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Determination of Trace Metals (Co, Cu, Cd, Pb, Fe, Ni and Mn) in Selected Sweets of Different Shops of Karachi City by Atomic Absorption Spectroscopy

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Abstract: The study presented was concerned with the determination of level of iron, nickel, cobalt, copper, lead, manganese and cadmium in different sweets (Gulab Jamun, White Chum Chum, Colored Chum Chum, Khopre ki Mithai, Qalaqand, Bhashani Chum Chum, Basin ka Lado and Patesa) collected from selected shops of Karachi city. Concentration of selected trace metals were estimated using atomic absorption spectrometer. Results obtained from study show high concentration of iron and manganese in all the sweets. High concentration of iron may be due to the cooking utensils rich of iron. Use of manganese in alloys may be responsible of such high concentration of manganese in sweets. Metal load in sweets of all shops seem in the limits offered by RDA for respective metals. All food colors used in making sweets are permitted food colors, because sweets show no abnormal metal load.

Key words: Trace metals, sweets, Karachi city, atomic absorption spectrometer

INTRODUCTION

Trace elements are those elements of periodic table that occur in animals or humans amounting to mg/kg of body weight or less. Some of trace elements found in living organisms considered being essential, i.e. indispensable for growth and health whereas remaining are non-essential. Some of non-essential trace elements can also be beneficial to health through pharmacological action[1]. All the trace elements are toxic when they intake in excess. Human require all the trace elements in quantities, measuring mg/day[2].

The term ultra trace elements have been generally applied to elements for which there are experimental evidence, usually from animals' models, suggesting that they are essential for humans. However, human nutritional importance has not been clearly established[3].

Trace elements and ultra trace elements have five known roles in living organisms, when an essential trace or ultra trace element is not available then death occurs[4].

Cities of Pakistan are sprawling with sweet meet marts. The society is much more concerned about the pollutants, which enter one body through food uptake. Food habits vary from populations to populations and therefore the threat through these pollutants also varies with the food habits. Sweets are the most common traditional food item in culture of Pakistan. Especially at the occasion of marriages and Eid. Owing to the high demands for sweets, this research investigated the metal load of various kinds of sweets being sold in different famous shops of Karachi. Various ingredients are used for making different kinds of sweets. Also the food colors used are of different grade and quality. These all things are responsible for differing metal load in sweets. This study have been conducted to analyze Co, Cu, Cd, Pb, Fe, Ni and Mn of which Fe, Ni, Co, Cu and Mn are essential elements whereas Pb and Cd are nonessential as well as toxic for health[2].

MATERIALS AND METHODS

Sampling: Eight different kinds of sweets were collected from eight different shops of Karachi City situated in different areas. Sampling process was periodically repeated three times with a difference of two weeks and that average value was calculated.

Sample preparation: Ten g of each sweet was digested in HNO_3 and $HClO_4$ in the ratio of 1:5, respectively. HNO_3 was used digest metal where as $HClO_4$ was use to digest organic matter. Digested samples were filtered through Whatman-40 filter paper. Filtrate and washings were make up to 50 ml with 5% HNO_3. Samples were stored in a teflon bottles.

Standards preparation: Standards were prepared in 5% HNO_3 using salts of metals that is lead acetate for lead, cadmium nitrate for cadmium, nickel sulphate for nickel,

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copper sulphate for copper, cobalt chloride for cobalt, manganese sulphate for manganese, ferrous ammonium sulphate for iron. Standards were also stored in teflon bottles. All chemicals have been of analytical grade and were obtained from Merck (Germany).

Determination: Metal concentration in samples was determined using PERKIN-ELMER 2380 Atomic Absorption Spectrometer and parameters have been chosen for Atomic Absorption Study (Table 1).

RESULTS AND DISCUSSION

Iron: Concentration of iron was found to be 0.4-1.4 ppm in the all selected samples of Mehmood Sweet Meet Mart (Table 2). Iron Concentration in the similar samples from "Dilpasand Sweets" was found between 6-19 ppm (Table 3). In "Darbar-e-Shiren Sweets" the iron concentration in the representative samples was found to be 7-18 ppm (Table 4). In the samples selected from "United King Sweets" iron concentration was found to be in the range of 5-18 ppm (Table 5).

Similar samples of sweets taken from "Fresko Sweets" show iron concentration in the range of 10-19 ppm. (Table 6). Samples from "S. Abdul Khaliq Sweets" show iron concentration between 8-12 ppm (Table 7). Concentration of iron in the samples selected from "Nirala Sweets" show the concentration in the range of 5-12 ppm (Table 8). The samples selected from "FreshWell Sweets" show iron concentration in the range of 5-15 ppm (Table 9).

Recommended dietary allowances (RDA) for iron is 50-400 μg/Day (Table 10). Results of iron concentration for Mehmood Sweets are lower than RDA value. Results of all remaining shops are in accordance with RDA value Iron is mainly used in making utensils especially Karhai from which iron get way to enter in sweets[5]. Iron is also present in milk[6], which is most commonly used to prepare

Table 1: Chosen parameters

Parameters	Fe	Mn	Cd	Cu	Pb	Co	Ni
Wave length (nm)	248.3	279.5	228.8	324.8	283.3	240.7	232.0
Flame	Air-Acetylene	Air-Acetylene	Air-Acetylene	Air-Acetylene	Air-Acetylene	Air-Acetylene	Air-Acetylene
Lamp current (mA)	26	16	6	8	12	26	26
Range of standards (ppm)	0.2-5.5	0.6-5.0	0.05-0.2	2-4	1-5	0.4-4	2-6
Zone of measurement (mm)	3-5	5-8	4-8	3-8	3-8	6-8	3-8
Slit width (mm)	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 2: Concentration of metals in sweets of Mehmood Sweet Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	1.4739	1.1532	0.1613	0.6135	3.1396	0.1776	4.9984
White Chumchum	0.5586	0.6438	0.2629	0.4012	3.4230	0.1788	4.7582
Colored Chumchum	0.6895	0.8282	0.2600	0.7335	3.1628	0.1794	4.8138
Khopre ki mithai	0.7729	0.9122	0.3309	2.1077	3.1688	0.1792	7.1346
Bhashani Chumchum	0.7240	0.3506	0.4694	0.5188	3.2494	0.1952	4.6924
Qalaqand	1.4464	1.8632	0.6760	0.4422	3.2769	0.2037	4.8924
Besin Ka Lado	1.4263	1.9852	0.1879	4.0717	3.2926	0.1846	9.4166
Patesa	0.4730	0.5888	0.1570	1.1999	3.2275	0.1623	5.8367

Table 3: Concentration of metals in sweets of Dilpasand Sweet Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	14.2829	0.2051	0.2876	0.5408	3.2900	4.8160	0.1702
White Chumchum	12.6808	0.2091	0.2019	0.6669	3.1537	4.6382	0.3621
Colored Chumchum	6.8222	0.1877	0.2792	0.7620	3.1467	4.7771	0.1564
Khopre ki Mithai	17.0576	0.8281	0.9814	1.3879	3.2021	5.0623	0.1655
Bhashani Chumchum	7.9632	0.2358	0.2334	0.5084	3.1947	4.5577	0.1504
Qalaqand	17.1949	0.9054	0.9124	0.9106	3.2219	4.7482	0.1682
Besin Ka Lado	14.3360	1.0722	0.2189	2.9514	3.1672	6.9856	0.1539
Patesa	19.2319	0.1188	0.1187	1.5468	3.2187	5.1000	0.1469

Table 4: Concentration of metals in sweets of Darbar-e-Shirin Sweet Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	18.1767	1.1541	0.3889	0.4833	3.5481	0.1778	6.3392
White Chumchum	11.6908	1.1927	0.3251	0.3768	3.4561	0.1708	5.8538
Colored Chumchum	11.5157	1.4089	0.2193	0.4325	3.4742	0.1839	6.0960
Khopre ki Mithai	14.9691	1.9010	0.6942	2.0531	3.5481	0.1944	8.0208
Bhashani Chumchum	7.6563	1.6619	0.4432	0.5014	3.3797	0.1801	5.9345
Qalaqand	18.9323	2.9543	0.8739	0.5153	3.5347	0.1854	6.0530
Besin Ka Lado	12.4260	2.1104	0.3279	2.2821	3.4057	0.1670	8.0925
Patesa	8.4987	0.9136	0.2177	0.7995	3.3861	0.1651	6.4565

Table 5: Concentration of metals in sweets of United King Sweet Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	14.5635	1.4382	0.3048	0.4353	3.3570	0.2553	6.5661
White Chumchum	5.7479	0.8659	0.3559	0.2664	3.3684	0.2564	6.3859
Colored Chumchum	7.0154	0.8257	0.3206	0.3097	3.4553	0.2558	6.6504
Khopre ki Mithai	11.1029	1.0233	0.2670	1.6590	3.4142	0.2536	8.4920
Bhashani Chumchum	8.6166	1.0869	0.2224	0.3210	3.4295	0.2582	6.5137
Qalaqand	18.8249	2.1798	0.7875	0.5964	3.5179	0.2731	6.5099
Besin Ka Lado	11.1498	0.9400	0.2848	1.9021	3.3164	0.2546	6.7991
Patesa	14.5612	2.4122	0.4282	2.7624	3.2489	0.2552	8.5496

Table 6: Concentration of metals in sweets of Fresco Sweets Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	16.0882	2.2553	0.1721	0.1634	0.9530	0.2678	7.2714
White Chumchum	16.9015	3.8206	0.2300	0.1081	0.9670	0.2621	7.1710
Colored Chumchum	13.7215	0.5390	0.9801	0.0735	0.6713	0.2842	7.4439
Khopre ki Mithai	17.3484	0.8060	0.4152	0.3377	1.7650	0.2667	7.4364
Bhashani Chumchum	19.7024	0.8625	0.3433	0.2009	0.5943	0.2667	7.3112
Qalaqand	18.5543	1.9953	0.7963	0.2303	1.3713	0.2780	7.3335
Besin Ka Lado	12.1966	0.9330	0.3297	2.448	1.3839	0.2482	7.7777
Patesa	10.0314	0.9199	0.2117	1.1156	1.4162	0.2416	7.3085

Table 7: Concentration of metals in sweets of S-Abdul Khaliq Sweet Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	12.1487	0.6165	0.1872	0.3967	0.5104	0.2572	7.5440
White Chumchum	8.8814	0.6503	0.1748	0.2062	0.6030	0.2557	7.4628
Colored Chumchum	9.2754	0.7260	0.2779	0.2185	0.5457	0.2465	7.2100
Khopre ki Mithai	12.3636	1.5892	0.5159	1.1734	0.7080	0.2663	8.7359
Bhashani Chumchum	11.7055	0.6079	0.3186	0.2920	0.4966	0.2610	7.6402
Qalaqand	12.9516	1.0849	0.4481	0.7373	0.9051	0.2712	7.8704
Besin Ka Lado	12.1187	1.3374	0.2299	2.8931	0.5614	0.2449	11.5716
Patesa	10.2065	1.2081	0.2057	2.3754	0.3172	0.2493	10.2189

Table 8: Concentration of metals in sweets of Nirala Sweet Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	9.0734	1.2805	0.2533	0.4056	0.6723	0.2457	7.5188
White Chumchum	5.3581	0.8610	0.4072	0.2987	0.6525	0.2336	7.4408
Colored Chumchum	5.2647	2.0892	0.2164	0.7645	0.5960	0.2313	7.2624
Khopre ki Mithai	--	--	--	--	--	--	--
Bhashani Chumchum	9.6013	1.9605	0.2580	0.6421	0.7945	0.2381	7.3587
Qalaqand	12.3531	2.4585	0.2696	0.7497	1.1581	0.2516	7.5101
Besin Ka Lado	--	--	--	--	--	--	--
Patesa	8.1773	1.4968	0.0698	1.9735	0.5219	0.2243	8.5301

Table 9: Concentration of metals in sweets of Fresh Well Sweet Meet Mart

Samples	Fe (ppm)	Ni (ppm)	Co (ppm)	Cu (ppm)	Pb (ppm)	Cd (ppm)	Mn (ppm)
Gulab Jamun	10.6791	0.2846	0.3620	0.2745	0.8895	0.2584	7.5108
White Chamcham	8.4176	0.2403	0.3163	0.3831	0.9225	0.2579	7.4617
Colored Chumchum	10.9617	1.1055	0.1841	1.6389	1.0644	0.2327	7.5054
Khopre ki Mithai	13.1777	0.6770	0.5341	1.2168	0.9737	0.2613	8.5798
Bhashani Chumchum	9.1394	0.3021	0.2299	0.2607	1.0673	0.2523	7.3104
Qalaqand	15.9649	0.7460	0.3627	0.3594	1.1997	0.2708	7.5175
Besin Ka Lado	10.6941	0.4908	0.3037	2.2788	1.1039	0.2521	10.1791
Patesa	5.8666	0.8043	0.1407	0.6114	0.8673	0.2476	8.0105

Table 10: RDA values for metals

Elements	RDA (µg/day)
Fe	50-400
Ni	300-600
Co	0.1-10
Cu	150-600
Pb	<100
Cd	10-60
Mn	20-90

sweets hence being responsible for the iron contents of sweets.

Nickel: Concentration of nickel in the samples selected from Mehmood Sweet Meet Mart, Dilpasand Sweet Meet Mart, Darbar-e-Shirin Sweet Meet Mart, United King Sweet Meet Mart, Fresco Sweets Meet Mart, S-Abdul

Khaliq Sweet Meet Mart, Nirala Sweet Meet Mart, Fresh Well Sweet Meet Mart was found to be 0.3-1.9, 0.1-1.0, 0.9-2.9, 0.8-2.4, 0.5-3.8, 0.6-1.5, 0.8-2.4 and 0.2-1.1 ppm, respectively (Table 2-9)

Recommended dietary allowances (RDA) for nickel is 300-600 μg/Day (Table 10). Results of all shops are in lower than RDA value for Nickel. Since sweets are prepared in "ghee" and we are not sure about the quality of that ghee, which becomes a main source of nickel in the sweets because nickel is used as a catalyst for the hydrogenation of oil to convert it into ghee. Nickel is used in large numbers of alloys including stainless steel[7] therefore the utensils used during the preparation of sweets are also responsible for the nickel contents of the sweets. Sugar the main ingredient of the sweets is also responsible for the nickel contents of the sweets[8].

Cobalt: Concentration of cobalt in the samples selected from Mehmood Sweet Meet Mart, Dilpasand Sweet Meet Mart, Darbar-e-Shirin Sweet Meet Mart, United King Sweet Meet Mart, Fresco Sweets Meet Mart, S-Abdul Khaliq Sweet Meet Mart, Nirala Sweet Meet Mart, Fresh Well Sweet Meet Mart was found to be 0.1-0.6, 0.1-0.9, 0.2-0.8, 0.2-0.7, 0.1-0.9, 0.1-0.5, 0.06-0.4 and 0.1-0.5 ppm, respectively (Table 2-9)

Recommended dietary allowances (RDA) for cobalt is 0.1-10 μg/Day (Table 10). Results of all shops are in accordance with RDA value for cobalt. Cobalt is also greatly used in alloys[9] hence it may also enter the sweets through utensils. Milk[6], water[10] and other ingredients mainly sugar[8] are also responsible for the entrance of cobalt in sweets.

Lead: Concentration of lead in the samples selected from Mehmood Sweet Meet Mart, Dilpasand Sweet Meet Mart, Darbar-e-Shirin Sweet Meet Mart, United King Sweet Meet Mart, Fresco Sweets Meet Mart, S-Abdul Khaliq Sweet Meet Mart, Nirala Sweet Meet Mart, Fresh Well Sweet Meet Mart was found to be 3.1-3.3, 3.1-3.2, 3.3-3.5, 3.2-3.5, 0.5-1.7, 0.3-0.9, 0.5-1.2 and 0.8-1.2 ppm, respectively (Table 2-9)

Recommended dietary allowances (RDA) for Lead is less than 100 μg/Day (Table 10). Results of all shops are in accordance with RDA value for lead. Although concentration of Lead is comparably high in the sweets of Mehmood Sweets, Dilpasand Sweets, Darbar-e-Shiren Sweets and United King Sweets. But these are also according to RDA values.

Lead may enter in sweets through milk[11,12] and water[13].

Cadmium: Concentration of cadmium was found to be 0.1-0.2 ppm in the selected samples of Mehmood Sweet Meet Mart (Table 2). Cadmium concentration in the similar samples from "Dilpasand Sweets" was found between 0.1-0.3 ppm (Table 3). In "Darbar-e-Shiren Sweets" the cadmium concentration in the representative samples was found to be 0.16-0.19 ppm (Table 4). In the samples selected from "United King Sweets" cadmium concentration was found to be in the range of 0.25-0.27 ppm (Table 5). Similar samples of sweets taken from "Fresko Sweets" show cadmium concentration in the range of 0.24-0.27 ppm (Table 6). Samples from "S. Abdul Khaliq Sweets" show cadmium concentration between 0.24-0.27 ppm (Table 7). Concentration of cadmium in the samples selected from "Nirala Sweets" show the concentration in the range of 0.22-0.25 ppm (Table 8). The samples selected from "FreshWell Sweets" show cadmium concentration in the range of 0.23-0.27 ppm (Table 9).

Recommended dietary allowances (RDA) for Cadmium is 10-60 μg/Day (Table 10). Results of all shops are less than RDA value for cadmium. Cadmium is used in electroplating and pigment stabilizers and making alloys[14] therefore electroplated utensils and utensils made up of alloys used during sweets preparation and for their storage can contribute for cadmium contents of sweets. Milk also contains cadmium[11] hence cadmium entered in sweets also through milk.

Manganese: Concentration of manganese in the samples selected from Mehmood Sweet Meet Mart, Dilpasand Sweet Meet Mart, Darbar-e-Shirin Sweet Meet Mart, United King Sweet Meet Mart, Fresco Sweets Meet Mart, S-Abdul Khaliq Sweet Meet Mart, Nirala Sweet Meet Mart, Fresh Well Sweet Meet Mart was found to be 4.6-9.4, 4.5-6.9, 5.8-8.09, 6.3-8.5, 7.1-7.7, 7.2-11.5, 7.2-8.5 and 7.3-10.2 ppm, respectively (Table 2-9).

Recommended dietary allowances (RDA) for manganese is 20-90 μg/Day (Table 10) Results of all shops are higher than RDA value for Manganese. Manganese is also used in alloys and cleansing agents for steel[15]. Manganese load in sweets indicated the use of alloys containing manganese. Also water[16,17] and milk[6] are the sources of manganese in sweets.

Copper: Concentration of copper in the samples selected from Mehmood Sweet Meet Mart, Dilpasand Sweet Meet Mart, Darbar-e-Shirin Sweet Meet Mart, United King Sweet Meet Mart, Fresco Sweets Meet Mart, S-Abdul Khaliq Sweet Meet Mart, Nirala Sweet Meet Mart, Fresh

Well Sweet Meet Mart was found to be 0.4-4.0, 0.5-3.0, 0.3-2.0, 0.2-2.7, 0.07-2.44, 0.2-2.8, 0.2-1.9 and 0.2-2.2 ppm, respectively (Table 2-9).

Recommended dietary allowances (RDA) for Copper is 150-600 μg/Day (Table 10). Results of all shops are less than RDA value for copper. Copper finds its way to sweets through water[18], milk[6] and also through oil[19] use to prepare sweets.

The current study was only limited to well known shops of Karachi city but it is required that all remaining shops must be monitored continuously for metal load, in order to force all shop keepers to maintain allowed metals level. This is necessary to save life of humans.

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