Dept. of Forensic Med. And Toxicology,
Fac. of Vet. Med. (Been-Suef), Cairo University

LEAD, CADMIUM AND MANGANESE IN MILK AND SOME MILK PRODUCTS IN UPPER EGYPT

(With 2 Tables and 2 Figures)

By

K.A. ABDOU and EMAN KORASHY*

*: Animal health research Institute, Assiut, Egypt

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تركيز الرصاص ، الكادميوم والمنجنيز في اللبن وبعض منتجات الألبان في صعيد مصر

خالد عباس ، ايمان قرشي

تمت مناقشه الأضرار الصحية الناتجة عن وجود بعض المعادن الثقيلة في الألبان و بعض منتجات الألبان في صعيد مصر و تم تقدير كميه الرصاص و الكادميوم و المنجنيز في عدد مائه و عشره عينه من الألبان و بعض منتجات الألبان المختلفة (جبن قريش – جبن طازج – جبن قريش مملح مخزون – زبد – زبادى – قشدة – حليب مجفف كامل الدسم – لبن أطفال مجفف – أيس كريم – أيس كريم مجفف) جمعت عشوائيا بواقع عشرة عينات من كل نوع من بيوت المزارعين و محلات البقالة و متاجر كبيره و صيدليات في مناطق مختلفة من محافظتي أسيوط و بنىسويف في صعيد مصر. أثبتت النتائج وجود أعلى نسبه للرصاص في عينات الجبن القريش و الزبادي ١,٢ و ٠,٠٧٨ مجم/كجم من الوزن الكلى و أعلى نسبه للكادميوم كانت في اللبن المجفف كامل الدسم وأيس كريم المجفف ٠,٠٤٩ و ٠,٠٩٤ مجم/كجم من الوزن الكلى أما المنجنيز فكانت أعلى نسبه هي ٠,٠٨٧ و ١,١٩ مجم/كجم من الوزن الكلى في الزبادي و أيس كريم المجفف. تم التنويه عن ضرورة الاهتمام بطرق تصنيع و معالجه الألبان في الصناعات المختلفة من أجل حماية الإنسان و الحيوان.

SUMMARY

One hundred and ten samples of milk and different milk products (Kareish, Damietta and pickled Kareish cheeses, butter, yoghurt, cream, full cream milk powder, baby milk powder, ice cream and powdered ice cream were collected randomly from different localities from Assiut and

Beni-Suef cities including farmer's houses, groceries, supermarkets and pharmacies. Lead, cadmium and manganese were estimated after wet digestion by using flame atomic absorption spectrophotometer. The obtained results revealed that the mean concentration of lead in milk, cream, butter, yoghurt, soft cheese, Kareish cheese, pickled Kareish cheese, milk powder, baby milk powder, ice cream and powdered ice cream were; 1.65±0.6, 0.80±0.38, 1.25±0.59, 2.7±1.13, 1.53±0.56, 3.66±0.94, 1.44±0.41, 0.23±0.28, 0.14±0.09, 0.078±0.05 and 0.12±0.034 mg/Kg dry weight, respectively and 0.25±0.13, 0.64±0.25, 0.51±0.15, 0.78±0.43, 0.77±0.31, 1.2±0.37, 0.67±0.18, 0.27±0.22, 0.13±0.09, 0.08±0.05, and 0.04±0.01 mg/Kg wet weight, respectively. For cadmium the mean values were; 0.067±0.11, 0±0, 0±0, 0.17±0.36, 0±0, 0±0, 0.06±0.11, 0.21±0.06, 0.06±0.10, 0±0 and 0.19±0.04 mg/Kg dry weight, respectively and 0.001±0.0, 0±0, 0±0, 0.024±0.051, 0±0, 0±0, 0.02±0.037, 0.049±0.018, 0.06±0.1, 0±0 and 0.094± 0.04 mg/Kg wet weight, respectively. While the mean values for manganese were; 2.33±1.27, 1.07±0.84, 1.24±0.37, 6.4±2.52, 1.53±1.63, 3.59±1.69, 3.4±3.16, 2.69±4.03, 2.48±1.91, 1.62±0.86, and 4.43±4.05 mg/Kg dry weight, respectively and 0.61±0.6, 0.61±0.73, 0.79±0.33, 0.87±0.3, 1.01±0.8, 1.3±0.8, 1.22±0.92, 2.63±3.95, 3.57±4.62, 1.65±0.89 and 1.19±1.28 mg/Kg wet weight, respectively. Possible health risk of these metals was discussed.

Key words: *Heavy metals, lead, cadmium, manganese, milk, products.*

INTRODUCTION

Today, one of the most important problems in the world is the environmental pollution. Various chemicals are used at different stages in the production and processing of food. At the farming level several hundred compounds are used and some of these compounds may find their way into animal tissues and their products. In the preservation and processing of foods many substances are employed to prevent the onset of spoilage, promote binding properties and enhance flavor and nutritive value, etc.: antioxidants, coloring agents and others (Gracey, 1986). Also, metals may contaminate a food source by a leaching process between the food and its container (Hagstad and Hubbert, 1986). The main route of exposure of human to these metals is via the ingestion of contaminated food.

Lead (Pb), a known neuro-toxicant and of a major public health concern which causes both acute and chronic intoxication (Gossel and Bricker, 1990). It has been known to be toxic to most organisms. It is found naturally in earth and present in almost all parts of the environment, such as foods, air, water, dust, soil, paint, and tissues of living organisms including human. The most vulnerable groups at risk to lead exposure are fetuses and preschool age children. Toxicities are mainly on heme biosynthesis, neurological effects including encephalopathy, and peripheral neuropathy. It also affects renal tissues to produce acute and chronic nephropathy and elevated blood pressure (Srianujata, 1998). In the last years a strict correlation between chronic exposure to low lead doses and neuropsychological impairment in first childhood is often reported (Guidi et al., 1996).

Cadmium and its salts are widely employed in numerous industrial processing. It is a component of many commercial products and found in nature in close association with lead and zinc (Klaassen, 1985). Cadmium is known to induce chronic renal disease due to the fact that urinary elimination is a main route of excretion, and the proximal tubules are especially sensitive due to their high reabsorptive activity (Madden and Fowler, 2000).

Manganese is one of certain chemicals that are capable of causing permanent brain damage and chronic manganese has been reported among manganese miners in Latin America. The effect is similar to idiopathic or post encephalitic Parkinsonism (Bender, 1984).

The magnitude of the risk that the presence of such metals in dairy product may pose to the human health. This work was planned to investigate the incidence of lead, cadmium and manganese contamination in milk and dairy-products at Upper Egypt.

MATERIAL and METHODS

One hundred and ten samples of milk and different milk products (Kareish, Damietta and pickled Kareish cheeses, butter, yoghurt, cream, full cream milk powder, baby milk powder, ice cream and powdered ice cream), ten from each type were collected randomly from different localities from Assiut and Beni-Suef cities including farmer's houses, groceries, supermarkets and pharmacies. Samples were frozen in separated plastic bags until analysis

One gram from each sample was completely dried in hot air oven and weighted before digestion. Samples were digested by using nitric and sulfuric acids on hot plate as reported by Koirtyohann et al. (1982). Lead, cadmium and manganese were estimated after digestion by using flame atomic absorption spectrophotometer (GBC 906 AA) according to Madera (1982).

RESULTS

The obtained results revealed that the mean concentration of lead in milk, cream, butter, yoghurt, Damietta cheese, Kareish cheese, pickled Kareish cheese, milk powder, baby milk powder, ice cream and powdered ice cream were; 1.65±0.6, 0.80±0.38, 1.25±0.59, 2.7±1.13, 1.53±0.56, 3.66±0.94, 1.44±0.41, 0.23±0.28, 0.14±0.09, 0.078±0.05 and 0.12±0.034 mg/Kg dry weight and 0.25±0.13, 0.64±0.25, 0.51±0.15, 0.78±0.43, 0.77±0.31, 1.2±0.37, 0.67±0.18, 0.27±0.22, 0.13±0.09 ,0.08±0.05, and 0.04±0.01 mg/Kg wet weight, respectively. For cadmium the mean values were; 0.067±0.11, 0±0, 0±0, 0.17±0.36, 0±0, 0±0, 0.06±0.11, 0.21±0.06, 0.06±0.10, 0±0 and 0.19±0.04 mg/Kg dry weight and 0.001±0.0, 0±0, 0±0, 0.024±0.051, 0±0, 0±0, 0.02±0.037, 0.049±0.018, 0.06±0.1, 0±0 and 0.094± 0.04 mg/Kg wet weight, respectively. While the mean values for manganese were; 2.33±1.27, 1.07±0.84, 1.24±0.37, 6.4±2.52, 1.53±1.63, 3.59±1.69, 3.4±3.16, 2.69±4.03, 2.48±1.91, 1.62±0.86, and 4.43±4.05 mg/Kg dry weight and 0.61±0.6, 0.61±0.73, 0.79±0.33, 0.87±0.3, 1.01±0.8, 1.3±0.8, 1.22±0.92, 2.63±3.95, 3.57±4.62, 1.65±0.89 and 1.19±1.28 mg/Kg wet weight, respectively (Tab. 1and 2).

DISCUSSION

During the last years, great deals of environmental researches are directed towards environmental pollution with heavy metals. Heavy metals are persistent contaminants in the environment and come to the forefront of dangerous substances causing serious hazard in animal and human. Industrial and agricultural use of heavy metals and their compounds resulted in environmental pollution and presence of metal residues at all levels of food chain (Tork, 1996). The obtained results revealed that the mean concentration of lead in milk, cream, butter, yoghurt, Damietta cheese, Kareish cheese, pickled Kareish chees, milk

powder, baby milk powder, ice cream and powdered ice cream were; 1.65±0.6, 0.80±0.38, 1.25±0.59, 2.7±1.13, 1.53±0.56, 3.66±0.94, 1.44±0.41, 0.23±0.28, 0.14±0.09, 0.078±0.05 and 0.12±0.034 mg/Kg dry weight and 0.25±0.13, 0.64±0.25, 0.51±0.15, 0.78±0.43, 0.77±0.31, 1.2±0.37, 0.67±0.18, 0.27±0.22, 0.13±0.09, 0.08±0.05, and 0.04±0.01 mg/Kg wet weight, respectively (Tab. 1&2). The highest lead level was detected in Kareish cheese samples followed by yoghurt (Table 1). The hygienic standards of the foreign substances content in food stated that, 0.1 ppm is the maximum lead content in milk (Bartik and Piskac, 1981).

The concentration of lead in cheese produced from lead contaminated milk will be about six times that in milk (Marletta and Favretto, 1983). The maximum permissible limits of lead in low fat cheese reported by the Egyptian Organization for Standardization (1993) is 0.1 mg/kg. The casein fraction in cow's milk contained 90-96% of the total amount of lead in the diet (Hallen and Oskarsson, 1995). In Finland, Tahvonen and Kumpulainen (1995) estimated lead content in nationally representative sample of low-fat milk and cheese. Mean lead content was 1.7 micrograms/kg in milk, 17 micrograms/kg in Finnish cheese and 17- 60 micrograms/kg in imported cheese. In Italy, Guidi et al. (1996) estimated lead content of milk-based formulas and found that, 73 - 139.11 microgram/L was the mean concentration of lead. The authors hope milk-formula industry to have a more specific control on lead milk content for children feeding. Baum and Shannon (1997) determined lead concentration of home-prepared reconstituted infant formula during 1994 and 1995. They suggested that reconstituted infant formula might present in advertent lead hazards to young infants.

Cadmium is the most prone to accumulate in the body. Its level increases throughout life because its biological half-life is 10 to 30 years (Klaassen, 1985). Food represents the second major source of exposure to cadmium (Lee and White, 1983). The mean cadmium levels in our study were; 0.067±0.11, 0±0, 0±0, 0.17±0.36, 0±0, 0±0, 0.06±0.11, 0.21±0.06, 0.06±0.10, 0±0 and 0.19±0.04 mg/Kg dry weight and 0.001±0.0, 0±0, 0±0, 0.024±0.051, 0±0, 0±0, 0.02±0.037, 0.049±0.018, 0.06±0.1, 0±0 and 0.094± 0.04 mg/Kg wet weight, respectively. The highest cadmium level was detected in full cream powdered milk followed by ice cream powder (Table 1). Lucas, (1975) reported that 0.49 ppm is the normal cadmium concentration in dried non-fat cheese. 0.05 mg/kg is the maximum permissible limit of cadmium in processed

cheese with vegetable oil (Egyptian Organization for Standardization, 1993). In Sweden, cadmium levels were determined in 59 baby food samples, including milk-based, cereal and milk based and soy-based formulas. Mean cadmium levels were found to range from 1.10 to 23.5 micrograms/kg fresh weights concentrated formulas. Levels were related to the composition of the diets. Formulas based on cow's milk had the lowest concentrations (Eklund and Oskarsson, 1999).

Cadmium and lead are the most hazardous to human and animals and have toxic potential as a high correlation between levels of cadmium in air, kidney and heart diseases were observed by (Fribeog et al., 1986). Determination of lead and cadmium in milk and dairy products was reported by Lucis et al. (1972), Underwood (1977); IDF (1991); Coni et al. (1995) and El-Leboudy et al. (1997). International Dairy Federation, IDF, (1991) reported that, 0.001-0.005 and 0.00002-0.0008 mg/kg are the normal range of lead and cadmium in milk, respectively. According to the WHO (1998), the provisional tolerable weekly intakes of lead and cadmium are, 50 and 7 ug/kg bw/week for adults, respectively.

Manganese in human milk is found mostly in the whey whereas in cow s' milk it is present primarily in the casein fraction (Fairweather-Tait, 1992). Our results revealed that, the mean values for manganese were; 2.33±1.27, 1.07±0.84, 1.24±0.37, 6.4±2.52, 1.53±1.63, 3.59±1.69, 3.4±3.16, 2.69±4.03, 2.48±1.91, 1.62±0.86, and 4.43±4.05 mg/Kg dry weight and 0.61±0.6, 0.61±0.73, 0.79±0.33, 0.87±0.3, 1.01±0.8, 1.3±0.8, 1.22±0.92, 2.63±3.95, 3.57±4.62, 1.65±0.89 and 1.19±1.28 mg/Kg wet weight, respectively (Tab. 1and 2). Results revealed also that, yoghurt and ice cream powder contained the highest manganese levels (Table 1). Ockerman, (1978) reported that the normal manganese level in hard cheese is 0.11 mg/100 grams.

As the heavy metals are considered the main toxic by- products causing serious health hazard to human and animal populations through progressive irreversible accumulation in their bodies as a result of repeated consumption of small amounts of these elements (Wheaton and Lawson, 1985). In order to avoid possible toxic injuries in human specially little infants and children, industry should certainly pay more attention both in supplying and in technological management of milk and its products.

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Table, 1: Lead, cadmium and manganese concentrations in dry milk and milk products samples (dry weight)

Products	Lead (mg/Kg)	Cadmium (mg/Kg)	Manganese (mg/Kg)
Milk	0.51-2.3	0.0-0.27	0.0-3.93
	1.65 ± 0.6	0.067±0.11	2.33±1.27
Cream	0.3 -1.3	0-0	0.0-2.44
	0.60±0.38	0±0	1.07±0.84
Butter	0.6-2.03	0-0	0.0-1.28
	1.25±0.59	0±0	1.24±0.37
Yoghurt	0.7-3.8	0.0-0.91	4.31-11.1
	2.7±1.13	0.17±0.36	6.4±2.52
Damietta cheese	1.02-2.6	0-0	0.09-2.83
	1.53±0.56	0±0	1.53±1.63
Kareish cheese	2.6-4.9	0-0	1.86-6.3
	3.66±0.94	0±0	3.59±1.69
Pickled Kareish cheese	0.61-1.88	0.0-0.31	0.07-7.9
	1.44±0.41	0.06±0.11	3.4±3.16
Full cream milk powder	0.08-0.76	0.0-0.97	0.0-10.1
	0.23±0.28	0.21±0.06	2.69±4.03
Baby milk powder	0.02-0.27	0.0-0.29	0.0-4.12
	0.14±0.09	0.06±0.10	2.48±1.91
Ice cream	0.005-0.13	0-0	0.7-2.41
	0.078±0.05	0±0	1.62±0.86
Ice cream powder	0.06-0.15	0.0-1.31	0.0-11.6
	0.12±0.034	0.19±0.04	4.43±4.05

Results represented by range & (X ± SE)

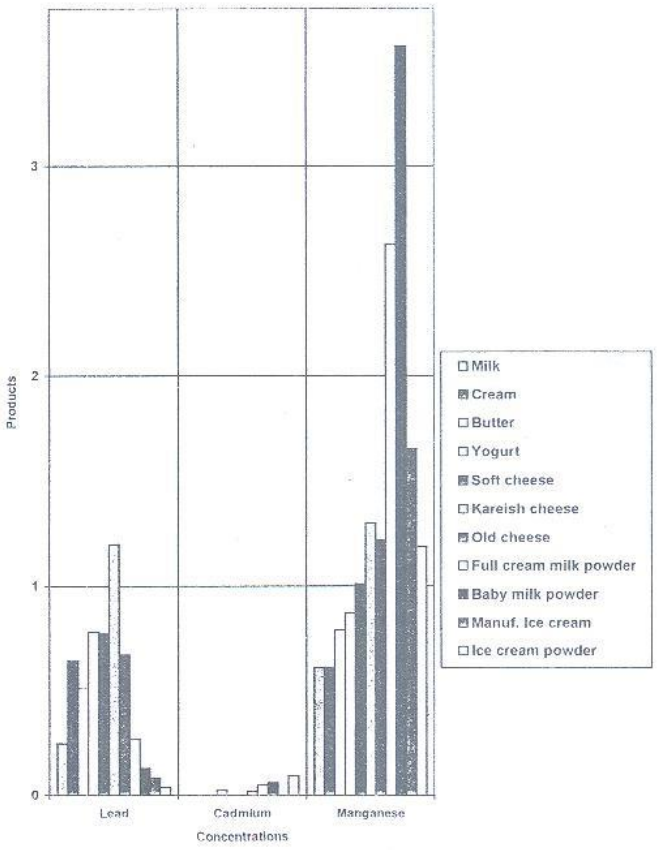
Table, 2: Lead, cadmium and manganese concentrations in dry milk and milk products samples (wet weight)

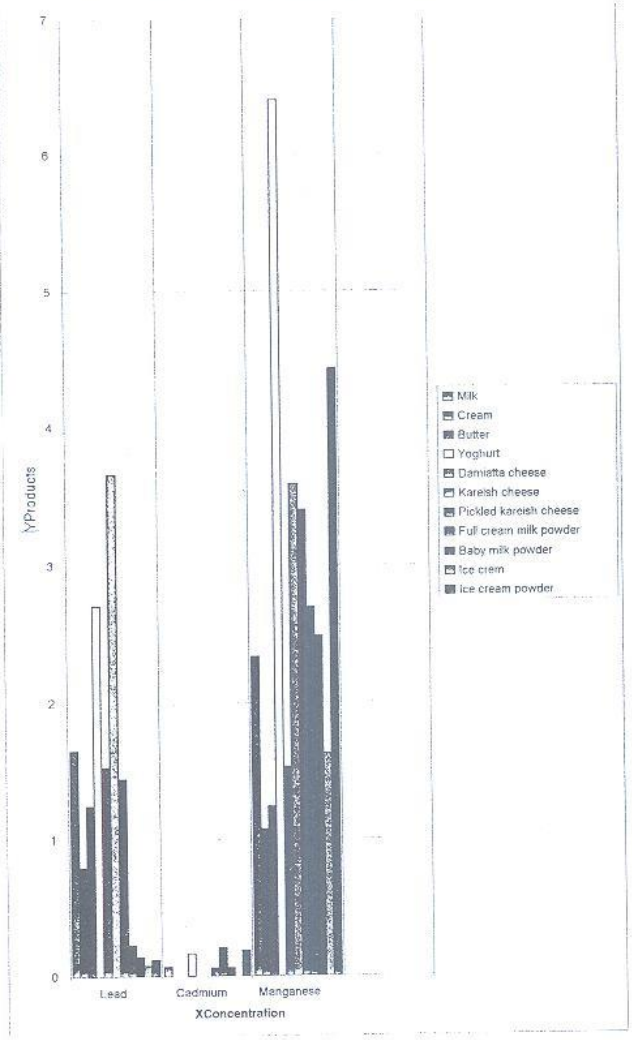
Products	Lead (mg/Kg)	Cadmium (mg/Kg)	Manganese (mg/Kg)
Milk	0.05-0.36	0.0-0.03	0.0-1.64
	0.25±0.13	0.001±0	0.61±0.6
Cream	0.31-0.97	0-0	0.0-1.77
	0.64±0.25	0±0	0.61±0.73
Butter	0.33-0.79	0-0	0.0-1.14
	0.51±0.15	0±0	0.79±0.33
Yoghurt	0.36-1.25	0.0-0.13	0.65-1.44
	0.78±0.43	0.024±0.051	0.87±0.3
Damietta cheese	0.48-1.37	0-0	0.039-2.41
	0.77±0.31	0±0	1.01±0.8
Kareish cheese	0.72-1.75	0-0	0.49-2.4
	1.2±0.37	0±0	1.3±0.8
Pickled Kareish cheese	0.46-0.96	0.0-0.08	0.04-2.45
	0.67±0.18	0.02±0.037	1.22±0.92
Full cream milk powder	0.07-0.73	0.0-0.08	0.0-9.8
	0.27±0.22	0.049±0.018	2.63±3.95
Baby milk powder	0.01-0.27	0.0-0.28	0.0-7.7
	0.13±0.09	0.06±0.1	3.57±4.62
Ice cream	0.005-0.13	0-0	0.58-2.41
	0.08±0.05	0±0	1.65±0.89
Ice cream powder	0.02-0.05	0.0-0.16	0.0-3.41
	0.04±0.01	0.094±0.04	1.19±1.28

Results represented by range & (X ± SE)

Products	Lead	Cadmium	Manganese
Milk	1.65	0.067	2.33
Cream	0.8	0	1.07
Butter	1.25	0	1.24
Yoghurt	2.7	0.17	6.4
Damitta cheese	1.53	0	1.53
Kareish cheese	3.66	0	3.59
Pickled kareish cheese	1.44	0.06	3.4
Full cream milk powder	0.23	0.21	2.69
Baby milk powder	0.14	0.06	2.48
Ice cream	0.078	0	1.62
Ice cream powder	0.12	0.19	4.43

Lead, cadmium and manganese concentration in wet milk and milk products samples (mg/Kg wet weight)

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Kareish cheese
Pickled kareish cheese
Full cream milk powder
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