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Estimation of Toxic Metals in Milk Collected from Lactating Mothers in Karak, Khyber Pakhtunkhwa Pakistan.

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Abstract – The objective of the study was to assess the concentration of heavy metals like Zn, Ni, Fe, Cd and Pb in human milk. Human milk was obtained from lactating mothers. Breast milk samples were collected from thirty lactating mothers below the age of forty who patronize the post natal clinic of Karak Government district hospital. The samples were obtained by self-milking into sterilized polyethylene bottles and well labeled. Few drops of 0.1M trichloroacetic acid were added to the sample and the aqueous layer was heated at 500 ° C for one hour. After ashing, it was digested with 0.5 M HNO_3 and the metals were analyzed using an AAS (Perkin Elmer 400).The study showed that most of the samples were found to have Pb below detection limit, and ranged between 0.006 -0.269. Cadmium was not detected throughout the study. The mean Nickel concentration was found to be 0.545µg/L and ranged between 0.004-0.745µg/. From the analysis it was concluded that heavy metals in human milk do not exceed the permissible limit, so it is safe to lactate child in the selected community.

Keywords – Heavy Metal, Human Milk, Atomic Absorption Spectrophotometer

1. Introduction

Heavy metals are a group of elements with a mass density greater than 4.5 g/cm^3, which tend to release electrons in chemical reactions and form simple cations. In the solid and liquid states they are characterized by good heat and electrical conductivity, and are glossy and opaque. They have high melting and boiling points [1]. They are malleable with usually monatomic pairs. The metals classified as heavy metals include: Cu, Co, Cr, Cd, Fe, Zn, Pb, Hg, Mn, Ni, Within the group of heavy metals one can distinguish both the elements essential for living organisms (Microelements) and the elements whose physiological role is unknown, and thus they are "inactive" towards plants, animals and people. The metals serving as microelements in living organisms usually occur in trace amounts that are precisely defined for each species. Both their deficiency and excess badly affect living organisms [1].

Breast feeding is the recommended way of feeding and nurturing infants worldwide

Nevertheless, breast milk can also be a pathway of maternal excretion of toxic elements. Exposure of newborns to mercury (Hg), lead (Pb) and cadmium (Cd) is of special interest due to its widespread use and toxicity. Hg and Pb can adversely affect infants' nervous system. Though pregnancy has been reported to be the most hazardous period for mercury exposure transplacentary [2].

Transference, lactating females have also an increased Hg clearance rate, explained at least in part, by the excretion of this metal. Even if methyl mercury, the most neurotoxin form, is barely transferred to milk, this organic form of Hg is absorbed almost completely from the breast-fed infants' gastrointestinal tract and can readily cross through the brain barrier [2]. Regarding Cd, this heavy metal is a well-known human carcinogenic that can also affect brain development in infants, and it has also been suggested that it might increase the risk of premature delivery. Once absorbed, this metal is transported into the liver, where it induces the synthesis of Metallothionein (MT). Cd bound to MT is released into blood and excreted by the kidney, accumulating in the renal cortex over the woman's lifetime. Unlike Hg and Pb, very little Cd is transferred across the placenta and only a small percentage reaches breast milk [2].

Heavy metal contaminations have been found in human milk and have been found to have potential course of ill health in infants. Exposure of mother to chemicals in most cases is food intake. Even though inhalation and dermal route are possible they are not significant. These metals such as mercury, lead, arsenic, cadmium bismuth antimony and others frequently disrupt immune function, neurological and endocrine functions. Some common effects of heavy metal toxicity include brain fogginess, problem with concentration, bi-polar disorders or obsessive compulsive disorder (OCD), infertility, insomnia in children, memory loss, dementia tremors and delay development [3]. Regarding toxic nature of heavy metals, the human body upon assimilation begins to quickly remove it out of its system through the organs such as the skin, liver, kidney and through urine and sweat. Unfortunately human milk is one of the roots of elimination for mother's burden, and also a source of exposure to infants. Some of these metals are stored in the mother's bones and are extracted from her to provide calcium for the development of the children's bone and as a result these metals enter the maternal blood and breast milk during pregnancy and lactation, exposing the fetus and infants to risk [3].

Milk products are a very important human nutrient since their consumption has increased in recent years. These products are also a good source of calcium and there biodisponibility is high. Many dangerous elements or

compounds, such as metals and metalloids, accumulate along the food chain. Furthermore their concentrations in the environment grow with the increase of urban, agricultural, and industrial emissions. The almost ubiquitous presence of some metal pollutants, especially Cd and Pb, facilitates their entry into the food chain and thus increases the possibility of them having toxic effects on humans and animals [4].

Infant feeding deserves top priority in any program aimed at sound child healthcare, irrespective of racial, communal and religious considerations. It is estimated that proper infant feeding can prevent millions of deaths occurring from infantile gastroenteritis and malnutrition. Milk is the fundamental food for infants. The most natural and best source is from breast feeding and this is greatly encouraged for the first 6 months of life and should be continued for as long as 2 years [5]. Aim of this work was to detect toxic metals for the awareness of human being.

2. Materials and Methods

2.1. Sample collection

Samples were collected from thirty (30) lactating nursing mothers aged below 40 years who patronize the postnatal clinic of Karak Government district hospital. They were mothers who have had their first delivery. Two locations were visited for milk collection; Government district hospital Karak and Sabir Abad (Badin khel) Karak. The milk samples were collected in labeled sterilized polyethylene bottles (50 ml) from both breasts after they have been well washed. The milk was collected by self-milking with the nipple well inserted into the bottles.

2.2. Samples treatment

Few drops of 0.1 M trichloroacetic acid were added to the sample of breast milk to precipitate the proteins, and the aqueous layer of the milk separated by centrifugation. 5mL of the aqueous layer were placed in porcelain crucible and then heated in a muffle furnace at a temperature of 500 ºC for one hour. After ashing, 3mL of 0.5M HNO_3 was added and then filtered through Whattman (No 41) filter paper into a volumetric flask. 0.5M HNO_3 was added to the 10mL mark. The concentrations of lead, Zinc, Iron, Copper and cadmium in blank and the breast milk samples were analyzed with an AAS (Atomic absorption spectrometer PerkinElmer 400) model. The samples were analyzed in duplicate.

3. Results and Discussion

The samples of breast milk from thirty different lactating mother resident of District Karak of Khyber Pakhtunkhwa Pakistan were analyzed in order to determine the toxic metals concentration in these subjects, all the analytical data are given in table 1. Some of heavy metals are required by most living organisms in small but critical concentration for normally healthy growth but excess concentration causes toxicity. No doubt zinc in trace amount is very important for growth and proper function of the body but its high concentration have numerous adverse effects. Taking too much zinc into the body through food, water, dietary supplements or smoking etc. can also affect health. If large doses of zinc are taken by mouth even for a short time, stomach cramps, nausea, and vomiting may occur. Ingesting high levels of zinc for several months may cause anemia, damage the pancreas, and decrease levels of high-density lipoprotein (HDL) cholesterol. The effects of lead are the same whether it enters the body through breathing or swallowing. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults to lead at work has resulted in decreased performance in some tests that measure functions of the nervous system. Lead exposure may also cause weakness in fingers, wrists, or ankles, lead can severely damage the brain and kidneys in adults or children and ultimately cause death. Breathing air with very high levels of cadmium can severely damage the lungs and may cause death. The U.S. Department of Health and Human Services (DHHS) has determined that cadmium and cadmium compounds are known human carcinogens. The most serious harmful health effects from exposure to nickel are chronic bronchitis, reduced lung function, and cancer of the lung and nasal sinus. High level of Fe may affect kidneys, lungs and also the CNS. Inhalation in high amount can cause headache, nasal and eye irritation and even death.

Nickel: In current study, the concentration of Nickel ranged 0.004-0.745µg/lit. Maximum level found in sample No. 28 in which concentration of Ni was 0.745µg/lit. The difference in the concentration of nickel in breast milk samples may be due to the food and exposure to the different environment. The permissible limit for nickel in milk is 0.50.The values recorded in breast milk samples were compared with studies of other researchers and it was found that the nickel concentration was below than those reported.

*Zinc:*The results revealed the concentration of Zinc ranged between 0.056-0.498µg/lit. Maximum value observed in sample No.28 while the lowest concentration was found in sample No.30. All breast milk samples (Except samples 4&28) contained zinc concentration within the permissible limit 450µg/lit set by WHO [5].

Iron: The results revealed the concentration of iron ranged between 0.930-6.107µg/lit. Maximum value was observed in sample No.21 while the lowest concentration was found in sample No.14 [5].

*Lead:*The results revealed the concentration of lead ranged between 0.006-0.441 µg/lit. Maximum value was observed in sample No.2 while the lowest concentration was found in sample No.1.and the remaining sample were below detecting level [5].

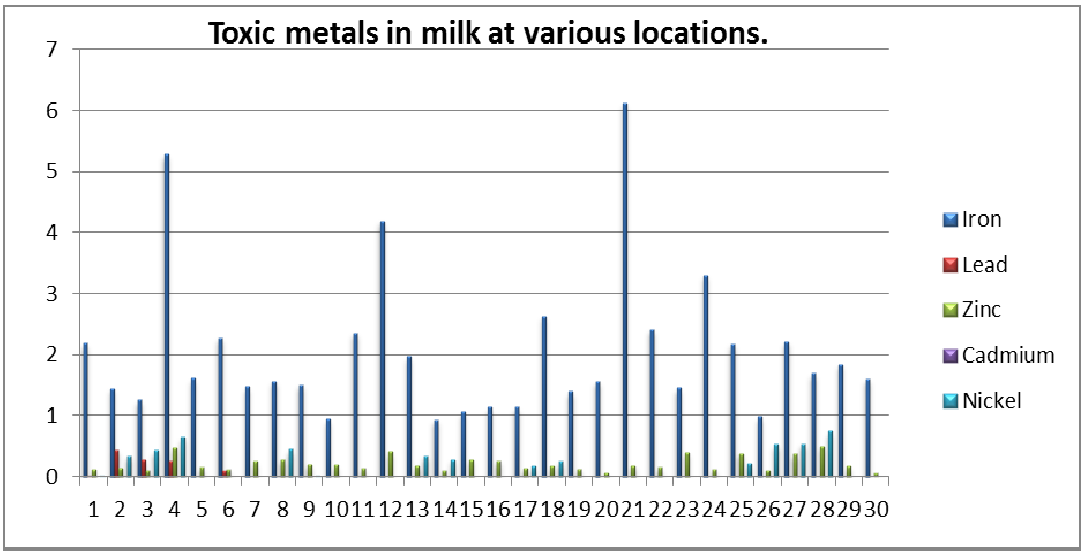

Figure 1. Toxic metals in collected milk samples at various locations

Table 1: Detection of toxic metals in collected milk samples at various locations.

S .No	Iron	Lead	Zinc	Cadmium	Nickel
1	2.187±0.435	0.006±0.022	0.123±0.005	BDL	0.004±0.23
2	1.451±0.040	0.441±0.068	0.148±0.003	ND	0.345±0.025
3	1.256±0.074	0.289±0.034	0.103±0.007	BDL	0.434±032
4	5.285±0.134	0.269±0.037	0.4800±0.048	BDL	0.65±0343
5	1.615±0.030	BDL	0.160±0.003	ND	ND
6	2.272±0.65	0.097±0.139	0.112±0.012	BDL	ND
7	1.479±0.053	BDL	0.256±0.006	BDL	ND
8	1.564±0.050	BDL	0.285±0.026	BDL	0.454±0.004
9	1.507±0.020	BDL	0.210±0.004	BDL	0.004±0.013
10	0.941±0.022	BDL	0.193±0.013	BDL	ND
11	2.351±0.066	BDL	0.139±0.001	BDL	ND
12	4.191±0.078	BDL	0.417±0.010	BDL	ND
13	1.973±0.112	BDL	0.187±0.004	BDL	0.345±0.222
14	0.930±0.016	BDL	0.102±0.006	BDL	0.28±0.012
15	1.061±0.067	BDL	0.281±0.003	BDL	ND
16	1.138±0.029	BDL	0.268±0.007	BDL	ND
17	1.140±0.057	BDL	0.137±0.003	BDL	0.175±0.004
18	2.635±0.19	BDL	0.173±0.005	ND	0.255±0.006
19	1.396±0.074	BDL	0.131±0.001	ND	ND
20	1.565±0.078	BDL	0.070±0.004	BDL	ND
21	6.107±0.117	BDL	0.190±0.001	ND	ND
22	2.409±0.161	BDL	0.158±0.001	ND	BDL
23	1.458±0.04	BDL	0.398±0.003	BDL	BDL
24	3.297±0.08	BDL	0.127±0.005	BDL	BDL
25	2.173±0.021	BDL	0.386±0.001	BDL	0.222±0.346
26	0.980±0.074	BDL	0.107±0.005	ND	0.534±0.453
27	2.219±0.049	BDL	0.375±0.005	BDL	0.545±0.345
28	1.694±0.080	BDL	0.498±0.002	ND	0.745±0.342
29	1.839±0.042	BDL	0.178±0.006	ND	BDL
30	1.603±0.012	BDL	0.056±001	BDL	BDL

4. Conclusion

The results suggested that significant differences existed in the concentrations of heavy metals in breast milk. The estimated concentration of lead, nickel, iron, zinc and cadmium in all samples of milk have a concentration lower than the safe level recommended by WHO, ANZFA and European commission, so it is safe to lactate the child in the selected subjects

Recommendations

Large numbers of children in the world today suffer from heavy metals contamination caused largely by the milk by which they are feed. The heavy metals in breast milk of lactating milk are contaminated because of the food which the mother uses to eat or to the environment to which she is exposed. Lack of knowledge of hazards associated with contaminated food products is the key factor of many harmful diseases.

Keeping in view the results of present study it is recommended that;

- Mother should be fed on uncontaminated food and water.

- The living place of mothers must be clean properly.
- Precautionary measures should be taken to prevent toxicity.
- As common man does not know about the harmful presence of heavy metals in breast milk therefore public should be made aware through print and electronic media and health education.

Conflict of interest statement

We declare that we have no conflict of interest.

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