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Evaluation of essential and toxic metals in bakery foods consumed in Chittagong (Bangladesh)

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ABSTRACT

The concentration of essential metals such as potassium (K), Iron (Fe), Calcium (Ca), Copper (Cu), Magnesium (Mg), Cobalt (Co), Zinc (Zn) & Manganese (Mn) and toxic metals such as Lead (Pb), Cadmium (Cd), Chromium (Cr) & Nickel (Ni) were evaluated in Bakery Foods consumed in Chittagong, Bangladesh. In the sampling step fourty samples of eleven types of Bakery food item were collected and analyzed after dry ashing by using Atomic Absorption Spectrometer (AAS). The essential metal evaluation in the investigated samples indicated the following range of concentration: K: 2.18 -162.62 mg kg^{-1}, Fe: 1.01-33.47 mg kg^{-1}, Ca: 4.86-138.06 mg kg^{-1}, Cu: 0.05-5.14 mg kg^{-1}, Mg: 35.55-593.26 mg kg^{-1}, Co: BDL, Zn: 1.02-14.80 mg kg^{-1}, Mn: 1.34-9.62 mg kg^{-1}. The essential metals concentration is in the range of human necessities. Pb, Cd, Cr and Ni were not detected at the ppm level in 67.5%, 87.5%, 100% and 72.5 % of analyzed bakery food sample respectively while in few food samples the concentrations of toxic metals were found: Pb: 0.06-1.21 mg kg^{-1}, Cd: 0.08-0.47 mg kg^{-1}, Ni: 0.49-2.94 mg kg^{-1}. All analyzed bakery products are safe to human health considering the recommended daily allowance (RDA) and maximum permissible limits (MPL) value of Pb, Cd, Cr and Ni. The information obtained from the present investigation is expected to be useful to the general people of this region in selecting bakery foods as their diets.

KEYWORDS

Bakery foods;
Essential metals;
Toxic metals;
AAS;
Chittagong.

INTRODUCTION

An element is essential for life if its removal from the diet or other route of exposure to an organism "results in a consistent and reproducible impairment of a physiological function." Human requirement for essential minerals vary from a few micrograms per day up to about 1g/day. Bioavailabilities of mineral nutrients vary from less than 1% for some forms of iron to greater than 90% for sodium and potassium[1]. The study of metal composition of foods is of great significance because some of these metals are essential or toxic. Metals such as Fe, Cu, Mg, Mn, Co, Zn are essential for human body but chronic metabolic disturbances may occur due to the deficiency or excess of these metals[2]. Human dietary deficiencies had been reported for Ca, Co (as vitamin B_{12}), Cr, I_2, Fe, Se and Zn[3]. Deficiencies of these minerals result from a combination of poor

bioavailability and low intakes. According to the U.S. Agency for Toxic Substances and Disease Registry, there are more than 20 heavy metals, they tend to accumulate in the food chain and in the body and can be stored in soft (e.g., kidney) and hard tissues (e.g., bone). Being metals, they often exist in a positively-charged form and can bind on to negatively-charged organic molecules to form complexes. Non essential elements such as Pb, Cd, Cr, Ni are considered to be toxic and their presence in the body can cause profound biochemical and neurological changes in the body[4]. Modern analytical techniques and ultra sensitive instruments analyzing metal contents even at ppb levels have recently resolved several health disorders associated with intake of toxic metals. Recent developments in toxicities and other disorders resulting from ingestion of toxic metals have compelled food regulators around the world to revise the safe limits of these toxicants to ensure consumer health.

Heavy-metal food intoxications are generally associated with one of three patterns of occurrence, environmental pollution, accidental inclusion during processing and contamination during processing or storage of food. In Iranian flat bread analysis, the highest concentration of Pb, Cd and Ni were found 0.52 mg kg^{-1}, 0.65 mg kg^{-1} and 2.67 mg kg^{-1} respectively[5]. In Pakistan the concentration of Cd, Ni and Pb were observed in chocolates and candy samples was ranged as of 0.099 - 0.353, 1.45 - 4.33 and 1.11 - 2.48 µg/g respectively which indicated that cocoa-based chocolates have higher contents of toxic metals than milk- based chocolates and candies[6]. In Southern Nigeria the mean concentrations of Zn, Fe, Cr, Mn, Ca, Mg, Ni, Pb, Cu. Co and Cd in various biscuit classes were determined and it was found that the metal content was below permissible limits except for nickel and lead in some types[7]. The level of heavy metals in foodstuffs has been reported around the world; from Sweden, USA, Egypt, China, Nigeria, Italy, and Turkey[8]. Preliminary studies in different parts of Bangladesh indicate that the food chain is exposed to contamination by heavy metals and trace elements. A number of animal meats, organ meats, meat products and egg were analyzed which were collected randomly from six different market of Chittagong city area, are the good sources of macro and micro nutrients and most of the studied foodstuffs contain the toxic elements within consumable limits but some of the food items bear noticeable amount of toxic metals[4]. Another analysis of heavy metal concentrations in vegetables in Jessore shows that all of the vegetables commonly consumed in diets contain dangerously high concentrations of heavy metals[9]. The need to take action to prevent and control contamination of the food chain by heavy metals and trace elements in Bangladesh is therefore becoming increasingly obvious.

It is also noticeable that

People of all ages are affectionate of different bakery products, because of their taste, color and easy to digest nature. Bakery products are becoming prominent day by day. Nowadays individuals have virtually no time to invest much on making breakfast it is the bread and bun or biscuits which had occurred instead of other sorts of stuff. There are numerous varieties of bakery products like bread, cakes, biscuits, pastries, pizzas and they all are popular worldwide. The major route of entry of most metals into the body is through the diet. Bakery products are consumed largely at Breakfast and/or Tiffin by the general people of Bangladesh since it supplies carbohydrates, proteins and certain inorganic micro nutrients that are vital for normal growth of human. Bakery foods contain several essential and trace elements even some toxic metals also. However, their relative composition is not clearly known as it should be and we have not enough information about the toxic metal contents in bakery foods which we are consuming everyday. The objective of this work is to estimate the levels of toxic metals such as Pb, Cd, Cr and Ni as well as essential metals such as K, Fe, Ca, Cu, Mg, Co, Zn and Mn in these foods consumed in Chittagong & to provide suggestions for actions to reduce contamination.

MATERIALS AND METHODS

Sample preparation

In this study Forty samples of Eleven types of Bakery food products namely 1) Bread 2) Bakar Khani [Dry flat bread] 3) Chocolate Cake, 4) Round Cake, 5) Custard Cake, 6) Horlicks Biscuit 7) Bela Biscuit 8) Milk Marie Biscuit 9) Chanachur [Bombay mix/Hot mix/ Chivdo] 10) Toast Biscuit 11) Butter Toast Biscuit of

available different brands were collected randomly from different fast food shops of Chittagong city area. A total of 2-7 different brands were collected within each major group or type. The choice of the samples was carefully made to reflect the various brands consumed by different income classes and influenced availability as of the time of the study.

Sampling

The sample was dried at 105°c for three (3) hours. Dried samples were powdered as well as homogenized using a porcelain crucible and stored in pre-cleaned polyethylene bottles until analysis.

Digestion procedure

Dry ashing: 5 g of dried, homogenized sample were placed into a high form porcelain crucible and few drops of con. HNO_3 were added to the solid as an ashing aid. Dry ashing process was carried out in a muffle furnace by stepwise increase of the temperature up to 550°c and then left to ash for about eight hours until a white or gray ash residue was obtained[8,10]. The residue was dissolved in 5 mL of HNO_3 (25%, v/v) and, when necessary, the mixture was heated slowly to dissolved the residue. The dissolved portion was filtered through a Whatman No. 40 filter paper and the solution was transferred to 50 mL volumetric flask and made upto volume. A blank control was carried out in the same way using the solvent alone.

Analytical techniques

The samples were analyzed by an atomic absorption spectrophotometer (Type: iCE 3300 AA system, Thermo Scientific, designed in UK) using an air acetylene flame. The analysis was carried out using respective hollow cathode lamps under standard instrumental conditions (TABLE 1). All the spectroscopic measurements of the standard metal solutions as well as the sample solutions were done at their respective wavelength of maximum absorptions λ_{max}. The detection limit of the element for the instrument and the spike recovery rates of the elements analyzed under the experimental conditions were also determined (TABLE 1).

TABLE 1 : Standard conditions used in determination of different elements, their detection limits, and spike recovery using atomic absorption spectrometer

Elements	Wave Length (nm)	Lamp Current (mA)	Slid width (nm)	Fuel Flow (L min^{-1})	Burner Height (mm)	Number of resamples	Detection Limits (ppm)	Spike Recovery (%)
K	766.5	8	0.5	1.2	7	3	0.0009	90-97
Ca	422.7	6	0.5	1.4	11	3	0.0037	92-98
Mg	285.2	12	0.5	1.1	7	3	0.0022	92-101
Fe	248.3	15	0.2	1.0	7	3	0.0043	92-97
Cu	324.8	5	0.5	1.1	7	3	0.0045	91-98
Mn	279.5	12	0.2	1.0	7	3	0.0016	92-99
Zn	213.9	10	0.2	1.2	7	3	0.0033	94-98
Pb	217.0	10	0.5	1.1	7	3	0.013	93-100
Ni	232.0	15	0.2	0.9	7	3	0.008	95-103
Cd	228.8	8	0.5	1.2	7	3	0.0028	95-102
Cr	357.9	12	0.5	1.0	8	3	0.0054	92-97
Co	240.7	15	0.2	1.7	7	3	0.01	93-102

Detection limit- the analyte concentration (or mass) that is equivalent to three times the standard deviation of twenty replicates of a blank sample.

Reagents and solutions

The chemicals used for the analysis were of the A R grade and redistilled water (RD H_2O) was used in preparation and dilution of all the solution. HNO_3 were procured from E. Merk, Germany. 1000 ppm spectral solutions of K, Ca, Fe, Cu, Mg, Mn, Co, Zn, Pb, Cd, Cr and Ni for AAS were obtained from BDH, England, for calibration purpose. All working solutions were prepared by de-ionized water. The respective metal concentrations were determined from each of the corresponding calibration curves.

RESULT AND DISCUSSION

The amount of essential and toxic metals in bakery foods is shown in TABLE 2 & 3. As wheat flour is the common ingredient for all types of bakery foods which forms the foundation of most of the bakery foods and gives the structure to the product, two different brands white flour were analyzed for comparison. Bread, Bakarkhani and Cake samples contain 29%, 18% and 16 % moisture respectively while other bakery items contain less than 5%. Consequently metal content were found higher in most of the analyzed bakery items rather than Bread, Bakarkhani and Cake. The magnesium (Mg) levels in the samples varied from 35.55 mg kg^{-1} in round cake (C_4) to 593.26 mg kg^{-1} in chanachur (H_2) (TABLE 2).

TABLE 2 : Amounts (mg kg^{-1}) of K, Mg, Ca, Fe, Zn in bakery food products of Chittagong city area

Sample Type	No. of Sample (n)	Sample Code No.	Metal Content (mg kg^{-1}) ± SD				
			K	Mg	Ca	Fe	Zn
Bread	5	A_1	12.91±0.013	198.59±0.794	63.21±0.885	3.78±0.030	3.23±0.010
		A_2	16.72±0.084	96.67±0.193	73.41±0.294	1.01±0.036	1.02±0.010
		A_3	13.41±0.040	85.55±0.171	20.50±0.123	4.81±0.038	4.28±0.004
		A_4	23.08±0.069	169.41±0.339	22.19±0.266	4.04±0.012	5.14±0.026
		A_5	23.43±0.047	120.97±0.242	101.58±0.711	3.75±0.030	3.46±0.007
Bakarkhani	4	B_1	8.13±0.008	85.77±0.257	23.69±0.118	2.00±0.034	1.73±0.014
		B_2	2.18±0.004	98.56±0.296	4.86±0.058	1.95±0.016	1.43±0.010
		B_3	7.18±0.007	130.33±0.521	39.02±0.117	2.96±0.041	1.73±0.012
		B_4	5.5±0.010	108.95±0.167	19.95±0.045	2.20±0.022	1.25±0.015
Chocolate Cake	2	C_1	114.51±0.573	124.02±0.248	42.19±0.295	12.94±0.078	6.26±0.006
		C_2	85.5±0.140	118.55±0.142	38.50±0.206	13.55±0.052	3.68±0.005
Round Cake	4	C_3	75.5±0.056	55.80±0.242	31.60±0.198	12.50±0.035	4.58±0.009
		C_4	69.83±0.178	35.55±0.181	34.38±1.044	10.48±0.074	5.00±0.089
		C_5	81.1±0.811	76.15±0.076	41.81±0.418	11.02±0.110	5.99±0.018
		C_6	65.5±0.461	65.85±0.343	35.55±0.439	9.75±0.090	4.50±0.021
Custard Cake	2	C_7	88.9±0.234	90.35±0.159	130.50±0.355	10.60±0.044	5.24±0.018
		C_8	76.85±0.275	68.55±0.143	39.95±0.285	8.95±0.036	6.93±0.011
Horlicks Biscuit	3	D_1	84.46±0.422	93.66±0.281	29.71±0.238	6.88±0.083	4.42±0.013
		D_2	85.73±0.171	56.76±0.114	30.69±0.368	11.45±0.172	4.21±0.013
		D_3	61.34±0.061	105.16±0.210	34.14±0.102	7.18±0.022	2.17±0.017
Bela Biscuit	7	F_1	162.62±0.488	165.59±0.662	41.70±0.167	8.95±0.081	5.37±0.011
		F_2	40.3±0.040	124.89±0.624	28.38±0.199	9.36±0.028	2.18±0.009
		F_3	59.73±0.299	97.70±0.098	38.50±0.500	29.71±0.149	14.80±0.044
		F_4	32.55±0.158	78.85±0.106	26.55±0.168	10.50±0.027	2.58±0.009
		F_5	36.45±0.234	85.14±0.089	23.54±0.232	12.85±0.016	1.98±0.011
		F_6	38.55±0.166	76.35±0.082	19.58±0.155	13.55±0.009	4.50±0.014
		F_7	37.55±0.198	86.85±0.205	25.50±0.225	18.50±0.015	1.65±0.008
Milk Marie Biscuit	2	G_1	130.74±0.261	96.09±0.192	138.06±2.215	33.47±0.067	6.19±0.019
		G_2	71.97±0.432	123.91±0.372	46.59±0.419	18.54±0.111	4.52±0.018
Chanachur	7	H_1	100.49±0.502	579.37±1.159	33.31±0.133	23.72±0.095	13.11±0.026
		H_2	89.07±0.267	593.26±1.187	97.27±1.167	17.61±0.035	10.52±0.042
		H_3	87.99±0.616	528.71±1.586	34.30±0.103	16.09±0.080	9.40±0.019
		H_4	94.52±0.325	570.15±0.789	28.52±0.023	14.53±0.011	8.43±0.012
		H_5	89.85±0.452	540.65±0.856	31.52±0.024	24.58±0.008	9.12±0.009
		H_6	78.95±0.455	520.55±0.848	45.55±0.015	17.58±0.032	10.25±0.014
		H_7	92.25±0.345	496.50±1.009	33.56±0.008	23.50±0.045	8.25±0.021

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Sample Type	No. of Sample (n)	Sample Code No.	Metal Content (mg kg^{-1}) ± SD				
			K	Mg	Ca	Fe	Zn
Toast Biscuit	2	I_1	114.47±0.687	138.83±0.278	7.15±0.057	19.05±0.171	8.87±0.018
		I_2	90.55±0.465	122.85±0.151	9.46±0.033	21.50±0.078	6.58±0.016
Butter Toast	2	I_3	46.52±0.140	101.12±0.101	18.42±0.184	10.92±0.055	2.73±0.025
		I_4	48.43±0.009	96.58±0.089	14.12±0.115	9.55±0.046	2.55±0.020
Wheat flour	2	E_1	106.17±1.805	203.78±0.815	25.79±0.103	20.39±0.061	8.95±0.036
		E_2	133.8±1.204	91.66±0.367	42.05±0.336	14.44±0.072	7.58±0.008

SD indicates standard deviation of three replicate measurements

The concentration of Mg in most of the samples was found higher than the other essential metals. Magnesium is a critical co-factor in more than 300 enzymatic reactions in the human body[11]. Magnesium deficiency can affect virtually every organ system of the body. With regard to skeletal muscle, one may experience twitches, cramps, muscle tension, muscle soreness, including back aches, neck pain, tension headaches and jaw joint (or TMJ) dysfunction[12]. The lowest and highest content of iron (Fe) were found 1.01 mg kg^{-1} for bread (A_2) and 33.47 mg kg^{-1} in milk marie biscuit (G_1) respectively. In humans, iron is an essential component of proteins involved in oxygen transport. It is also essential for the regulation of cell growth and differentiation. A deficiency of iron limits oxygen delivery to cells, resulting in fatigue, poor work performance, and decreased immunity. On the other hand, excess amounts of iron can result in toxicity and even death[13,14]. The concentration of potassium (K) in the different bakery foods ranges from 2.18 -162.62 mg kg^{-1}. The highest level of K was observed in bela biscuit (F_1) and lowest level was found in Bakarkhani (B_2). Newer evidence suggests that dietary potassium may play a role in decreasing blood pressure. Potassium is involved in nerve function, muscle control and blood pressure. A diet low in potassium and high in sodium may be a factor in high blood pressure. Increasing potassium in the diet may protect against hypertension in people who are sensitive to high levels of sodium[15].

The concentration of calcium (Ca) was found to be 4.86-138.06 mg kg^{-1}. The mean concentration of Ca was above 21 mg kg^{-1} for all types of bakery food except toast and butter toast biscuits. Ca is essential for bone formation in children. Ca^{2+} ions are central to a complex intracellular messenger system that is mediating a wide range of biological processes: muscle contraction, secretion, glycolysis and glyconeogenesis, ion transport, cell division and growth[16]. Bone mineral serves as the ultimate reservoir for the calcium circulating in the extracellular fluid (ECF)[17].

The recommended daily allowance (RDA) of Mg, Fe, K, Ca, Co, Cu and Zn are shown in TABLE 4. Zinc (Zn) concentration of was found 1.02 mg kg^{-1} in bread (A_2) to 14.80 mg kg^{-1} in bela biscuits (F_3).

The mean concentration of Zn was found maximum in chanachur. Zinc enhances the stereo selectivity of the polymerization of nucleotides under reaction conditions designed to simulate the environment for prebiotic reactions[16]. Zinc functions as a component of various enzymes in the maintenance of the structural integrity of proteins and in the regulation of gene expression[14]. The highest value of Copper (Cu) was found 5.14 mg kg^{-1} in horlicks biscuits (D_1) and lowest value was found 0.05 mgkg^{-1} in bread (A_2) (TABLE 3).

Although Cu is essential element in trace amount but can be toxic when it exceeds the maximum permissible limit. Cu serves as an antioxidant and helps the body to remove free radicals, prevent cell structure damage and responsible for hyperactivity in autistic children. Many copper metalloenzymes have been identified in humans[14]. Cobalt (Co) were not detected at the ppm level in all types of bakery food sample. The manganese (Mn) levels in the sample varied from 1.34 mg kg^{-1} in baker khani (B_2) to 9.62 mg kg^{-1} in chanachur (H_1). Mn plays a critical role in oxygen evolution catalyzed by the proteins of the photosynthetic reaction center. Pyruvate carboxylase in mammals are also manganese protein[16]. Mn is involved in the formation of bone and in amino acid, lipid, and carbohydrate metabolism. The Adequate Intake (AI) of Mn for adult men and women is 2.3 and 1.8 mg/day respectively[14]. Chanachur consists peanuts, chickpea flour, flattened rice, palm oil, corn, chickpeas etc. as ingredients. The concentration of Mg, Zn, Mn and Ni were maximum in

TABLE 3 : Amounts (mg kg^{-1}) of Cu, Mn, Co, Ni, Pb, Cd and Cr in bakery food products of Chittagong city area

Sample Type	No. of Sample (n)	Sample Code No.	Metal Content (mg kg^{-1}) ± SD						
			Cu	Mn	Co	Ni	Pb,	Cd	Cr
Bread	5	A_1	0.53±0.009	2.99±0.024	***	***	***	***	***
		A_2	0.05±0.002	2.17±0.011	***	***	***	***	***
		A_3	0.10±0.001	1.96±0.008	***	***	***	***	***
		A_4	0.33±0.006	2.96±0.018	***	***	***	***	***
		A_5	0.17±0.004	2.14±0.045	***	***	***	***	***
Bakarkhani	4	B_1	0.37±0.013	2.09±0.002	***	0.56±0.03	***	***	***
		B_2	0.30±0.018	1.34±0.008	***	***	***	***	***
		B_3	0.33±0.001	2.41±0.017	***	0.49±0.02	***	***	***
		B_4	0.28±0.009	1.98±0.013	***	***	***	***	***
Chocolate Cake	2	C_1	1.15±0.053	2.51±0.020	***	0.94±0.03	***	0.28±0.03	***
		C_2	0.96±0.038	2.35±0.032	***	***	***	***	***
Round Cake	4	C_3	1.96±0.002	1.65±0.015	***	***	***	***	***
		C_4	2.24±0.009	2.03±0.039	***	***	***	***	***
		C_5	2.64±0.008	1.89±0.027	***	***	***	***	***
		C_6	1.78±0.004	1.75±0.018	***	***	***	***	***
Custard Cake	2	C_7	1.78±0.007	2.15±0.009	***	***	***	***	***
		C_8	1.52±0.010	1.96±0.022	***	***	***	***	***
Horlicks Biscuit	3	D_1	5.14±0.021	2.76±0.028	***	1.61±0.05	***	***	***
		D_2	3.29±0.030	2.60±0.031	***	***	0.06±0.003	***	***
		D_3	3.06±0.058	2.22±0.038	***	***	0.27±0.011	***	***
Bela Biscuit	7	F_1	1.13±0.015	2.02±0.059	***	***	***	***	***
		F_2	0.45±0.009	3.27±0.023	***	***	***	***	***
		F_3	0.74±0.012	3.78±0.023	***	***	***	***	***
		F_4	0.50±0.007	1.98±0.027	***	***	***	***	***
		F_5	0.55±0.006	2.85±0.008	***	***	***	***	***
		F_6	0.59±0.004	1.65±0.017	***	***	***	***	***
		F_7	0.35±0.009	2.15±0.018	***	***	0.08±0.005	***	***
Milk Marie Biscuit	2	G_1	2.55±0.043	6.90±0.007	***	***	1.21±0.059	0.47±0.03	***
		G_2	1.02±0.005	2.98±0.027	***	***	***	***	***
Chanachur	7	H_1	0.98±0.010	9.62±0.010	***	1.94±0.10	1.10±0.022	0.10±0.02	***
		H_2	1.74±0.030	7.92±0.063	***	2.94±0.10	***	***	***
		H_3	1.04±0.007	7.72±0.039	***	1.26±0.08	0.16±0.004	0.13±0.04	***
		H_4	0.89±0.010	6.55±0.026	***	0.98±0.04	0.13±0.003	***	***
		H_5	0.96±0.008	8.25±0.042	***	1.12±0.07	0.10±0.010	***	***
		H_6	0.98±0.008	7.61±0.045	***	0.96±0.04	0.09±0.006	0.08±0.01	***
		H_7	1.01±0.007	6.53±0.027	***	1.08±0.08	***	***	***
Toast Biscuit	2	I_1	2.16±0.006	3.54±0.002	***	***	0.49±0.017	***	***
		I_2	1.95±0.010	3.15±0.005	***	***	0.40±0.011	***	***
Butter Toast	2	I_3	0.57±0.020	2.86±0.003	***	***	0.46±0.028	***	***
		I_4	0.75±0.011	2.45±0.006	***	***	0.30±0.021	***	***
Wheat flour	2	E_1	3.71±0.033	5.46±0.016	***	***	***	***	***
		E_2	4.99±0.070	6.77±0.007	***	***	***	***	***

***** indicates below detection limit**

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TABLE 4 : Recommended daily allowance (RDA) value of the metals (mg / day) for an adult person[4,14].

	Mg	Fe	K	Ca	Co	Cu	Zn
RDA (mg/day)	310-400	8-18	4700	1000-1300	1-1.5	1.5-3.2	12-15

Chanachur and mean concentration of other metals also found satisfactory compare to flour which indicates it is a very good source of minerals.

Ni, Pb and Cd were not detected at the ppm level in 72.5 %, 67.5% and 87.5% of analyzed bakery food sample respectively. Maximum value of Ni was 2.94 mg kg^{-1} in chanachur (H2) while minimum was 0.49 mg kg^{-1} in bakar khani (B3). Both Pb (1.21 mg kg^{-1}) and Cd (0.47 mg kg^{-1}) was found maximum in milk marie biscuit (G1) while minimum Pb was found 0.06 mg kg^{-1} in horlicks biscuits (D2) and minimum Cd was found 0.08 mg kg^{-1} in chanachur (H6). The permisble limit of Ni is 4 μg g^{-1} according to Food and Nutrition Board: Institute of Medicine, 2010[18]. The concentration of Pb if exceeding the maximum permissible limits (0.2 μg g^{-1}) in human, affect nervous system, bones, liver, pancreases, teeth and gum & causes blood diseases[19]. When the concentration of (Cd) in diet is higher than RDA and maximum permissible limits (MPL) value, it accumulates especially in the kidney and the liver that can cause serious biological and neurological changes in human body even at ultra trace level[4]. The permissible limit of Cd is 0.3 μg g^{-1} in food samples as per World Health Organization and Federal Drug Administration. All analyzed bakery products are safe to human health considering the RDA and MPL value of Ni, Pb and Cd. Though Chromium (III) plays an important role in the body function (metabolic functions, cofactor of insulin etc.) in trace amount but it turns to be toxic when it exceeds the tolerance limit. However, chromium (VI), which is a by-product of manufacturing stainless steel, pigments, chromate chemicals, and numerous other products, is strongly oxidizing, produces local irritation or corrosion, and is recognized as a carcinogen when inhaled[14]. Cr were not detected at the ppm level which indicates all food sample were also free from Cr contamination.

CONCLUSION

The present study provides information about mineral nutrients as well as useful guide for bakery foods choice taking into consideration the heavy metal toxicity effects. All bakery items are good source of macro and micronutrients. Most of the studied food samples are free from toxic metal contamination and little food stuff contains the toxic elements within consumable limit. Moreover, concerned authority should take necessary steps for reducing the toxic metal contamination into the food chain. This study also provided baseline data on toxic metal concentrations for baker foods in this region of Bangladesh.

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