

Quantitative determination of lead and cadmium in samples of six brands of infant's milk powder formulae marked in Libya

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Abstract: Six commercial samples of Infant milk formulae (powdered form) which represent most kinds of milk formulae used for feeding infants from birth up to three years of age were taken from reputed Pharmacies of different cities of Libya for the estimation of heavy metals, lead (Pb) and cadmium (Cd). All samples were analyzed by Flame Atomic Absorption Spectrophotometer. The different kinds of infants milk formulae were found to have concentration of Pb and Cd ranging from 0.0000-0.0080 ppm and 0.0001 – 0.0015 ppm, respectively. Results obtained revealed that level of values of Pb and Cd were below the permissible limits as recommended by WHO and other standards. This study signifies its importance for consumers, manufactures and professionals in children's health care programs.

Introduction

Human milk contains optimal amount of carbohydrates, proteins and fats and is best source of nutrition for feeding infants (1). The milk is also an important source of major and trace elements necessary for normal development of infants. Milk powder is one of the important dairy products being used in the preparation of condensed milk, cheese, ice creams, infant milk formula, evaporated milk and as an ingredient in many bakery products. Infant milk formula is considered as nearly complete food and an excellent source of protein, fat and major minerals for the normal growth of infants. During manufacturing of infant milk formula essential elements are added in appropriate quantity in order to meet nutritional requirement (2). Excess from required quantity of the added elements may be a potential source of danger to health. Therefore, accurate measurement of the concentration of the trace elements in formula is very essential by using sensitive and advanced methods of elemental analysis (3-7).

More than 20 different trace elements are reported in milk and milk products and most of them are essential and very important as cofactors in many enzymes play important role in many physiological function and deficiency of these elements may produce pathological disorders (3, 4). The low concentration of heavy metals such as Pb and Cd leads to metabolic disturbances and causing serious health problems including heart failure, cancer, kidney damage etc. (8 - 10). UNICEF, 1999, emphasize on control and assessment of babies food product's by purpose of their maintaining good health (11). The aim of the present study to test for the presence of toxic heavy metals, Lead and Cd in infant's milk formulae used in feeding to three years aged infants available in standard pharmacy stores of Libyan markets through Atomic Absorption spectrophotometry and to compare the results gathered to an existing Egyptian standard as set for allowable amounts of toxic heavy metals for feeding to infants and manufacture of food products.

Materials and methods

Collection of Samples: A total of six random tin containers of milk powder representing most kinds of powdered milk formula for infants from birth up to third year of age were collected from local renowned pharmacy stores of Zliten and Alkhoms cities of Libya. The samples were collected from its original packages in clean polyethylene bags, labeled and taken to the laboratory and kept in refrigeration till analysis.

The following Infant's milk powder formulae were taken for the analysis:

Formula A1: for feeding new born infants.

Formula A2: for feeding new born infants.

Formula B1: for feeding infants at one year.

Formula B2: for feeding infants at one year.

Formula C1: for feeding infants at three year.

Formula C2: for feeding infants at three year.

Quantitative determination of heavy metals in each sample: All chemicals were used of AR grades for each analysis. The samples were digested following the procedure

described by Oddy (12). Briefly, 20 ml HNO₃ was added to 10.0 gm of each sample and allowed to stand for 15 min. The mixture was heated until the liquid reduced to 5 ml. After cooling, 20 ml HNO₃, 10 ml H₂SO₄ and 8 ml H₂O₂ were added and the contents were evaporated to 5 ml. After cooling 10 ml deionized H₂O was added for the removal of residual acid and the mixture was boiled for 10 min (this was repeated twice). After cooling the digest was filtered into 25 ml volumetric flask and made up to mark with deionized H₂O. The infant formula filtrate's were subsequently analyzed for the presence of heavy metals (Pb and Cd) by Flame Atomic Absorption Spectrophotometer (FAAS) Model VARIN SPECTR AA 55B.

Results and discussion

The results of the estimated concentration of Pb and Cd in six infant's milk powder formulae procured from different Standard Pharmacies of Al-khoms and Zliten cities of Libya are shown in table 1.

Table 1: Heavy metals concentration in different infant's milk powder formulae

Infant Formula	Pb (ppm)*	Cd (ppm)*
Formula A1	0.0080	0.0015
Formula A2	0.0060	0.0005
Formula B1	nil	0.0011
Formula B2	0.0032	0.0001
Formula C1	0.0007	0.0004
Formula C2	0.0022	0.0005

*All results are below permissible limit (13-15)

Two formulae (A1 and A2) were for new born infants. They have shown Pb concentration ranging from 0.0060 - 0.0080 mg/kg and Cd concentration ranging from 0.0005 - 0.0015 mg/kg. Formulae B1 and B2 were for one year aged infants have shown Pb concentration

ranging from 0 - 0.0032 mg/kg and Cd concentration ranging from 0.0001 - 0.0011 mg/kg. Formula C1 and C2 were for infants of three years age have shown Pb concentration ranging from 0.0007 - 0.0022 mg/kg and Cd concentration ranging from 0.0004 - 0.0005

mg/kg. The results indicate that nil/lowest concentrations of Pb and Cd were recorded in Formula B1 (nil ppm) and Formula B2 (0.0001 ppm), respectively, however, the highest concentration of Pb and Cd were recorded in Formula A1 (Pb : 0.0080 ppm; Cd : 0.0015 ppm). Thus, it is apparent from the results that none of the infant's formulae exceeded the permissible limit for Pb and Cd levels as set by WHO and other Organization's Standards (13-15). However, the presence of Pb and Cd in infant food is of great concern since infants are particularly more sensitive to ingested toxicants even in very low concentration than adults so infants health goes at risk (16). Exposure to Pb during infancy irreversibly affects development of the nervous system, causing reduction of IQ and learning disabilities (17). Chronic exposure to Cd and Pb is associated with kidney damage (18). It is reported that milk powder formulae containing soy flour were high in trace elements Pb and Cd (19, 20). It is also reported that lead intake was most strongly influenced by storage of infant formulae in lead-soldered cans (21).

It is apparent in the present study that all kinds of infant's formulae have shown very low levels of concentration of Pb and Cd in acceptable limit. Thus this study demonstrates that all kind of infant's formulae are devoid of any risk of untowards health hazards to infants. Numerous milk formulae and milk products are available in markets for all age

groups of children and adults but it cannot be generalized from this study that all of the infant's milk formulae contains lead, cadmium or other toxic heavy metals below standard permissible limit. Many analyst have reported higher concentration of toxic trace or heavy metals in milk powder formulae than recommended standard concentration of permissible limit which may have caused wide array of hazardous impacts on human health (22-26).

In conclusion: All of six infant's formula samples tested were positive for lead and cadmium concentrations except Formula B1 which did not show the presence of lead, however, the concentrations of both heavy metals were below the level of permissible limit as recommended by WHO and other Organization's Standards. However, this study can be used for general awareness as a reference for consumers, manufactures and health care professionals for the sake of maintaining good health for children and adults using good quality milk formulae and milk products following their regular monitoring of heavy metals applying standard analytical techniques.

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