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DETECTION OF SOME HEAVY METAL RESIDUES IN RAW MILK AND MILK PRODUCTS MARKETED IN KAFER ELZIAT CITY

By

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ABSTRACT

A total of sixty random samples of raw milk, fermented milk (Egyptian laban rayeb) and kareash cheese (20 for each) were collected from different locations from **Kafer Elziat city** at Gharbia governorate for determination of their residues of some heavy metals (lead and cadmium). The results showed that the average concentrations of lead were 0.31±0.07, 0.57±0.09 and 0 ppm for raw milk, fermented milk and kareash cheese, respectively. While those for cadmium were 0.13±0.03, 0.27±0.03 and 0.28±0.24 ppm for the same samples, respectively. Furthermore, the percentage of raw milk, fermented milk and kareash cheese samples which exceeded the safe permissible limits were 30%, 55% and 0% for lead (0.5 mg/kg) and 40%, 75% and 80% for cadmium (0.1mg/kg), respectively. However, all examined samples of kareash cheese come in accordance with the standard limits of lead. The significance of contamination with such pollutants and their public health hazards were discussed.

INTRODUCTION

Increasing industrialization has been accompanied throughout the world by the new distribution of mineral substances from the natural deposit. Many of these have undergone chemical changes and finally pass, finely dispersed in solutions, effluent sewage, dumps and dust, water, earth and the air and thus into food chain. These include the metals and thus also the heavy metals ***(Florea et al., 2006).***

Heavy metals are recognized as toxic substances due to the low rate of elimination from the consumer body.

The contamination with heavy metals such as lead, cadmium, mercury, copper and zinc which are widely distributed in the air, agricultural lands and water is possible. Some of these metals are toxic to virtually every system of human body and may cause serious health hazards to man depending on their levels of contamination ***(Luckey and Venugopal, 1977).***

The presence of heavy metals in dairy products may be attributed to contamination of the original cow's milk, which may be due to exposure of lactating cow to environmental pollution or consumption of feeding stuffs and water ***(Carl, 1991).*** Moreover, raw milk may be exposed to contamination during its manufacture ***(Ukhun etal., 1990)*** and ***(El-Batanouni & Abo El-Ata, 1996).***

Heavy metals are released into the environment by metal smelters and other industrial activities, unsafe disposal of industrial wastes and the use of lead in water pipes and petrol. Cow on farms near industrial areas have exceptionally higher levels of heavy metals in their milk. Still another source of feed contamination is recycled farmyard waste.

The most dangerous metals, when concentrated above naturally occurring levels, include lead, mercury, cadmium, arsenic, copper, zinc and chromium.

These have diverse effects relating to cancers (cadmium and arsenic), genetic damage (mercury) and brain and bone damage (lead, copper and mercury), ***(Fisher etal., 1996).***

Thus, the purpose of the present study was to determine the concentrations of lead and cadmium in raw milk, fermented milk and kareash cheese which were collected from different localities and markets at **Kafer Elziat city** in Gharbia Governorate which is considered from the most polluted industrial city all over the world.

MATERIAL AND METHODS

A total of 60 samples of raw milk, fermented milk, and kareash cheese (20 of each) were collected randomly from markets at different localities to estimate the residues of some heavy metals contaminating such products. All samples were stored at 20ºC and transferred in an ice box to the Animal Health Research Institute, Dokki- Giza for analysis of lead and cadmium. Samples were prepared and digested according to the technique described by ***Khan et al. (1995).***

All samples were analyzed by Atomic Absorption Spectrophotometer **(Unicam 969 AA Spectrophotometer)** under the following condition:

Metal / Condition	Lead (Pb)	Cadmium(Cd)
Methods	**Normal segmented curve fit**	**Normal segmented curve fit**
Measurement time	**4.0 second**	**4.0 second**
Wave length (nm)	**217**	**228.8**
Lamb current/m.am	**15**	**8**
Technique	**Flame**	**Flame**
Flame type	**Air/Acetylene**	**Air/Acetylene**
Air/1	**30**	**30**
Acetylene/1	**20**	**20**
Fuel flow (L/Min)	**1.1**	**1.2**

N.b: The estimation of such heavy metals in each examined sample was in p.p.m. on the basis of wet weight.

Statistical analysis:

Analysis was carried out according to method described by ***Rosner (2002)*** by using student's (t-test).

RESULTS

Table (1) Concentrations of lead (ppm) in the examined samples of raw milk and milk products (n=20)

Kind of samples	Permissible limits	Unaccepted samples		Min	Max	Mean±S.E
	E.O.S.Q.C• mg/kg	No	%			
Raw milk*	0.5	6	30%	0.08	0.85	0.31±o.07
Fermented milk	0.5	11	55%	0.01	1.22	0.57±0.09
Kareash cheese	0.5	0	0%	0	0	0

*Significant difference by student's t-test ($p<0.05$)

•**E.O.S.Q.C** = Egyptian Organization of Standardization and Quality Control.

N.B = p.p.m (mg/kg) (ml/L).

Table (2) Concentrations of cadmium (ppm) in the examined samples of raw milk and milk products (n=20).

Kind of samples	Permissible limits	Unaccepted samples		Min	Max	Mean±S.E
	E.O.S.Q.C mg/kg	No	%			
Raw milk*	0.1	8	40%	0.02	0.33	0.13±0.03
Fermented milk	0.1	15	75%	0.02	0.59	0.27±0.03
Kareash cheese	0.1	16	80%	0.12	0.45	0.28±0.24

*Significant difference by student's t-test ($p<0.05$)

Figure (1): Mean values of lead (ppm) in examined samples of raw milk and milk products

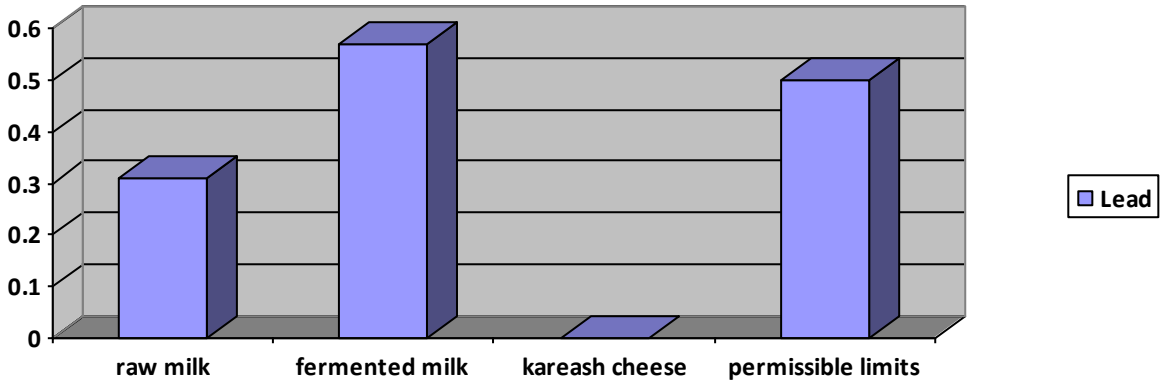
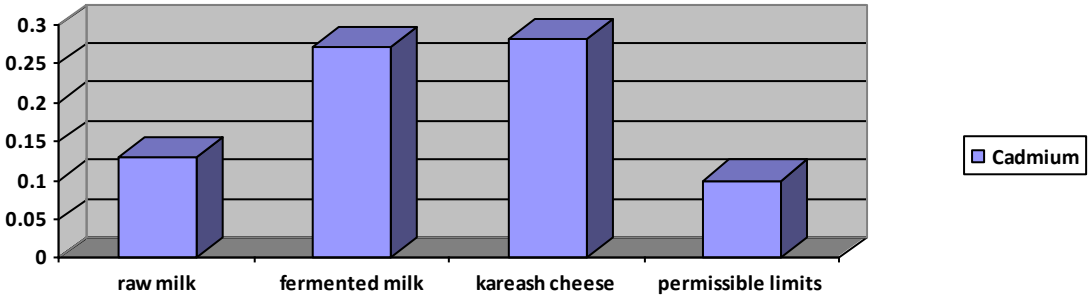


Figure (2): Mean values of cadmium (ppm) in examined samples of raw milk and milk products



DISCUSSION

Milk is a primary source of nutrients in diets all around the world. Attention has been focused on milk as it is nearly almost the perfect single foodstuff especially for children, however lactating cattle may be exposed to high quantities of toxic metals in the environment by air, water and ingestion of polluted feeds. Fortunately, these animals act as a very efficient biological filter against heavy metal contamination, where, it is valid when the animals are grazing near motor ways and road with heavy car traffic ***(Carl, 1991)***.

Results recorded in Table (1) and Fig(1) declared that the concentration of lead varied from 0.08 to 0.85 with an average of 0.31±0.07 ppm for raw milk, from 0.01 to 1.22 with an average of 0.57±0.09 ppm for fermented milk and 0 ppm for kareash cheese. Accordingly, 30% and 55% of examined samples of raw and fermented milk hare exceeded the safe permissible limits for lead (0.5mg/kg) recommended by Egyptian Organization for Standardization and Quality Control

"E.O.S.Q.C" (1993).The current results may agree with those obtained by ***Nasr et al (2002)*** and ***Elham et al (2011)*** who recorded high concentration of lead in raw milk samples which exceeded the permissible limits, while higher results were reported by ***Florea et al (2006),*** while lower results were recorded for kareash cheese samples.

The main sources of lead in Egyptian irrigation system are industrial wastes. Lead is a toxic metal which accumulates in the body due to its low rate of elimination. Chronic lead poisoning is characterized by liver dysfunction, anemia, muscular pain, lead nephropathy and neuropathy of both central and peripheral nervous system ***(Goldfrank et al.,1990)***.Lead toxicity causes reduction in the hemoglobin synthesis , disturbance in the function of kidney , joints , reproductive and cardiovascular systems ***(Ogwuegbu and Muhanga ,2005).***

In men, lead affects the male gametes resulting in abnormalities in sperms, decreased sexual drive, impotence and sterility ***(Timbrell, 1982),*** while in women its exposure associated with abnormal ovarian cycles and menstrual disorders in addition to abortion, stillbirth and foetal macrocephaly ***(Needleman et al., 1984).*** Table (2) and Fig (2) pointed out that cadmium levels ranged from 0.02 to 0.13 ± 0.03 ppm for raw milk and from 0.02 to 0.59 with an average of 0.27 ±0.03 ppm for fermented milk while it was from 0.12 to 0.45 with an average of 0.28 ±0.24 ppm for kareash cheese .Generally, the Egyptian Organization for Standardization and Quality Control ***"E.O.S.Q.C"(1993)*** stated that the safe permissible limit of cadmium should not exceed 0.1 mg/kg, consequently, 40%, 75% and 80% of raw milk, fermented milk and kareash cheese disagreed with such limits, respectively. The obtained data may agree with those reported by ***Nasr et al (2007)*** for cadmium in milk but higher values were obtained by ***Florea et al. (2006).*** On the other hand, lower value was detected by ***Elham et al .(2011)*** who reported a mean value of 0.013±0.002 for cadmium residue in raw milk samples from Gharbia governorate, also ***Lant et al (2006)*** who found that cadmium was absent in milk.

The contamination of milk with cadmium might be due to the use of cadmium in manufacture of pesticides and in some fertilizers ***(Saad and Emam, 1998).***

Cadmium compounds are mainly used in re-chargeable nickel – cadmium batteries, one reason for the increase of cadmium emissions is that the cadmium – containing products are rarely re – cycled, but often dumped together with household wastes ***(Jarup, 2003).***Sever exposure to cadmium may result in pulmonary effects such as emphysema, bronchiolitis and alveolitis. Renal effects may also result due to sub chronic inhalation of cadmium ***(Young, 2005).***Following

absorption cadmium is transported and bound to certain proteins of the plasma and red blood cells to other sites through out the body. However, the metabolism of cadmium was antagonized with the copper and iron leading to anemia. It acts on sulfa hydryle groups of essential enzymes and binds to phospholipids and nucleic acids ***(Carl, 1991).*** The International Agency for Research on Cancer (IARC) classified cadmium into Group I substances which are carcinogenic to human ***(IARC, 1993).***In conclusion, it could be observed that raw milk and milk products samples from Kafr ELzayat city showed a higher level of contamination of lead and cadmium, this may be attributed to the industrial activities, unsafe disposal of industrial wastes and the use of lead in water pipes .It may be also due to presence of farms near industrial areas which lead to higher level of heavy metals in milk in such city. The presence of these residues in raw milk and milk products raising a serious concern, also the continuous consumption of such products may constitute a public health hazard through progressive accumulation of these elements inside the human body. We can say that, people in this area are in a considerable risk from heavy metals poisoning. So in order to minimize the hazardous effect of these pollutants and to protect human health, strict and regular monitoring and periodical surveys of heavy metal residues in such products. Control efforts must be taken to limit the exposure of such products to these sources of contamination. If the initial contamination level is limited, this strategy may lead to produce products safe for consumption for human being. Also education of consumers with these pollutants, their sources, health hazards and control should be carried on.

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