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ESTIMATION OF SOME METALLIC POLLUTANTS IN MILK AND MILK POWDER IN BENI-SUEF GOVERNORATE

(With 4 Table and 1 Figure)

By

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قياس مستوى بعض الملوثات المعدنية في اللبن واللبن البودرة في محافظة بني سويف

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تم فى هذه الدراسة قياس مستويات بعض المعادن الثقيلة في ١٢٥ عينة من الألبان (تم جمعها من الحيوانات الحلابة مثل الأبقار والجاموس والأغنام في نطاق محافظة بني سويف) ولبن البودرة (٢٥ عينة) وذلك باستخدام جهاز الامتصاص الذري.وقد أظهرت النتائج أن مستوي الرصاص والكادميوم (جزء في المليون) في ألبان الأبقار (٦٤٨و٠ ، ١٦٩و٠ في مزرعة بياض العرب ، ٤٨٥و٠ ، ٠٧٦و٠ في مزرعة إسلام باشا ، ٣٦٨و٠ ، ٠٥٣و٠ في مزرعة كلية الطب البيطري ببني سويف) وفي ألبان الجاموس (٦٦١و٠ ، ١٧٤و٠ في مزرعة بياض العرب ، ٤٨٧و٠ ، ٠٩٣و٠ في مزرعة إسلام باشا) وفـــي ألبان الأغنـــام (٤٦٠و٠ ، ١٠٩و٠) وفي اللبن البودرة (٠١٠و ، ٠٣٦و٠). وكانت تركيزات الكروم والحـــديـــد والنحـــاس والزنـــك (جزء في المليون) في ألبان الأبقار (٤٢٨و٠ ، ٠٤٦و٠ ، ١٦١و٠ ، ٥٧٢و١ في مزرعة بياض العرب و٤٢٨و٠ ، ٢٠٨و٠ ، ٠٩٥و٠ ، ٠٢٥و٢ في مزرعة إسلام باشا ٢٤٥و٠ ، ٢٣٢و٠ ، ٠٨٧و٠ ، ٧٧٨و١ في مزرعة كلية الطب البيطري بني سويف) وفي ألبان الجاموس (٣٤٧و٠ ، ٠٤١و٠ ١٠١,٠ ، ٧٦٥و١ في مزرعة بياض العرب و ٤١١و٠ ، ٢١٣و٠ ، ١٠٠و٠ ، ٦١١و٢ في مزرعة إسلام باشا) وفي ألبان الأغنام (٩٩٦و٠ ، ٠٩٠و٠ ، ١١٤و٠ ، ٥٣٥و١) وفـــي ألبـــان البودرة (٨٨٢و٠ ، ٤٣٤و١ ، ١١٨و٠ ، ٨٣٤و٢). مقارنة بالحد المسموح به أو المعدل الطبيعي فقد أوضحت النتائج وجود زيادة معنوية في مستوي كل من الرصاص والكادميوم ووجود نقص معنوي في كل الكروم والحديد والنحاس والزنك في العينات التي تم فحصها. مما سبق يتضح مدي خطورة ارتفاع مستويات الرصاص والكادميوم في ألبان الحيوانات المختلفة ونقص شديد في مستويات كل من الكروم والحديد والنحاس والزنك في ألبان الأبقار والجاموس والأغنام مما يؤدي إلي الإقلال بقيمتها الغذائية لذلك يجب مراعاة أن يتم الفحص بصورة دورية وتفادى مخاطر التلوث فى هذه المناطق كما توصى هذه الدراسة بإضافة المعادن الأساسية مثل

النحاس والحديد والزنك لما قد يسببه استهلاك هذه الألبان من أضرار صحية على الإنسان والحيوان.

SUMMARY

The present study estimates the levels of some metallic pollutants and related elements (in Beni-Suef Governorate) in milk collected from different lactating animals (cows, buffaloes and sheep) and milk powder. One hundred and twenty- five samples of milk and twenty-five samples of milk powder were used. Lead (Pb) and cadmium (Cd) as non essential toxic elements as well as chromium (Cr), iron (Fe), copper (Cu) and zinc (Zn) as essential elements were measured by using flame atomic absorption spectrophotometer (GBC Avanta 906 AA). The analytical results revealed that Pb and Cd levels (ppm) in cow's milk were 0.648 and 0.169 at Bayad El-Arab farm, 0.485 and 0.076 at Islam Basha farm, and 0.368 and 0.053 at Fac. Vet. Med. farm, while in buffalo's reached to 0.661 and 0.174 at Bayad El-Arab farm) and 0.487 and 0.093 at Islam Basha farm respectively. In sheep milk the levels were 0.460 and 0.109, while in milk powder the levels were 0.010 and 0.036 respectively. The concentrations of Cr, Fe, Cu and Zn (ppm) in cow's milk were 0.428, 0.046, 0.161 and 1.572 at Bayad El-Arab farm, 0.428, 0.208, 0.095 and 2.025 at Islam Basha farm, and 0.245, 0.232, 0.087 and 1.778 at Fac.Vet.Med. farm respectively While in buffalo's milk they were 0.347, 0.041, 0.101 and 1.765 at Bayad El-Arab farm, 0.411, 0.213, 0.100 and 2.611 at Islam Basha farm respectively In sheep milk their levels were 0.996, 0.090, 0.114 and 1.535, and in milk powder they were 0.882, 1.434, 0.118 and 2.834 respectively. In comparison with the permissible limits or normal levels, the results showed that : (1) A significant increase in Pb and Cd levels in all investigated samples with exception of milk powder which showed significant decrease. (2) Cr level showed a significant increase in all examined samples except a significant decrease in cow's milk of Fac. Vet. Med. farm, and no changes in buffalo's milk of Bayad El-Arab. (3) Fe, Cu and Zn showed a significant decrease in all of investigated samples of milk while in milk powder there was a significant increase in Fe and no changes in Zn level. The public health hazard and sources of milk contamination by heavy metals (Pb and Cd), and the changes in essential elements (Cr, Fe, Cu and Zn) were discussed.

Key words: Milk-milk powder-Lead-Cadmium-iron-Copper-Zinc-metallic pollutants.

INTRODUCTION

We have recently become more and more a ware of the problems related to pollution and both government and industries have begun to take steps to avert further deterioration of our surrounding environment. However, the situation is already so grave, particularly on the local level that the controllable measures for pollution might not show any positive effects in the near future. The pollution in air, soil and water has become serious matter, since the pollutants found their way into the food chain and reached to the body resulting in harmful effects. Heavy metals are considered as the most important groups of pollutants in our environment. People have always been exposed to heavy metals in the environment. In areas of high concentration of metallic pollutants, contamination of food and water can lead to intoxication (Protasowiki, 1992). Milk and milk products represent an important part of man's and children's diet. However, lactating animals may be exposed to high quantities of toxic metals from air, water and feeds (Carl, 1991).

Blood and Radostits (1989) found that lead in cow's milk ranged from 0.028 to 0.030 ppm and may be elevated to as high as 2.26 ppm in severely intoxicated cows. Cimino *et al.* (1991) reported that the average values of Pb, Cd and Cu in ewe's milk were 16 ug/ kg, 14 μg/kg and 0.69 mg/kg, respectively. Alanis Guzman and Castro Gongora (1992) stated that the average mineral composition of analyzed milk samples was (ppm): lead (0.04), iron (0.59), zinc (5.89) and chromium (0.02). In a subsequent study, lead level in analyzed cow milk samples was 0.020 to 0.130 ppm (Mitrovic *et al.*, 1992). They also found that lead concentration was 0.270 ppm in breast milk and from 0.025 to 0.220 ppm in adopted milk for babies.

Shehata and Saad (1992) estimated the level of lead in milk samples from lactating cows, buffaloes, sheep and goat in Assiut Governorate. They found that lead levels were 0.019,0.245.0.4 and 0.197 ppm in cows, buffaloes, sheep and goat respectively. Muller *et al.* (1993) showed a lead content of 604 and 608 mg/l in farm and market milk. Jeng et al (1994) determined lead concentration in raw milk of dairy farms as 2.03 ng/ml. Ayoub *et al.* (1994) found that the average lead levels in pasteurized, sterilized, fermented, condensed and powdered milk were 1.501, 1.087, 4.6, 11.071 and 8.133 ppm respectively. Tork (1994) estimated lead level of 0.51 ppm in farm milk in Sharkia Governorate. El- Prince and Sharkawy (1999) found that lead content in the milk of cows and buffaloes was 0. 240 and 0.447 ppm respectively. Hygienic standards of the contents of foreign substances in food state that 0.1 ppm is the maximum Pb content in milk (Bartik and Piskac, 1981). Carl (1991) postulated that the acceptable limits ranged from 0.05 to 0.2 ppm , while the acceptable level of lead in milk was set in Britain at 0.04 ppm (Humphreys, 1991).

Cadmium has been shown to affect the disposition and excretion of copper and zinc in growing and adult animals (Mahaffey *et al.*, 1981; Wesenberg *et al.*, 1981). As cadmium is ubiquitous in nature, all food is exposed to and contains it (Watson, 1993). It is present in the human food chain including milk (Jeng *et al.*, 1994; Dwivedi *et al.*, 1997). FAO/WHO (1989) recommended that the provisional weekly intake of cadmium in food is 0.007 mg/kg body weight. The maximum acceptable limits for cadmium in milk ranged from 0.005 to 0.05 µg/kg in different countries (Carl, 1991). The average cadmium was 0.01 ppm in raw milk (Alanis Guzman and Castro Gongora, 1992), ranged from zero to 1 µg/l in raw cow's milk and 1-20 µg/l in pasteurized milk (Mitrovic *et al.*, 1992), in farm milk and market milk were 1.5 and 1.9 µg/l (where the maximum permissible limits is 5 µg/l) (Muller *et al.*, 1993). Egyptian Organization for Standardization (1993) has established Egyptian standard No. 2360/1993. Maximum levels for heavy metal contaminants in food". It considered PTWI (provisional tolerable weekly intake) for Cd of 0.0067-0.0083 mg/kg body weight/week, applicable to adults as well as infants and children.

Tripathi *et al.* (1999) measured the concentrations of Cd in different milk samples and baby food materials. The geometric mean concentration of Cd in different types of milk were found to vary from 0.07 to 0.10 µg/l., while the mean values in different baby foods ranged from 0.45 to 17.7 µg/kg. The concentration of Cd was found to be very low (0.1 µg/l) and fairly constant in all types of milk. The daily intakes of Cd (0.01 µg/kg) for infants through baby foods are well below the recommended tolerable levels of 0.8-1.0 µg/kg. El-Malt (2001) found that the average concentration of cadmium in raw milk in three different localities in Assiut Governorate was 0.199, 0.299 and 0.466 µg/g and in powdered milk as 0.473 µg/g and finally as 0.033 µg/g in baby formulas. El-Prince and Sharkawy (1999) measured Cd levels in cows and buffalo's milk (farms) as 0.017 and 0.019 ppm respectively.

In addition to the previous toxic elements that may contaminate milk, there are a large number of essential elements usually measured in ppm or per liter and referred as trace elements e.g. iron, copper, zinc and chromium. Iron (Fe) is necessary to all living cells and body fluids and plays an important role in regulation of vital cell processes (WHO, 1972). This element becomes toxic at sufficient high intake leading to health hazards as hepatocellular damage and fibrosis (Doyle *et al.*, 1993). The maximum permissible Limit of Fe in food daily intake is 0.8 mg/kg body weight according to the Egyptian Organization of Standardization (1993). Copper (Cu) is an essential element for all plants and animals, is widely distributed and occurs in food in many chemical forms which affect its availability to the animals (Watson, 1993). Interest in the biological significance, that both deficiency and excess of Cu in the mammalian system result in serious effects (Hostynek *et al.*, 1993). Its content in milk varies with the species, stage of lactation and Cu intake of dairy animal, although milk is considered the poorest source of copper (not more than 0.3 ppm) as recorded by Underwood (1977) or less than 0.1 ppm as reported by Harrison (1993). Ibrahim *et al.* (1984) recorded Cu levels of 0.136 and 0.132 ppm in cow' s and buffalo' milk, respectively in Assiut Governorate.

Chromium (Cr) is considered as an essential trace metal and, required for maintenance of normal glucose metabolism, protein synthesis, lipid metabolism and for growth and longevity. Also a beneficial effect of supplemental Cr on weight gain in infants suffering from marasmic protein-calorie malnutrition has been recorded. Cr has long been recognized as a carcinogen and due to the effects of continuous low-level exposure to Cr both occupationally and environmentally. Cr emissions to the environment are predominantly derived from fuel combustion, waste incineration, and industrial processes. Food is the major source of exposure to Cr. The mean total Cr concentration (ppm) in milk was 0.3 (Bartik and Piskac, 1981; Rowbotham *et al.*, 2000).

Zinc (Zn) is essential for biological functions as protein synthesis and carbohydrate metabolism. A number of diseases and dermatological conditions are attributable to Zn deficiency. Consequently, in extreme cases, alopecia, acrodermatitis and enteropathica are the most serious manifestations and are lethal if not treated successfully (Miyata *et al.*, 1986).

Fransson and Lonnerdal (1983) found that concentration of iron, copper and zinc in cow's milk was: for iron, 0.40-0.59, for copper 0.06-0.09, for zinc 3.23-5.15 μg/ml respectively. Alanis Guzman and Castro Gongora (1992) stated that the average mineral composition of raw milk (mg/l) was copper 0.15, iron 0.59 and zinc 5.89. Anderson (1992) reported that the concentration of iron and copper in cows milk was < 2 ppm and 0.05 ppm respectively. Cabrera *et al.* (1996) determined that the levels of copper, iron, zinc and chromium in children's milk were 0.02-2.80, 0.75-20.0, 0.25-4.50 and 0.020-2.800 μg/g respectively. Garcia *et al.* (1999) measured the concentrations of copper, zinc and chromium in samples of whole, low-fat, skim, condensed, evaporated and powdered milk and found that they were 0.041-0.370, 0.297-0.827 and 0-0.177 μg/g respectively. Tripathi *et al.* (1999) found that the mean concentrations of Cu and Zn in different types of milk varied from 43.2 to 195 and 1772 to 4230 μg/l, and in different baby food were from 1106.3 to 3157.3 and 9367 to 34592 μg/kg respectively. El-Malt (2001) found that the copper levels were 0.092, 1.6, 0.259, 0.127 and 0.11ppm (μg/g) in fresh milk of Assiut, Rifa, Hawatica, powdered and baby formulas respectively.

As milk is an essential life food for both newly born animals as well as for human consumption and because of the deleterious effects of some heavy metals on animal and human health, this study aimed to investigate the environmental pollution with some heavy metals in cow's milk, buffalo's milk, sheep milk and milk powders to suggest a protocol for prevention of this pollution in Beni- Suef Governorate.

MATERIALS and METHODS

Collection of samples:

A total of 150 samples of cow's, buffalo's, ewe's raw milk and powdered milk were obtained as following (Table 1):

	Product	Farm or locality	Number of samples
1	Raw cow's milk	Bayad El-Arab farm	20
		Islam Basha farm	20
		Fac.Vet.Med. Beni-Suef farm	20
2	Raw buffalo's milk	Bayad El-Arab farm	20
		Islam Basha farm	20
3	Raw ewe's milk	Beni-Suef City	25
4	Milk powder	Beni-Suef City	25

The farm of Bayad El-Arab lies near the cement industry plant in Beni-Suef City, while the farm of Islam Basha lies far away from this cement factory. The milk samples of sheep were collected randomly from the rearing flocks in Beni-Suef city. The samples were collected in glass containers which were thoroughly cleaned with HCL and bidistilled water, and dried. The collected samples were dispatched to the laboratory without delay in ice-pack containers. All glass and plastic wares were rinsed with HNO_3 (25%) to avoid metal contamination.

Estimation of metals:

The levels of lead, cadmium, chromium, iron, copper and zinc were estimated using the Atomic Absorption Spectrophotometer AAS (GBC Avanta 906, Australia). The absorption and concentration were recorded directly from the digital scale of AAS in ppm. 5 ml milk or 5 g milk powder were used from each sample. Duplicate samples were digested with concentrated nitric acid and perchloric acid (2:1), samples were brought to a constant volume. Estimation of lead and cadmium were carried out according to Agemain *et al.* (1980). Copper, iron, chromium and zinc were measured according to Parker *et al.* (1968).

Statistical analysis:

The obtained data were statistically analyzed according to Snedecor and Cochran (1974) using student's "t" test. The obtained values were compared with the permissible and acceptable limits of both lead and cadmium (0.02 and 0.002 ppm) respectively (Carl, 1991), and the normal levels of iron (0.8 ppm) by Egyptian Organization of Standardization (1993), copper (0.3 ppm) by Forstner and Prosi (1979), zinc (3.0 ppm) by Underwood (1977) and chromium (0.3 ppm) by Rowbotham *et al.* (2000).

RESULTS

The analytical results are represented in (Tables 2,3 & 4 and Figure 1).

Table 2: Lead levels (ppm) in examined samples of milk and milk powder in Beni-Suef Governorate.

Product	Farm or locality	No. of samples	Min.	Max.	Mean	S.E.
Cow's milk	-Bayad El-Arab	20	0.542	0.754	0.648	0.023
	-Islam Basha farm	20	0.331	0.630	0.485	0.033
	-Fac. Vet. Med. Beni-Suef	20	0.131	0.550	0.368	0.038
Buffalo's milk	-Bayad El-Arab	20	0.486	0.849	0.661	0.045
	-Islam Basha	20	0.363	0.581	0.487	0.023
Sheep milk	-Beni-Suef City	25	0.384	0.567	0.460	0.022
Milk powder	-Beni-Suef City	25	0.0006	0.0012	0.010	0.0001

Table 3: Cadmium levels (ppm) in examined samples of milk and milk powder in Beni-Suef Governorate.

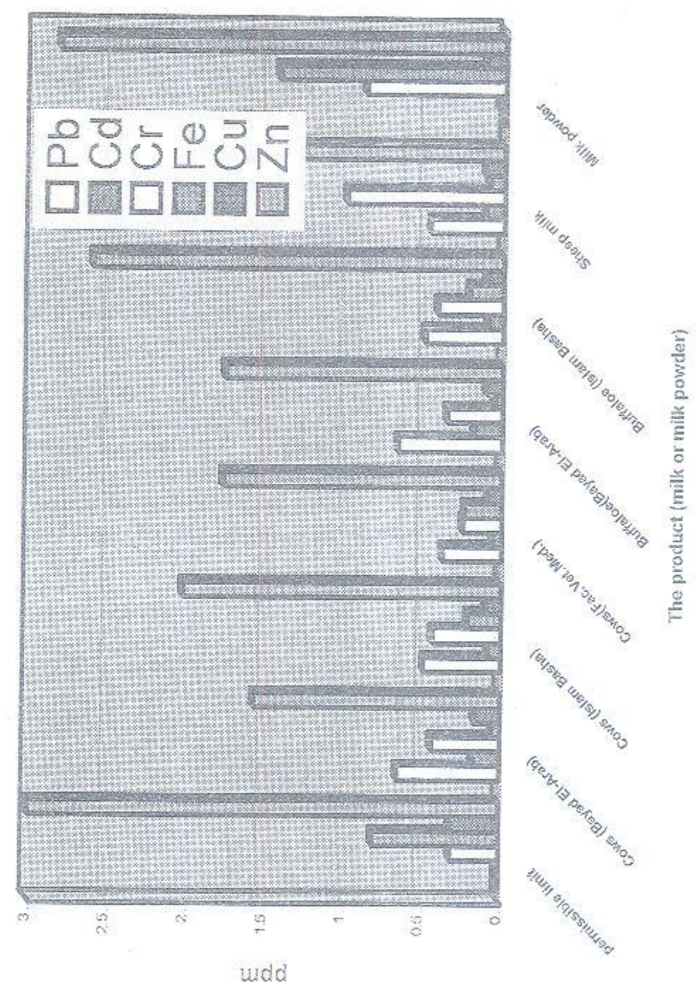
Product	Farm or locality	No. of samples	Min.	Max.	Mean	S.E.
Cow's milk	-Bayad El-Arab	20	0.100	0.295	0.169	0.022
	-Islam Basha farm	20	0.061	0.091	0.076	0.003
	-Fac. Vet. Med. Beni-Suef	20	0.042	0.058	0.053	0.003
Buffalo's milk	-Bayad El-Arab	20	0.147	0.195	0.174	0.005
	-Islam Basha	20	0.066	0.113	0.093	0.005
Sheep milk	-Beni-Suef City	25	0.067	0.150	0.109	0.009
Milk powder	-Beni-Suef City	25	0.024	0.060	0.036	0.004

Table 4: Levels of Pb, Cd, Cr, Fe, Cu and Zn (ppm) in examined samples of milk and milk powder at Beni-Suef Governorate (mean ± S.E.).

			Elements					
Product	Farm or locality	No. of samples	Pb	Cd	Cr	Fe	Cu	Zn
Cow's milk	-Bayad El-Arab	20	0.648 ± 0.0230 **	0.169 ± 0.022 **	0.428 ± 0.027 **	0.046 ± 0.003 **	0.161 ± 0.015 *	1.572 ± 0.127 **
	-Islam Basha farm	20	0.485 ± 0.033 **	0.076 ± 0.003 **	0.428 ± 0.039*	0.208 ± 0.013 **	0.095 ± 0.006 **	2.025 ± 0.035 **
	-Fac. Vet. Med. Beni-Suef	20	0.368 ± 0.038 **	0.053 ± 0.003 **	0.245 ± 0.021 *	0.232 ± 0.012 **	0.087 ± 0.007 **	1.778 ± 0.135 **
Buffalo's milk	-Bayad El-Arab	20	0.661 ± 0.045 **	0.174 ± 0.005 **	0.347 ± 0.028	0.041 ± 0.002 **	0.101 ± 0.003 **	1.765 ± 0.113 **
	-Islam Basha	20	0.487 ± 0.023 **	0.093 ± 0.005 **	0.411 ± 0.013 **	0.213 ± 0.006 **	0.100 ± 0.008 **	2.611 ± 0.057 **
Sheep milk	-Beni-Suef City	25	0.460 ± 0.022 **	0.109 ± 0.009 **	0.996 ± 0.046 **	0.090 ± 0.007 **	0.114 ± 0.006 **	1.535 ± 0.140 **
Milk powder	-Beni-Suef City	25	0.010 ± 0.0001 **	0.036 ± 0.004 **	0.882 ± 0.035 **	1.434 ± 0.161 **	0.118 ± 0.006 **	2.834 ± 0.231

*: Significant different at $p<0.05$. **: Significant different at $p<0.001$.

Fig. 1: Levels of Pb, Cd, Cr, Fe, Cu and Zn in milk and milk powder at Beni-Suef Governorate



DISCUSSION

As the dairy animals can be exposed to toxic pollutants from various sources, it is necessary to monitor the level of lead and cadmium as toxic elements and iron, copper and zinc as related essential elements in milk. Investigation of essential elements have been screened mainly on whether they were present in toxic amounts, rather than on its occurrence as normal constituents. Lead and cadmium are of the most hazardous pollutants to animal and human beings health status. Several enzootic lead and cadmium poisoning in domestic animals have been recorded throughout the world, where the source of the metal contaminates pasture or crops (Aronson, 1972; WHO, 1992). The previous toxicological studies revealed a high level of lead and cadmium in all examined water sources and plants (El-Shreif, 1991; Sayed, 2001).

The analytical results (Tables 2-4 and Fig.1) revealed that Pb levels (ppm) in cow's milk were 0.648 at Bayad El-Arab farm, 0.485 at Islam Basha farm, and 0.368 at Fac.Vet.Med. farm, in buffalo's milk the levels were 0.661 at Bayad El-Arab farm and 0.487 at Islam Basha farm). In sheep milk Pb levels were 0.460, and in milk powder the levels were 0.010. This increase of milk lead level was in agreement with the previous toxicological studies recorded by Shehata and Saad (1992) in milk samples from lactating cows, buffaloes, sheep and goat in Assiut Governorate. They found that lead levels were 0.019, 0.245.0.4 and 0.197 ppm in cows, buffaloes, sheep and goat respectively. Muller *et al.* (1993) showed lead content of 6.4 and 6.8 mg/l in farm and market milk. Jeng *et al.* (1994) determined lead concentration in raw milk collected from the bulk holding tanks of dairy farms as 2.03 ng/ml. Ayoub *et al.* (1994) found that the average lead level in milk powder as 8.133 ppm. Tork (1994) estimated lead level of 0.51 ppm in farm milk in Sharkia Governorate. El- Prince and Sharkawy (1999) found that lead content in milk of cows and buffaloes was 0. 240 and 0.447 ppm, respectively. Hygienic standards of the contents of foreign substances in food state that 0.1 ppm is the maximum Pb content in milk (Bartik and Piskac, 1981). The provisional weekly intake of Pb in food must not be exceeding than 0.005 mg/kg body weight as recommended by FAO/WHO (1989). However, Carl (1991) postulated that the acceptable limits ranged from 0.05 to 0.2 ppm, while the acceptable level of lead in milk was set in Britain at 0.04 ppm (Humphreys, 1991). It has been apparent that the results in this study concede the maximum acceptable lead limits. El-Shreif (1991) recorded a high lead level in all examined water sources and plants in Assiut Governorate. This may arise from the food, as cattle are normally fed on grasses and the milk lead content will be dependent on the amounts which are present in pasture and cereals. The major source of lead in the environment resulting from the manufacture and application of alkyl lead fuel additives. Its transport and distribution from stationary or mobile sources mainly via air and probably discharged into soil and water (WHO, 1977). In a previous survey in India, milk of cow, buffalo and goat collected from an area of a heavy traffic, lead had a higher range of 4.6-7.7 μg/gm (Bhatia and Choudhri, 1996). Lower lead levels (0.032, 0.049 and 0.018 μg/gm) were found in raw milk samples from an industrial region, followed by a traffic intensive region and rural region respectively (Simsek *et al.*, 2000). Also in Assiut Governorate the mean lead levels recorded in cow's and buffalo's milk were 0.019 and 0.245 μg/gm (Shehata and Saad, 1992), 0.24 and 0.447 μg/gm (El-Prince and Sharkawy, 1999), and 0.193, 0.247, 0.343 and 0.008 ug/gm (El-Malt, 2001). A very low lead concentration was found in raw milk samples reaching to 0.091-0.1 ug/gm (Bruhn and Franke, 1976), 0.0024 μg/gm (Kofer *et al.*, 1987).

Velasco-Conzalez and Echavarria-Almedia (1991) determined the lead content of 182 samples of industrialized milk samples as 0.134 ppm. Also some samples have average contents higher than this level (0.364 ppm), and 0.23 ppm by Protasowicki (1992). These results were higher than the highest allowable amounts (0.03 ppm for lead).

Dabeka and McKemzie (1987) analyzed market milk and infant formula samples for detection of their Pb content. They found that ranges were Pb (0.01-2.48) and (37.3). Mitrovic and Todorovic (1992) found that Pb level was 20-130 and 25-220 μg/l in raw cow milk and in adopted milk for babies respectively.

Higher measured contents than reported can be traced back and related to: (a) Secretory contamination due to high contents of feeding stuffs (in areas of industrial pollution or areas close to melting plants). (b) Post-secretory contamination due to high lead content in soldered tins. This needs know how the tin cans produced.

Lead is a cumulative toxic heavy metal that produces continuous effects on the hemebiosynthesis, nervous system and kidneys. Exposure to lead occurs by inhalation and through ingestion of contaminated food and water. (Gossel and Bricker, 1990). Lead neurotoxicity is more common in children and newly born and postnatal exposed animals than in adults (Silbergeld, 1992).

The analytical results (Table 2-4 and Fig. 1) revealed that Cd levels (ppm) in cow's milk were 0.169 at Bayad El-Arab farm, 0.076 at Islam Basha farm, and 0.053 at Fac.Vet.Med. farm, while in buffalo's milk the levels were 0.174 at Bayad El-Arab farm and 0.093 at Islam Basha farm. In sheep milk they were 0.109, and in milk powder they were 0.036. Concerning cadmium, the mean content (ppm) in cow's milk was 0.017 and in buffalo's milk was 0.019 (El-Prince and Sharkawy, 1999). Tork (1994) and Fayed (1997) recorded higher findings. They showed a higher level of 0.113 and 0.20 ppm in the examined raw milk samples, respectively. It has been reported that the concentration of cadmium in milk at or below the limits of detection <0.002 mg/kg (Galal, 1990 and Galal-Gorchev, 1993). According to Carl (1991) the maximum acceptable limits of cadmium in milk was 0.005-0.05 mg/kg body weight. Hence, the obtained results in this study showed a slight rise above the previously recorded maximum acceptable limits. Higher milk cadmium concentration in lactating animals could be attributed to the greater ingestion of contaminated feed and water and inhalation of fumes and dusts from the industrial activities (Dwivedi *et al.*, 1997).

Dabeka and McKemzie (1987) analyzed market milk and infant formula samples for detection of their Cd content (ng/g). They found that ranges were 0.005-0.742 and 1.500. Mitrovic and Todorovic (1992) reported that the concentration of cadmium (ug/l) was 0.0-1.0 in raw cow milk, 1.0-20.0 in pasteurized cow milk and 0.0-26.0 in evaporated adopted milk. Protasowicki (1992) found that the mean content of cadmium in milk was 0.018 ppm. These results were higher than the highest allowable amounts (0.003 for cadmium).

Cadmium, which is an environmental contaminant, has a number of industrial applications, but it is used mostly in metal plating, pigments, batteries, and plastics. However, for most people the primary source of Cd exposure is Food (WHO, 1992) since food materials tend to take up and retain Cd. Many toxicological effects can be induced by cadmium these effects are renal dysfunction, cellular damage (through interference with metalloenzymes, alteration of energy metabolism and altered membrane structure and functions), effects on lipid peroxides and superoxide dismutase in hepatic, renal and testicular tissues. and on the hematological system (Patra *et al.*, 1999; kostic *et al.*, 1993). It was found that Cd can induce anemia and alteration of antioxidant and metabolic status of RBCs. Recently, Cd alters membrane skeleton, one of the structures responsible for erythrocyte deformability (Jan and Franktisek, 2000).

In this study the mean concentrations of Fe (ppm) (Table 4 and Fig. 1) in cow's milk were 0.046 at Bayad El-Arab farm, 0.208 at Islam Basha farm, and 0.232 at Fac.Vet.Med. farm, while in buffalo's milk were 0.041 at Bayad El-Arab farm, 0.213 in Islam Basha farm. In sheep milk the mean concentrations were 0.090, and in milk powder were 1.434. El-Prince and Sharkawy (1999) recorded that the mean levels of milk iron were 0.428 and 0.322 ppm in cow's and buffalo's milk, respectively. A previous study revealed that the mean contents of iron in cow's, buffalo's and sheep milk were 0.053, 0.077 and 0.099 ppm, respectively (Shehata and Saad, 1992). The normal acceptable limits in food daily intake is 0.8 mg/kg body weight (Egyptian Organization of Standardization, 1993), therefore, the obtained results in this study are considered lower than the normal range. This held the view reported by Abdel-Maged and Oheme (1990) as they postulated that milk is considered a poor source of iron. Depletion of iron stores in human or animal body or latent iron deficiency leading to overt iron deficiency anemia which is characterized by fatigue, listlessness, anorexia, depressed growth and immunosuppression in children and young growing mammals. So, it is necessary to increase the iron food intake to overcome its low level in milk.

Fransson and Lonnerdal (1983) found that concentration of iron, copper and zinc in cow's milk was: for iron, 0.40-0.59, for copper 0.06-0.09, for zinc 3.23-5.15 µg/ml respectively. Alanis Guzman and Castro Gongora (1992) stated that the average mineral composition of raw milk (mg/l) was copper 0.15, iron 0.59 and zinc 5.89. Anderson (1992) reported that the concentration of iron and copper in cows milk was < 2 ppm and 0.05 ppm respectively. Cabrera *et al.* (1996) determined the levels of copper, iron, zinc and chromium in children's milk were 0.02-2.80, 0.75-20.0, 0.25-4.50 and 0.020-2.800 µg/g respectively. Garcia *et al.* (1999) measured the concentrations of copper, zinc and chromium in samples of whole, low-fat, skim, condensed, evaporated and powdered milk and found that they were 0.041-0.370, 0.297-0.827 and 0-0.177 µg/g respectively. Tripathi *et al.* (1999) found that the mean concentrations of Cu and Zn in different types of milk varied from 43.2 to 195 and 1772 to 4230 µg/l, and in different baby food varied from 1106.3 to 3157.3 and 9367 to 34592 µg/kg respectively. El-Malt (2001) found that the copper levels were 0.092, 1.6, 0.259, 0.127 and 0.11ppm (µg/g) in the fresh milk of Assiut, Rifa, Hawatica, powdered and baby formulas, respectively.

Dabeka and McKemzie (1987) analyzed market milk and infant formula samples for detection of their iron level. They found that the Fe (ng/g) in milk was (7-86) and in infant formulas was (480) respectively.

The concentrations of Cu (ppm) (Table 4 and fig. 1) in cow's milk were 0.161 at Bayad El-Arab farm, 0.095 in Islam Basha farm, and 0.087 at Fac.Vet.Med. farm, while in buffalo's milk they were 0.101 at Bayad El-Arab farm, 0.100 at Islam Basha farm. In sheep milk it was 0.114, and in milk powder it was 0.118. Lower levels of copper than that obtained in this study were recorded by Favretto and Marletta (1984), Ibrahim et al (1984) and Shehata and Saad (1992). In cow's and buffalo's milk, the mean values of copper (ppm) were 0.592 and 0.825 (El-Prince and Sharkawy, 1999). It is well documented that milk is considered the poorest source of copper, not more than 0.3 ppm as reported by Underwood (1977) and Forstner and Prosi (1979) or less than 0.Img/kg as stated by Harrison (1993). Dorner *et al.* (1989) concluded that cow's milk formula should be fortified with copper up to a level of at least 600 µg/l. Friel *et al.* (1999) mentioned that infants consuming evaporated milk formulas should receive iron supplement throughout infancy. More or less similar findings were reported by Garcia *et al.* (1999) who found values ranged from 0.02 to 2.8 ppm of copper in children's milk. Also lower levels (0.041-0.370 ppm) were detected by Garcia *et al.* (1999) in whole, low fat, skimmed, condensed, evaporated and powdered milk. El-Malt (2001) found that copper level (ppm) in milk samples from different areas in Assiut Governorate was 0.092, 1.6, 0.259, 0.127 and 0.11.

Our obtained results in this study (Table 4 and Fig. 1), show that the mean content of zinc (ppm) in cow's milk was 1.572 at Bayad El-Arab farm, 2.025 at Islam Basha farm, and 1.778 in Fac.Vet.Med. farm, while in buffalo's milk was 1.765 at Bayad El-Arab farm, 2.611 at Islam Basha farm. In sheep milk it was 1.535, and in milk powder it was 2.834. In both cow's and buffalo's milk it was 2.060 and 2.337 ppm (El-Prince and Sharkawy, 1999). The obtained findings in cow's milk were in accordance with those recorded by Citek et al (1994), while higher values were estimated by Fayed (1997) in the examined raw milk samples. Underwood (1977) showed that zinc level in normal milk was 3 ppm, however CAC (1984) recorded that 300-1000mg/kg body weight was the maximum load of zinc in all foods and drinks. Accordingly, the reported zinc levels in this investigation do not exceed the normal limit

(3 ppm). On the contrary, high levels of dietary zinc may interfere with the hepatic copper storage and may compete with calcium for intestinal absorption. The antagonistic effects of zinc against iron and copper can result in suppression of hematopoiesis (Osweiler, 1996). Our results revealed a highly significant decrease in Zn concentration in all examined milk samples which if administered for a long time for newly born animals or children can induce signs of zinc deficiency. Zinc is an essential trace element and is ubiquitous in the human body. Without zinc, many functions of the organism would cease since more than 60 enzymes are dependent on this element for their activity. The recommended daily intake for adults has been set at 15 mg, based on a net absorption of 20% from food. Milk contains approximately 4 mg Zn/kg and thus contributes substantially to the daily intake (Koops *et al.*, 1986).

The concentrations of Cr (ppm) (Table 4 and Fig. 1) in cow's milk were 0.428 at Bayad El-Arab farm, 0.428 at Islam Basha farm, and 0.245 at Fac.Vet.Med. farm, while in buffalo's milk it was 0.347 at Bayad El-Arab farm, 0.411 at Islam Basha farm. In sheep milk it was 0.996, and in milk powder it was 0.882. Kofer *et al.* (1987) found that mean values of lead, cadmium and chromium in milk samples were 2.4, 0.1 and 0.7 ug/l respectively. Favretto and Marletta (1984) found that the concentration of Cr, Cu, Cd and Pb in milk samples were 0.75, 103, 3.11 and 27.5 μg/kg respectively.

Kessels et al (1990) stated that cows kept in farms near Cd contaminated areas showed lowering blood iron, iron binding capacity, iron saturation, Hb and packed cell volume. Ragan and Most (1990) recorded that the effect of exposure to Cd in laboratory animals induces anemia, deficiencies of iron, copper and zinc. Wentink et al (1992) studied the effect of environmental Cd on cattle kept in vicinity of a zinc processing plant. They found that Hb, blood iron, iron binding capacity and iron saturation were subnormal, like that recorded by Kessels et al (1990).

CONCLUSION

In conclusion a regular general and representative monitoring of metallic pollutants contamination of milk and milk products is recommended at an appropriate frequency to establish the true contribution of milk and milk products to the dietary intake of heavy metals. Although there is a little secretion into the animal milk, the feed in polluted areas should be controlled. Standard hygienic measures should be applied during the production of phosphate fertilizers, cement plant, sewage sludge and also in drainge system. Also mineral salts must be kept under control. Cans with lead containing solder should not be used for milk (unless special know-how in production of cans is available to keep contamination of milk as low as possible. Care should be taken to ensure that the dairy equipments does not contaminate the milk and milk products. Construction of a center for environmental health and harmful control is recommended. Periodical measuring and evaluation of heavy metals, especially toxic one (lead and cadmium) in blood and different environmental compartments (food, water, soil and air) is also proposed.

Higher levels of lead in the examined milk samples may be attributed to heavy automobile traffic using leaded gasoline as well as using water from lead pipes in these localities. The obtained results emphasize the importance of warning about the harmful and toxic effects of these pollutants on infants as well as newly born animals. The most dangerous effects resulting from accumulation of small amounts of these pollutants and on the long run of exposure, the chronic effect appears very dangerous and sometimes fatal. So more accurate preventive measures should be undertaken and regular measuring for these pollutants must be done. The high cadmium levels in examined samples from different areas may result from industrial activities in these areas (Cement industry plant, coal manufacturing plant or super phosphate plant) or from leakage of cadmium from galvanized pipes.

The investigation of milk revealed a high concentration of lead and cadmium. It is seemly necessary to warning about the hazardous effects of these toxic elements on both newly born animals and human being in Beni-Suef Governorate. The consuming of such milk is considered an additional source of exposure beside the direct sources of air, water and plants. Moreover, the effect on consumers may contribute through disturbing the levels of essential elements (chromium, iron, copper and zinc) in vital foods.

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