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Daily Intake of Cadmium, Lead, Iron and Zinc by Infants Through Milk Formulae and Cereal Based Food With Milk

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Key words: essential elements; toxic element; infant milk formula; cereal food with milk ; lead; cadmium; iron; zinc.

Abstract:

Concentrations of the essential elements Zn and Fe and potentially toxic elements Pb and Cd in different milk formula samples and cereal based food with milk were measured, primarily to assess whether the intake comply with recommended desired levels for essential and permissible levels for toxic elements. The geometric mean concentrations of Pb, Cd, Fe and Zn in different types of based milk formula (birth – 6 month) were found to vary from 0.117 to 0.297, 0.00, 51.13 to 70.50 and 75.61 to 95.51mg/kg, while the same in follow up formula (6-12 month) had values from 0.0483 to 0.6753, 0.000 to 0.003, 63.586 to 83.516 and 68.216 to130.506mg/kg, and from 0.704 to 1.737, 0.000 to 0.0026, 58.303 to 118.837and 54.496 to 72.176mg/kg, in white based food with milk but ranged from 1.383 to 1.490, 0.00, 53.313 to 73.543 and 47.623 to 75.283mg/kg, in rice based food with milk for infant respectively. The concentration of Cd was found to be very low 0.0013 to 0.003 mg/kg and fairly constant in all samples test. The lead content in based milk infant formula was observed to be the lowest even in comparison with rice based food with milk for infant which recorded high concentration of this element. The based milk infant formula and rice based food with milk could not show any amount of toxic element Cd but high concentrations of essential Fe and Zn elements were found in white based food with milk for infant and follow up infant milk formula. The daily intake of Pb, Cd, Fe and Zn by infants through milk formula and infant cereals formula with milk marketed in Assiut city have also been estimated. The daily intake level of toxic element (Pb) for infants through most infant formulae was high than recommended tolerable levels but (Cd) was in the recommended limits.

Introduction:

All major and minor elements are important, beside that some of the trace elements e.g;

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Cr, Fe, Co, Cu Zn, Se, Mo and I are essential elements; and some of them; Mn, Si, Ni, B, V, and Sn are probably essential elements; and further some of them As, Cd, Pb, Al and Hg are considered potentially toxic, some possibly essential elements for animal and human life (Aras and Ataman ,2006). Trace elements may be essential or they may be detrimental if ingested in high concentrations. For young infants, mother's milk is considered the best food, provided there is enough and that the mother's diet is adequate during pregnancy and lactation (Murthy and Rhea,1971). The World Health Organization (1973) recommends that infants up to 6 months be exclusively breastfed. Breastfeeding should continue along with complementary feeding until 2 years of age. However, this is not always possible due to the fact that not all mothers are able to produce sufficient amounts of milk for their infants. According to (Codex Allimentarius,1982) the best substitute choices for maternal milk are infant milk formulas, and when prepared under proper hygienic conditions can be used to feed infants. Numerous infant products have been produced and formulated to meet the nutritional needs of healthy full-term infants. Due to variation in nutrient contents from the food sources used to the formula preparations, specifications of nutrient levels, including mineral elements, have been set to simulate levels of these nutrients similar to human milk. With increasing environmental pollution a heavy metal exposure assessment study is necessary (Raghunath *et al.* 1997) . The heavy metals enter the human body through inhalation and ingestion. The intake via ingestion depends upon food habits. It is well established that Pb and Cd are toxic and children are more sensitive to these metals than adults. Despite the benefits of infant formulas as a major source of food for infants, the presence of contaminants, such as heavy metals in infant formula may pose health risks to children. It has been reported that children are more susceptible to exposure (Tripathi *et al.* 1999) because of their greater intestinal absorption than adults, and a lower threshold for adverse effects (Cambra and Alonso, 1995). These pollutants may arise from the raw materials used in production, poor quality production processes, adulteration of infant foods and bad practices by mothers as regards infant formulation preparation and handling (Fein

and Falci, 1999).On the other hand nutritional lower values than the recommended daily intakes from the essential elements zinc and iron may suffer nutritional deficiencies and consequent health problems (Ikem *et al.* 2002). With increasing environmental pollution a heavy metal exposure assessment study is necessary (Barbera *et al.*1993; Schuhmacher et al., 1993; Ikeda et al., 1996; Raghunath *et al.*1997) . The metals, namely Fe and Zn, are essential micro nutrients and have a variety of biochemical functions in all living organisms. While Fe and Zn are essential, they can be toxic when taken in excess; both toxicity and necessity vary from element-to-element. The daily intake of the heavy metals Pb,Cd, Fe and Zn by different age groups of infants through different milks and baby foods marketed in this study and is discussed in relation to their requirements for essential elements Zn, Fe and permissible levels for toxic elements Pb, Cd to assess compliance with the recommended values.

Materials and Methods:

Samples Collection and Processing

A survey was elaborated to verify the more frequently consumed infant milk formula and cereal formula by the local population. In this study thirty –six samples from infant milk formula and cereal formulae which collected randomly from different pharmacies in Assiut city were analyzed. Table 1 describes the milk formula and cereal formula analyzed samples with their codes which were used in this study. There is an adequate age range for each milk formula and cereal formula sample, and these are also presented.

Table 1. Description of the infant dairy food samples

Sample Brands (codes)	Description	Adequate age
IF 1	Infant milk formula for regurgitated	0 - 6 months
IF 2	Infant milk formula free of lactose	0 - 6 months
IF3	Milk based starter infant formula with iron	0 - 6 months
IF4	Infant milk formula for extra car	0 - 6 months
FUF1	Follow on formula fortified with iron	6-12 month
FUF2	Follow on formula for baby from six month	6-12 month
FUF3	Follow up formula with iron	6-12 month
FUF4	Infant formula from birth onwards	6-12 month
W.F1	infant cereal (wheat with follow up milk formula)	+ 6 months
W.F2	infant cereal (wheat and fruits with follow on milk formula)	+ 6 months
W.F3	infant cereal (wheat and chocolate with follow on milk formula)	+ 6 months
W.F4	infant cereal (wheat and honey with follow on milk formula)	+ 6 months
W.F5	infant cereal (wheat and vegetables with follow on milk formula)	+ 6 months
R.F1	infant cereal (rice and fruits with follow on milk formula)	+ 6 months
R.F2	infant cereal (rice and vegetables with follow on milk formula)	+ 6 months
R.F3	infant cereal (rice and chocolate with follow on milk formula)	+ 6 months

Analysis by Atomic Absorption

A known sample weight ~20 g was dry-ashed at a temperature of 400°C. The ashed sample was then treated with 1 ml of electronic grade nitric acid highly pure acid having very low metallic impurities, mainly used in the electronic industry for cleaning purposes and the residue was dissolved in 10 ml of 0.25% HNO3 .The clear filtrate was used for determine the levels of lead, cadmium, zinc and iron in samples as p.p.m.by using atomic absorption (Khan *et al.* 1995).

Statistical Analysis.

Data of chemical properties were subjected to statistical analysis using F test. Means were compared using L.S.D. test **(Gomez and Gomez, 1984).**

Results And Discussion

Present study was carried out to determine two essential elements (Fe and Zn) and two toxic (Pb and Cd) trace elements in thirty six samples from infant milk and cereal formula . The daily intakes of Pb, Cd, Fe and Zn by children under 1 year were calculated as provided by the manufactures of different types of milk and baby foods and their

respective daily consumption rates. The Egyptian Standards (ES No. 3284/2005) of processed cereal- based food for infants for Iron is 1.5mg/100 calories or 6 mg/ 100g (60mg/kg) from product , and for lead does not exceed 1mg/kg. Codex Standard for Infant Formula Codex Stan. 72-1981 amount per 100 available calories the min. and max. of Iron and zinc are 1-not specified mg and 0.5- not specified respectively. Codex Standard for Follow-up Formula Codex Stan. 156-1987 amount per 100 available calories the min. and max of Iron and zinc are 1-2 mg and 0.5- not specified respectively. The limit of cadmium was determined by legal regulations and it amounts to 0.01 mg/kg (0.01µg/g) of the product and the acceptable amount of lead was also standaed as it was: 0.1 mg/kg (0.01µg/g) of the product in Journal of Laws 2003(Anna,2009)

Concentrations of essential elements in milk and cereal with milk formula.

Iron is a trace element that is essential to cell metabolism and life. Approximately 85% of total body iron can be classified as essential because it serves well-defined physiological functions. There are, however, two important concerns with respect to the dietary intake of iron. The first is iron deficiency, and the other is iron overload. Both of these problems have important public health consequences. Iron deficiency anemia is the most prevalent nutritional problem in the world today. In this study concerning Iron (Fe) in based infant milk formulae, table(2) revealed that the average of (Fe) based infant milk formulae (IF1, IF2, IF3 and IF4) were 56.71, 70.50, 56.65 and 51.13 ppm respectively .These results are harmony with those of (Paola *et al.* 2007), all infant formula are in agreement with those of (Codex Stan. 72-1981). Statistical analysis showed that there were highly significant ($P<0.01$) differences in iron among based infant formula types. All means have significant differences except between IF1, IF3 ; has no significant difference. On other hand follow-up infant milk formulae arranged from 63.58 to 83.51 ppm but these results are agreement with those of (Codex Stan. 156-1987 and Paola *et al.* 2007). Statistically, there were highly significant ($P<0.01$) differences in iron among F.U.F types.

Excess intake of iron can also result in toxic manifestations. Iron overload is a relatively common disorder of iron metabolism. (National Research Council,1989) and Dadone *et al.* (1982) The increased intestinal absorption of iron in hereditary hemochromatosis results in deposition of iron in parenchymal organs, eventually leading to cirrhosis, hepatocellular arcinoma, diabetes mellitus, congestive heart failure, hypogonadism and bronze skin pigmentation. The

American Academy of Pediatrics' Committee on Nutrition, since 1969 recommended "the early use of fortified formula which results in augmentation of iron stores which help prevent later development of iron deficiency". Infant formulas have therefore been classified as low-iron or iron-fortified, based on whether they contain less or more than 6.7 mg/l of iron (American Academy of Pediatrics, 1999). Iron fortified formulas in the USA are up to 12.7 mg/l and within the range 0.2–0.5 mg/l in Europe (Rodriguez Rodriguez *et al.* 2000). The mean concentration of Fe in infant cereal was in wheat formula with milk (W.F1, W.F2, W.F3, W.F4 and W.F5) were 118.83, 96.69, 69.39, 68.75and 58.30 ppm respectively, all wheat formula are harmony with Egyptian standard (No. 3284/2005) except W.F5 was less than standard. Statistical analysis of iron showed that there were highly significant differences ($P<0.01$) among types of wheat formulae . All means have significant differences except between W.F3, W.F5 ; has no significant difference. Mean value of R.F2 recorded high value 73.54 ppm compared with RF3 53.31ppm, all formula were in agreement with Egyptian standard (No. 3284/2005) except RF3. Statistically, there were highly significant ($P<0.01$) differences in iron among R.F types

Also zinc is essential for normal growth and development in infants, because the only food for the newborn infant is breast milk or formulas, usually based on cow's milk, it is important that the zinc in the milk or formula is available for absorption in order to prevent zinc deficiency. It has been shown that zinc bioavailability is higher from human milk than from cow's milk (Andstriöm *et al.* 1985). In this study the highest concentration of Zn in infant formula was in IF2 95.51mg/kg where the lowest was in IF4 75.61 mg/kg. These results are in agreement with Codex Stan. 156-1987. Statistical analysis showed that there were highly significant ($P<0.01$) differences in zinc among based infant formula types. In follow up formulae the values were ranged from 68.216 to 180.34 mg/kg .These results are in accord with those of (Codex Stan. 156-1987 and Paola *et al.* 2007). Statistically, there were highly significant ($P<0.01$) differences in zinc among F.U.F types. On other hand the concentration of Zn in wheat and rice infant formulae with milk were ranged from 54.496 to 72.176 and from 47.623 to 75.283 mg /kg respectively. These values were in ringed which recoded by Paola *et al.* (2007). Statistical analysis showed that there were highly significant ($P<0.01$) differences in zinc among cereal infant formula types.

Concentrations of toxic elements in milk and cereal with milk formula.

Food contain different harmful substances which, when ab-

sorbed may present a serious hazard to health (Tong *et al.* 2000). Newly born babies dot not have effectively regulatory mechanism and the absorption of elements, including Toxic ones, is higher than in older children and adults (Drobnik and Latour,2006) .Numerous studies demonstrated that food addressed to this particular group of consumers is not safe as far as the content of this toxic element is concerned (Winiarska-Mieczan and Gil,2007; Winiarska-Mieczan and Kwiecien, 2007 and Anna,2009). In this study the mean concentrations of Pb determined in different tinned baby foods such as based infant milk formulae, follow-up infant milk formulae, wheat with milk based food and rice with milk based food were found to vary with values of 0.117- 0.296, 0.048-0.675, 0.704-1.737 and 1.383-1.490 ppm, respectively. Concentrations of these metals in infant milk formula and follow up formula were not exceeding the acceptable amount except in IF1, IF2 and F.U.F3 as the acceptable amount of lead which was determined by the law was 0.1 mg/kg (0.1 µg/g) of the product in the same range in infant milk foods (Anna,2009).The concentration of lead in cereal with milk formula was exceeding those allowed by ES (No. 3284/2005) except W.F1. Statistically, there were highly significant ($P<0.01$) differences in lead among types except between IF2 and IF3, RF2 and RF3. Thus, the above results are alarming. Cadmium is regarded as an indicator of carcinogenic processes. It also impairs kidney functions (Waalkes, 2000). Moreover, a relationship between the presence of cadmium and iron in food from one side, and metabolism disturbances from the other side (Lkesson *et al.*2000).

More over Cadmium is a metal to which babies are exposed continuously, since its source may be water, air, food and cigarette smoke. Studies proved that this element accumulates in babies' organisms during their foetal lives to a much higher degree than in their mothers' organisms (Razagui and Ghribi, 2005). As it was demonstrated, cadmiums' half-life in human organism is ca 30 years, which explain why exposing children to this element it particularly hazardous (Anna, 2009). This studied demonstrated the levels of cadmium were found only in F.U.F3, W.F2, W.F5 were 0.003, 00266 and 0.0013 ppm respectively. These results were in agreement with those of legal regulations (0.01ppm

Table 2: Level of Pb, Cd, Fe and Zn in based milk infant formula (mg/kg).

S. N	Type of milk	Pb		Cd		Fe		Zn	
		M	C.S	M	L.R*	M	C.S**	M	C.S***
1	IF1	0.296	0.1	0.00	0.01	56.71	48.4-N.S	79.19	24.8
2	IF2	0.117	0.1	0.00	0.01	70.50	51.5-N.S	95.51	25.45
3	IF3	0.119	0.1	0.00	0.01	56.65	50.9-N.S	88.19	25.75
4	IF4	0.278	0.1	0.00	0.01	51.13	48.1-N.S	75.61	24.05
means		0.020	-	0.00	-	58.74	-	84.62	-
LSD 0.05		0.0063	-	0.00	-	0.3831	-	0.0598	-

*Abbreviations: L.R (legal regulation 0.01 of cadmium (Anna, 2009)), M: means of heavy meals.

**These numbers were calculated of Iron according to Codex standard (C.S) 72-1981 from the labels (1- not specified mg per 100 calories).

*** These numbers were calculated of zinc according to Codex standard (C.S) 72-1981 from the labels (0.5-not specified mg per 100 calories).

Table 3: Level of Pb, Cd, Fe and Zn in follow up infant milk formula (mg/kg).

S. N	Type of milk	Pb		Cd		Fe		Zn	
		M	C.S	M	L.R	M	C.S	M	C.S
1	FUF1	0.4666	0.1	0.0000	0.01	63.586	45.6-91.2	68.216	22.80
2	FUF 2	0.6753	0.1	0.0000	0.01	70.776	47.7-95.4	86.920	23.85
3	FUF 3	0.0483	0.1	0.0030	0.01	67.900	47.9-95.8	130.506	23.95
4	FUF 4	0.5326	0.1	0.0000	0.01	83.516	52.0-104.0	180.340	26.00
Means		0.4300	-	0.0007	-	71.44	-	116.495	-
LSD 0.05		0.0294	-	0.0009	-	0.0617	-	0.0702	-

Table 4: Level of Pb,Cd, Fe and Zn white based food with milk for infant (mg/kg).

S. N	Type of milk	Pb		Cd		Fe		Zn
		M	C.S	M	L.R	M	C.S	M
1	W.F1	0.704	1.0	0.00000	0.01	118.837	60	72.176
2	W.F 2	1.160	1.0	0.00266	0.01	96.963	60	57.790
3	W.F 3	1.737	1.0	0.00000	0.01	69.390	60	60.213
4	W.F 4	1.496	1.0	0.00000	0.01	68.753	60	54.496
5	W.F 5	0.903	1.0	0.00133	0.01	58.303	60	60.520
Means		0.200	-	0.0007	-	82.449	-	61.03
LSD 0.05		0.0251	-	0.0007	-	4.6978	-	0.0552

Table 5: Level of Pb,Cd, Fe and Zn rice based food with milk for infant (mg/kg)

S.N	Type of milk	Pb		Cd		Fe		Zn
		M	C.S	M	L.R	M	C.S	M
1	RF1	1.490	1.0	0.00	0.01	72.906	60	61.596
2	RF2	1.383	1.0	0.00	0.01	73.543	60	75.283
3	RF3	1.396	1.0	0.00	0.01	53.313	60	47.623
Means		1.423	-	0.00	-	66.58	-	61.500
LSD 0.05		0.0457	-	0.00	-	0.0663	-	0.0461

Daily intake of heavy metals by infants through milk and cereal formula.

The daily intake of heavy metals by infants through different milk and cereal with milk formula were calculated on the basis of feeding tables provided by the manufacturers (Table 6). On average, birth- 6 month-old and 6 – 12 month-old infant would require approximately 2-5 kg and 3.5-5 kg of milk powder every month respectively. On the other hand, the requirement of baby food containing cereals along with milk works out to be only 0.5-1.0 kg/ month. The daily intakes of essential element Fe arranged from 3292.7 to 9729 and from 4617.2 to 11098.2 µg/day in based milk infant formula and follow up formula respectively, but arranged from 2915.15 to 5941 and from2665.65 to 3677.15 in wheat and rice infant formula with milk respectively .Where the estimated requirements of absorbed iron from birth to one year was 550 to 750 µg/ day (Berdanier *et al.* 2002) .

Zinc is important for metabolism, cell growth, immunity, and defense against oxygen radicals (Loui *et al.* 2001). The value daily intake of zinc showed in table (6) was high except IF4(from birth) than recommended by (Vijaya,1993) for infant in milk and cereal formula (3000-5000 µg/ day) as it averaged from 4869.2 to 13845.8, 7735 to 12330.2 and from 3010.65 to 3608 µg/ day in IF,FUF,W.F and R.F respectively. The concentration daily intake of lead and cadmium was calculated in infant milk and cereal food .The results are summarized in (table 6 &7). According to WHO1972, the daily permissible intake (DPI) of cadmium though milk infant formula is 0.055-0.07 mg/day respectively (Zamir and Hussain, 2001).In the present study, the concentration daily intake of cadmium through baby food was 0.753 -83.85µg/day in different milk and cereal formula (exceeding the limit 3.57 µg/ day (Tripathi *et al.* 1999), except IF2 which was in the acceptable range.

Table 6: Daily intake of Pb, Cd, Fe and Zn from different milk for mula by infant.

S. N	Baby food	Baby age	Daily intake (µg/ day)			
			Pb	Cd	Fe	Zn
1	IF1	From birth	19.06	0.00	3652.12	5099.83
		1 week	24.50	0.00	4695.55	6556.93
		1 month	32.67	0.00	6260.78	8742.57
		2 month	40.84	0.00	7825.98	10928.22
		3 month	40.84	0.00	7825.98	10928.22
		5 month	38.12	0.00	7304.248	10199.67
		6 month	28.59	0.00	5478.18	7649.75
		Mean	32.08	0.00	6148.977	8586.456
2	IF2	From birth	0.753	0.00	4540.2	6150.844
		1 week	0.968	0.00	5837.4	7908.228
		1 month	1.29168	0.00	7783.2	10544.3
		2 month	1.6146	0.00	9729	13180.38
		3 month	1.6146	0.00	9729	13180.38
		5 month	1.50696	0.00	9080.4	12301.69
		6 month	1.13022	0.00	6810.3	9226.266
		Mean	1.268614	0.00	7644.214	10356.01
3	IF3	1-2 week	9.639	0.00	4588.65	7143.39
		3-4 week	10.71	0.00	5098.5	7937.1
		2 months	13.3875	0.00	6373.125	9921.375
		3-4 months	16.065	0.00	7647.75	11905.65
		5-6 months	18.683	0.00	8894.05	13845.83
		7 months and over	11.2455	0.00	5353.425	8333.955
		Means	13.28833	0.00	6325.917	9847.883
4	IF4	From birth	17.9032	0.00	3292.772	4869.284
		1 week	23.0184	0.00	4233.564	6260.508
		1 month	30.6912	0.00	5644.752	8347.344
		2 month	38.364	0.00	7055.94	10434.18
		3 month	38.364	0.00	7055.94	10434.18
		5 months	26.8548	0.00	6585.544	9738.568
		6 months	30.14314	0.00	3292.772	7303.926
		Means	29.33411	0.00	5308.755	8198.284
Means IF			19.20626	0.00	7923.302	9224.91
5	FUF1	From six months	52.91244	0.00	7210.652	7735.694
6	FUF 2	From six months	95.2173	0.00	9979.416	12255.72
7	FUF 3	From six months	7.894635	0.49035	11098.26	12330.23
		From seven months	5.52552	0.3432	7767.76	14929.2
8	FUF 4	1-2 week	36.2168	0.204	4617.2	8874
		2-8 week	54.3252	0.306	6925.8	13311
		2-3 months	54.3252	0.306	6925.8	13311
		3-6 months	54.3252	0.306	6925.8	13311
		After 6 moths	67.6402	0.381	8623.3	16573.5
		Means	72.4336	0.408	9234.4	17748
Means FUF			47.59806	0.259617	7785.999	12514.59

Table 7: Daily intake of Pb, Cd, Fe and Zn from different cereals for mula by infant.

S. N	Baby food		Daily intake (µg/ day)			
			Pb	Cd	Fe	Zn
9	W.F1	From six months	35.2	0.000	5941.85	3608.8
10	W.F 2	From six months	58	0.130	4848.15	2889.5
11	W.F 3	From six months	86.85	0.000	3469.5	3010.65
12	W.F 4	From six months	74.8	0.000	3437.65	2724.8
13	W.F 5	From six months	45.15	0.0665	2915.15	3026
Means W.F			60	0.0393	4122.46	3051.95
14	RF1	From six months	74.5	0.000	3645.3	3079.8
15	RF2	From six months	69.15	0.000	3677.15	3764.15
16	RF3	From six months	69.8	0.000	2665.65	3731.15
Means R.F			74.5	0	3645.3	3079.8

Conclusion

The results of this study cleared that most of the essential element levels in different infant milk and cereal formula marketed in Assiut city were agreed with standard values. The results showed that there are highly significant differences between types of studied elements levels, also the results showed that lead - toxic element- presents it in all formulae, and its levels were higher than the recommended values in most of these formulae. On the other hand, cadmium levels were agreed with standards in: infant milk, and cereal formulae. The daily intake levels of infants from toxic element (Pb) were higher than the recommended tolerable levels in most of infant formulae. On the opposite, (Cd) levels were in the recommended limits.

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الجرعة اليومية من الكادميوم والرصاص والحديد والزنك التى يتناولها الأطفال من خلال تركيبات الألبان وتركيبات أغذية الأطفال المحتوية على الحبوب واللبن .

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تم قياس تركيز عنصرين أساسيين هما الحديد والزنك وعنصرين من العناصر السامة هما الرصاص والكادميوم فى عينات من تركيبات ألبان الأطفال وتركيبات أغذية الأطفال المحتوية على الحبوب واللبن . ولتقييم مدى مطابقة الجرعات مع المستويات القياسية المسموح بها من العناصر الضرورية والسامة تم قياس المتوسط الحسابى لعناصر الرصاص والكادميوم والحديد والزنك فى أنواع مختلفة من تركيبات ألبان الأطفال الأساسية (منذ الولادة حتى ستة أشهر من العمر) وتراوحت النتائج ما بين 0.117- 0.297 ، لا يوجد ، 51.13- 70.50 ، 75.61- 95.51 ملجم / كجم على الترتيب ، و تراوحت القيم المقدرة فى تركيبات ألبان الأطفال لمتابعة الرضاعة (من ستة أشهر حتى عمر عام) ما بين 0.0483- 0.6753، 0.00 – 0.003 ، 63.586- 83.516 ، 68.216 – 130.506 ملجم / كجم على الترتيب ، أما في تركيبات أغذية الاطفال المحتوية على القمح واللبن تراوحت ما بين 0.704- 1.737،لا يوجد - 0.0026 ، 58.303-118.837 ، 54.496-72.176 ملجم / كجم بينما كان فى أغذية الأطفال المحتوية على الأرز واللبن فقد تراوحت القيم ما بين 1.383- 1.490 ، لا يوجد ، 53.313- 73.543 ،47.623-75.283 ملجم/ كجم. وفى أغذية الأرز واللبن كان تركيز الكادميوم منخفضا جدا (من 0.0013 إلى0.003 ملجم / كجم) وهذا يعتبر تركيزا مقبولا فى جميع العينات ، وكان تركيز الرصاص فى ألبان الأطفال من أقل النسب التى تمت ملاحظتها ، وذلك بمقارنتها بأغذية الأرز واللبن التى سجلت أعلى نسبة تركيز لهذا العنصر. ولم توجد أى كميات من الكادميوم فى كل من تركيبات ألبان الأطفال الأساسية وأغذية الأرز واللبن . كما وجد أعلى تركيز من العنصرين الأساسيين (الحديد و الزنك) فى الأغذية المحتوية على الأرز واللبن وألبان الأطفال لمتابعة الرضاعة . وقد تم قياس الجرعة اليومية المقدرة للأطفال فى ألبان الأطفال وأغذية الأطفال المعتمدة على الحبوب واللبن الموجودة فى مدينة أسيوط ، و دلت النتائج على أن هذه الجرعة اليومية تحتوي على نسبة من العنصر السام (الرصاص) أعلى من المستويات القياسية الموصى بها فى معظم التركيبات ، بينما كانت محتويات الجرعة اليومية من عنصر الكادميوم في الحدود المسموح بها .

الكلمات المفتاحية :العناصر الأساسية – العناصر السامة- ألبان الأطفال – أغذية الأطفال المعتمدة على الحبوب – الرصاص – الكادميوم – الحديد – الزنك.