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Testing Infant Milk Formulae for Lead and Cadmium

Klodiola DHAMO[1], Lauresha SHABANI[2]
Departament of Pharmacy, Aldent University of Natyral Science, Tirana Albania
Department of Industrial Chemisty, University of Natyral Science, Tirana Albania

Abstract:- The concentration of heavy metals, lead (Pb) and cadmium (Cd), were estimated in formula (powdered milk). Eight samples of infant milk formulae which represent most kinds of milk formulae used for feeding infants from birth up to 2 years were taken from pharmacies. All samples were analyzed using atomic absorption. The mean level of Pb and Cd was 0.1692±0.0324 ug/ml and 0.000725±0.000448 ug/ml, respectively in infant formulae. The Estimated Weekly Intake (EWI) for Pb In infant formulae varied between 8.77-24.08 g/kg BW/week for newborn, 7.08-18.146 g/kg BW/week for six months old and 6.54-22.32 g/kg BW /week for one year old. This intake was also lower than PTWI for all different ages, but the highest intake on body weight basis' which is likely to be near to PTWI, was found in infant formulae 2-a and 8-c.

Keywords*:-Lead, cadmium, infant formula, estimated weekly intake.*

I. INTRODUCTION

Human milk is the best natural source of nutrition for feeding infants; it contains the optimal balance of fats, carbohydrates, and proteins for developing babies.(1) Breast milk contains powerful immune factors that help infants fight infections.(2) Unfortunately, contamination of human milk is widespread. DDT, polychlorinated biphenyls, dioxins, and heavy metals are among the toxic chemicals most found in breast milk.(3) The level of risk to breastfeeding infants and children of mother's food consumption patterns, the nature and levels of chemical residues in her milk, and the toxicological potency of those chemicals. For example, calcium deficiency can increase the mobilization of lead from mother's bone to enter breast milk. (4) Fortunately, sufficient calcium intake during pregnancy and lactation significantly reduces the extraction of lead from the mother's bones. Thus women can reduce their fetus' exposure to lead by getting adequate calcium during pregnancy and lactation significantly reduces the extraction of lead from the mother's bones. Thus women can reduce their fetus' exposure to by getting adequate calcium during pregnancy and lactation, or by taking calcium supplement. (5) Infant formulas have a difficult gap to fill. They must mimic breast milk as closely as possible. But it is difficult to produce a formula equal in all respects to breast milk. (6,7)

Studies show that formula feeding is consistenly associated with the development of immune system disordes, diabetes, food allergies, obesity, and coronary heart disease in later life. On the other hand, breastfeeding reduces the risk for a wide range of diseases such, pneumonia, diarrhea, ear infections, bacteremia, obesity, and diabetes. (8- 10) Infant formula has been found to be contaminated with toxic metals, bacteria, and other environmental toxicants. It may contain excessive levels including aluminum, manganese cadmium and lead. An infant's exposure to cadmium from soy infant formula is about 20 times higher than the levels generally found in breast milk. (9, 11) Several studies found higher blood lead levels in formula-fed infants than in breast-fed ones. This may be a result of contaminated formula cans or formula prepared using tap water with high lead levels. (12, 13) This study aimed to estimate the level of lead and cadmium in infant milk formulae. (14)

II. MATERIAL AND METHODS

2.1. Materials:

A random sample of 8 infant's formula (powdered milk) was collected from the pharmacies representing most kinds of powdered milk formula for infants from birth up to second year of life. The samples were collected during the year 2012.

2.2. Methods:

Atomic Absorption Spectrophotometric Analysis

Analysis of the heavy metal contents in the milk samples was done with the use of the Atomic Absorption Spectrophotometer. Type atomic absorption spectrophotometer AA-200 with atomiser flame and electron GTA 100 Hydrides VGA77. For flame acetylene and argon for the furnace and equipment hydrides. The AA-200 not only detects the presence of heavy metals, but, if present, it is also designed to provide the concentrations in parts per million (ppm). Three trials were run on each milk sample in every replicate of the heavy metal and the averages of the concentrations were then taken and compared to Provisional Tolerable Weekly Intake as stated by the Food and Agriculture Organization/World Health Organization Joint Expert

Committee on Food Additives (JECFA).

All samples were prepared and extracted by using trichloroacetic acid method (14) to estimate the level of lead (Pb) and cadmium (Cd) using atomic absorption in the Institute of Public Health and Hygiene in Tirana for Estimated weekly intake (EWI) of Pb and Cd were calculated in all samples according to feeding table for a normal healthy baby for each type of milk.

III. RESULTS

"Table" (1) shows that powdered milk formulae have Pb concentration being 0.1563±0.0624 ug/ml, In respect to cadmium, the present work showed that the mean level of Cd for formulae 0.0012±0.0011 ug/ml

Table (1): Mean Pb and Cd Levels in Milk Formula.

.Samples	Pb ppm Mean±SD	Cd ppm Mean±SD
Formula (powdered milk) (n=8)	0.1692±0.0324	0.000725±0.000448

The levels of both Pb and Cd in the studied formulae are shown in "Table" (2). Two formulae (1a-2a) were for newborn infants. They have Pb concentration ranging from 0.079-0.168 ug/ml. and Cd concentration ranging from zero- 0.0013 ug/ml. Three samples (3b-5b) were formulae used for 6 month infant, where Pb concentration ranged between 0.085-0.235ug/ml and Cd ranged between 0.0002-0.0004 ug/ml. Three samples were formulae used for babies at 1 year of age. Formula, 6c showed the lowest Pb and Cd concentration (0.062 and zero) respectively. The highest Pb and Cd concentration were found in sample 8c, being 0.232 and 0.0021ppm respectively. The Estimated Weekly Intake (EWI) for Pb calculated according to feeding table for normal healthy baby is shown in table (2). For newborn formula, EWI for Pb varied from 8.77-24.08 g/kg BW/week. For 6 months old, it varied from 7.08-18.146 g/kg BW/week, while for 1 year old it varied from 12.18-22.32 g/kg BW/week. The table also shows that EWI for Pb for all types of milk formulae for different ages was lower than PTWI (25 g/kg BW/week) according to WHO expert group,(15) while in 2-a, 8-c were near to PTWI (24.08, 22.32 g/kg BW/week). EWI for Cd was lower than PTWI (7 g/kg BW/week) according to WHO in all samples and two samples 2a for newborn and 7c for 1 year old were free from Cd.

Table (2): Mean levels and Estimated Weekly Intake for Pb and Cd in Formula.

Formula	Pb ug/ml Mean ± SD	Cd ug/ml Mean ± SD	EWI for Pb* g/k.g/ml	EWI for Cd g/k.g/ml
1-a	**0.079±0.0108**	**0.0013±0.00050**	**8.77**	**0.144**
2-a	**0.168±0.0096**	**Zero**	**24.080**	**Zero**
3-b	**0.235±0.0507**	**0.0004±0.00049**	**14.022**	**0.029**
4-b	**0.085±0.0129**	**0.0003±0.00008**	**7.08**	**0.016**
5-b	**0.235±0.0634**	**0.0002±0.00090**	**18.146**	**0.031**
6-c	**0.062±0.0258**	**Zero**	**15.690**	**0.235**
7-c	**0.180±0.0222**	**0.0004±0.00005**	**12.180**	**0.027**
8-c	**0.232±0.0634**	**0.0021±0.00073**	**22.320**	**0.173**

*: Estimated Weekly Intake according to feeding table for a normal healthy baby in each kind of formula. (a): Formula used for feeding new born infant weighted 3 kg.

(b): Formula used for feeding infant at 6 month weighted 6.5 kg.

(c): Formula used for feeding infant at 1 year weighted 7.5 kg.

IV. DISCUSSION

Infants are especially susceptible to toxicity as a result of rapid growth, immaturity of kidneys, and liver and the vulnerability of the myelin central nervous system during the first year of life. Infants and young children may absorb as much as 50% of dietary Pb, compared to only 10% of adults .(16) Infants may be exposed to heavy metals via breast milk and other kinds of formula. In formulae' the high level of Pb in some kinds of formula (5b, 7c, and 8c) was related to its components. It was found that these formulae contain soy protein. In respect Murth and Rhea study found that formulae containing soy flour were high in trace elements i.e. Pb and Cd (17). Navarro also found that Soy formula contributed to the highest intake of lead (58-73%) of provisional tolerable weekly intake (PTWI). (18). Dabeka and Meckenzie found that cadmium intake was most strongly affected by soy based formula and ranged from 0.16 g/kg BW/day for infants fed human to 0.50 g/kg BW/day for infants fed soy-based concentrated liquid formula. They concluded that lead intake was most strongly influenced by storage of infant formulae in lead-soldered cans. (19).

V. CONCLUSION AND RECOMMENDATIONS

This study concluded that, although breast milk may contain contaminants in accordance with the environmental contamination and diet of mothers, the risk for infant exposure to dangers of heavy metals were at lower level than that due to milk formula. This can be avoided by adjusting the diet of lactating mothers and by increasing the daily intake of essential nutrients especially calcium. So breast feeding must be encouraged.

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