common sources for Cu contamination. Concentration for Cu in plants is 20-100mg/kg. [18]

The higher amount of Cu is due to the soil polluted with municipal wastes and also due to the atmospheric pollution to which the plant is exposed. Copper build up can result in a tendency for hyperactivity in autistin children .It can cause stuaering, Insomnia and hypertension. An excess of Cu can cause oily skin, usually around the face. Cu can cause nails to be brittle and thin. It can contribute to hair lose especially in women.

In our study the Detectable levels of cu varying from 1.373mg /kg -25.973 2mg/kg. Lower concentration was found in sample 5,7 which are below 2mg/kg.Sample no 3,4,6 are with in the range of the permissible level .The concentration of Cu is in order of Irani Biscuits>Barley> Wheat>Bean> Millet>Rice>Corn>Pakistani Biscuits>Spaghetti .Sample 1,2,8 are lower which are below 9mg/kg.

Copper also act as an anti oxidant and help body to remove free radicals and prevent all cell structure damage.

Zinc: The mean values of Zn have been presented in table 2.Zn is very important metal for plants and human life. In the blood about 85% of the Zinc combines with protein for transport after its absorption and its turn over is rapid in the pancreas .Deficiency of Zinc causes diabetic Hyposmia , Hypogensia or coma. Zinc is another enzymatic metal for both plants and animals.

In our study the detectable level of Zn varying from6.619-71.723mg/kg.The range of Zn is 20-200mg/kg above it that is the contamination of Zn in food items [19].The following samples are with in the range of 1, 2, 3,4,6,8 which are below 75mg/kg.The concentration of zinc is in order of increasing value Barley>Irani Biscuits>Wheat>Beans>Millet>Corn>Rice>Pakistani Biscuits>Spagetti. While sample 5,7,9 have zinc value which is below 20mg/kg.

Zn function as a cofactor for many enzymes of the body .It is concluded that atmospherics deposition from urban and agriculture are playing important role in the accumulation of these heavy metals. These can be also used for the chemical quality of food stuff and for the evaluation of the health risk associated with the consumption by humans.

Zinc and Copper reported have numerous beneficial and detrimental effects being essential component of many enzymes.

Lead: Lead is regarded as very hazardous for plants and humans. The source of lead pollution of Agriculture soils and plants are lead mines, fuel combustion, sewage sludge application and farmyard

manure [17]. The maximum acceptable concentration for food stuff is around 0.2mg/kg[4].Long term exposure to Pb can result in a build up of lead in the body and more severe symptoms. These include anemia, Pale skin, A blue line at abdominal pain, severe constipation, nausea, vomiting, and paralysis of the wrist joint. Prolonged exposure may cause kidney damage. If the nervous system is affected due to very high exposure the resulting effect include severe headache, convulsion, coma, delirium and death continued exposure can lead to decreased fertility or increase cause of miscarriage or birth defect.

From this study it is found that all food samples has greater value in which beans has greater value of 5.067mg/kg while the least value of Pb is in corn 1.4075mg/kg. The concentration of Pb is increase in order of Bean>Barley>Irani biscuits>Wheat>Millet >Rice>Spaghetti>Pakistani biscuits>Corn.

Cadmium: Cadmium level found above the acceptable value by the international food standard for heavy metal **.**Cadmium is a very toxic metal and can cause serious health problems. Recently attention has been focused for its availability in food sample though it occurred in very trace amount .Cd directly damage nerve cells. It inhibits the release of acetyl choline and activates cholinesterase enzyme, resulting in a tendency for hyperactivity of the nervous systems. Bones and joints by altering Ca and P metabolism. A toxic level of Cd contributes to arthritis, Osteoporosis and neuromuscular diseases. In cardiovascular system Cd replaces Zn in the arteries, which contributes to arteries being brittle and inflexible Cd accumulates in the kidneys, resulting in high blood pressure and kidney disease. Cd has reported to cause osteomalacia.

From this study it is found that sample 1,2,3,4,5,6,7,8,9 are greater than the permissible level. The conc of Cd is in order of Pakistani biscuits>Beans>corn >Irani Biscuits>Spaghetti>Millet>Rice>Wheat>Barley. The permissible limits for cadmium in all food sample is 0.05mg/kg[31].

Maganese: Maganese was observed in variable amount in table2.while sample 1, 2, 3,4,5,6,7,8,9 has greater values which are as follows Wheat>Barley>Beans>Millet>Irani Biscuits>Pakistani Biscuits>Rice>Spagetti>Corn. The highest value of manganese is in wheat which is 26.903mg/kg.

Manganese is an important element activating numerous essential enzymes. The essentially of manganese lies in the fact that its deficiency may lead to central nervous system (CNS) disorder [28] and low manganese level may reduce manganese dependent, superoxide, dismutase activity which may increase cancer susceptibility[7].Though the adequate dietary allowances of manganese recommended for an adult in indian context has not yet been established to be 2.5mg to 0.5mg per day[20].

Nickle: Although Ni is required in minute quantity for body.as it is mostly present in the pancreas and hence plays an important role in the production of insulin. Its deficiency results in the disorder of the liver[25].How ever increase concentration of Ni has many health affect .i.e.Ni tends to accumulate in the kidney causing kidney damage. Ni can play some physiological role related to this function .A common ingredient in fashion jewelry in Ni which can cause allergic reactions on some wearers. Eczema may develop and even asthma attacks.A steady exposure to nickel can cause cancer of the lungs and nasal sinus.

From this study Nickle is within range in all sample. The nickel is increase in order of Irani biscuits > Corn >Beans >Pakistani Biscuits > spagehatti >Wheat >Rice >Millet >Barley. Nickle value which is greater in Irani biscuits is 7.914mg/kg.

Iron:Fe is an essential element for plants, animals, and humans . Its deficiency cause problem in metabolism .For example Fe is the constituent of the active site of various reductive hydrogenases, Most frequent being associated with sulphur containing ligands. Fe together with hemoglobin and ferredoxin plays a central role in metabolism. Deficiency of Fe in plants produces chlorosis disease [19].Fe facilitates fat to control body weight which is an important factor in some body disease [29].

From our study it is found that sample 2 is greater which is 197.812mg/kg.Iron increase in order of Wheat>Bean>Barley>Millet>Irani biscuits>Corn>Rice> Spagetti>Pakistani biscuits

Table 3 shows the food items and quantitative contamination of heavy metal in duplicate Sample

FOOD ITEMS	ELEMENTS						
	COPPER	ZINC	LEAD	CADMIUM	MAGANESE	NICKLE	IRON
Beans	7.505±19.187	32.246±15.439	5.067±5.889	0.874±0.45	11.115±3.175	6.057±4.03	150.134±51.416
Wheat	8.686±6.070	42.152±24.945	3.44±1.817	0.306±0.899	26.903±12.575	5.636±2.350	197.182±54.522
Barley	1.440±4.655	71.723±65.885	4.194±1.560	0.212±0.194	15.227±2.005	2.710±2.838	141.305±39.660
Corn	4.438±0.273	25.888±2.61	1.4075±0.990	0.59±0.105	5.65±0.796	6.56±0.666	130.23±11.73
Pakistani Biscuit	1.983±2.153	10.278±7.999	2.835±1.653	0.911±0.4720	8.186±3.657	5.78±0.888	53.865±52.909
Irani Biscuits	25.973±54.356	55.633±105.300	3.482±2.388	0.569±0.104	10.902±2.886	7.914±5.244	132.619±34.576
Spaghetti	1.373±0.839	6.619±3.656	s2.947±2.274	0.553±0.041	7.023±1.076	5.758±0.476	81.076±50.005
Millet	7.226±7.083	28.168±23.673	3.210±1.0082	0.353±0.192	10.956±1.74	3.141±1.990	133.163±36.74
Rice	4.989±3.393	14.950±9.347	3.176±0.817	0.330±0.088	7.250±3.26	5.416±1.504	116.436±55.193

Mean value±SD

The permissible limits for Lead cereal and legumes: 0.2mg/kg [4].
The permissible limits for Copper in all food 10mg/kg[4].
The permissible limits for Cadmium in all food 0.05mglkg [31].
The permissible limits for Zinc in grain and beans 50-100mglkg respectively [30].

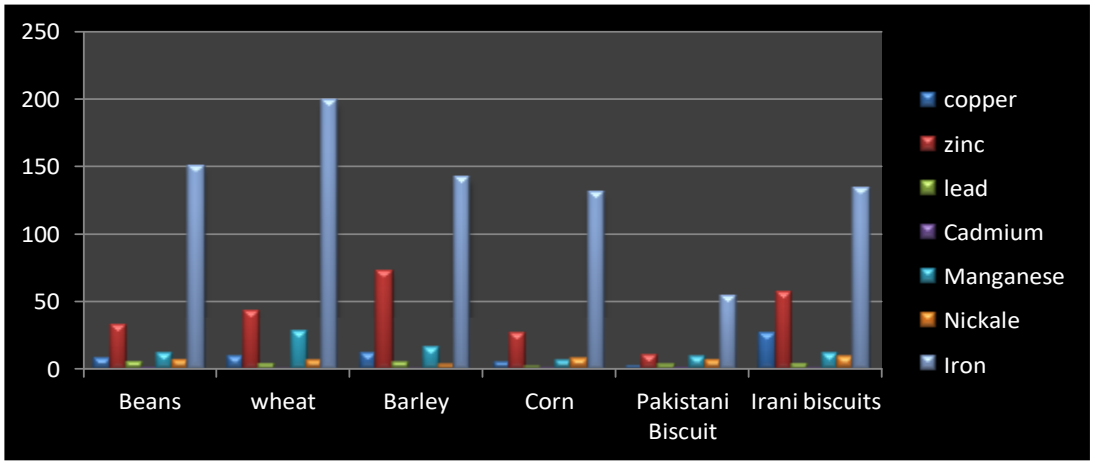

Fig 1:Graphical representation of heavy metals in cereal ,legumes and their products.

CONCLUSIONS:

the value of Cu, Zn, Pd and cd values which are reported are generally with in the range or lower than the permissible level while the pd value are greater than the permissible value which can show toxicity in human body.

It is concluded that metal based pesticides and fertilizer have cd or pd. These both are also responsible for contamination .copper also act as at as antioxidant and helps the body to remove free radicals and also safe the cell from damaging.

The result of this study provides valuable information about the content of heavy metals. More over quality for food stuffs of these chemicals can be used to evaluate the possible risks for human life.

ACKNOWLEDGEMENT:

We are thankful to ministry of science and technology PCSIR laboratories Quetta for providing all facilities to complete the project and for providing all support during the whole study.

REFERENCES:

1.A. Das.,Atext book of medical aspects of bio - inorganic chemistry ,CBS. Delhi, (1990).
2.B.E. Davies "Lead in heavy metals in soils"Ed.B.L .Alloway Blackie ,Glasgow,177(1990).
3.Codex Alimentarius Commission (CAC). Joint FAO/WHO Food Standards Program, 391, (1993).
4.Codex Alimentarius Commission (CAC) Evaluation of certain food additives and contaminants FAO/WHO, Codex stan. 230,(2001), (2003).
5.Conti, M. F. Cubadda and M. Carcea . Food Additives and Contaminants 17,45 ,(2000).
6. DJ.Rouse, Journal of Nutrition,2003; 133:1640S.
7. Finalay JW, Davis CD 1990.Maganese deficiency and toxicity are high or low dietary amount of manganese cause for cancer bio factors 10(1):15-24
8.Hussein, L and j Bruggeman, Food chemistry: 1997;58:391.
9.International Agency for Research on Cancer, Lyon 58., 119, (1993)
10.J, Rouse D,Journal of .Nutrtioni, 130,1640S, (2003)
11.J Pennington,S .Sehoen, G Salman,B Y oung ,R.John and R.Mart .1995b. "" Journal of food composition and analysis, 1982-1991;8:171.
12.J Pennington, S.Sehoen,G.Salman,B.young ,R.John and R .Mart. , journal of food composition and analysis,1995; 8:129.
13.J.M, Walker. Australian Govermment publishing Serviceanberra, 85,(1988).
14.Jarup, L., M. Berglund, C. Elinder, G Nordberg and M. Vahter ,Journal Work Environmental Health,1998; 24:51.
15.Jarup, L Hazards of heavy metal contamination. British Medical Bulletin 68,(2003).
16.Jorhem, L and B SUND STROEM,Journal of food composition and analysis,1993; 6 :223.
17.K Ahmed , Salama and Mohamed A. Radwan Emi,. Journal of Agricultural Science. 2005;17 (1): 34.
18.Maria dasGraces Andradr Korn, Elane Santos da Boa Morte Daniele Cristina Muniz B atista dos santos jacira Teixeria Cactro jose Tiago Peria Barbosa Alete Baixao Teixrira Andrea pires fermandes Bernhard welz wagna piler carvaldo dos santos Eduardo Batista Gu. "Sample preparation for the determination of metal of metal in food sample using spectranalytical methods-A Review ."
19.M .Ya Sakolink ,Elsevier Amsterdan,25 (1984).
20.NAS (National Academy of sciences)1980.Recommended Dietary Allowance Washington DC,USA: National research council.
21.N Range , J Changalucha ,H Krarup , P Magnussen ,AB Anderson ,H Friis , British Journal of Nutrtion , 2006;95:762.
22.N .S Rajurkar and B.M Perdeshi ,Appl .Radiat isot 1997;48:1059.
23.PC Onianwa, C Adetola,CM.Iwegbue, and O.Tella. Food chemistry,1999; 66:275.
24. PI Onianwa, j A Lawal, AA Ogunkeye and BM Orejimi, journal of food composition and Analysis: 2000;13:961.
25.R. Nath ,Biological and health effects interprint ,India (1986)
26.Saracoglu, S., M. Tuzen, D. Mendil M. Soylak, L. Elci and M. Dogan ,Bulletin of Environmental Contamination and Toxicology 73,264(2004).
27.S.P Mc Grath ,S smith ,chromium and nickel in heavy metals in soil .Ed. B. J Alloway .Blackie,Glasgow,125(1990).
28.Torente M, Colomia MT, Domingo JL, Effect of parental exposure to manganese to postnatal development and behaviour in mice ,influence of maternal restraints, Nurutoxicol,Teratol,2002;24(1):219-225
29.U Divirikli, N Horzum , M Soylak, L Elci,.International journal of .Food.science and .technoogy,2006; 41: 712.
30.USDA Zinc in foods-draft for comments. Foreign Agricultural Service (GAIN Report), (2003)
31.Walker, Australian Government Publishing Service, Canberra, 85.(1988).
32.WHO, Cadmium. Environmental Health Criteria,134, Geneva,(1992).
33.WHO. Lead. Environmental Health Criteria, 165, Geneva, (1995).
34.WU leung, W and R .Butrum. ,M.D Food and Agriculture Organisation (FAO) and united state department of health,education and welfare, 5, (1972)
35.Z Zhang, T.watanabe,S.shimbo,Khigashikawa and M.Ikeda.,Science and total environment,1998; 220:137.