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Assessment of Lead Residue in Raw Milk Obtained from Regions of Hamadan province in Iran

Mohammadreza Moradi [+1], Iraj salehi[2], Hadi Beiginejad [3], Jalal Pourtaghi[4], Zahra Nanzari[5]

[1] Department of Food and Drug, Hamadan University of Medical Sciences and Health Services, Iran
[2] Department of Physiology, Hamadan University of Medical Science, and Health Services, Iran
[3] Faculty of Chemistry, Bu-Ali Sina University, Hamedan, Iran
[4] Department of Food and Drug, Hamadan University of Medical Sciences and Health Services, Iran
[5]Department of Chemistry, Malayer University, Malayer, Iran

Abstract. During April 2011, 48 samples of raw whole milk were collected from milk products factories in different regions of the Hamadan province in western Iran and analyzed by atomic absorption spectroscopy. The mean level of lead content obtained from all samples were lower than the WHO/FAO standard permissible level (mean = 4.8 μg/kg milk SD = 2.2). According to the author`s forecast there were several factors which could affect the residue in raw milk. These factors can be due to the number of automobile, population and number of industrial factories. However, there was no statistically significant relationship among these factors and the amount of lead in the samples. The authors found out that under investigation regions which have the highest residue of lead in the samples there are located on the areas with the most number of metallic mines.

Keywords: Heavy metals, Residues of lead, Milk, Food contamination

1. Introduction

The ongoing improvements in science and technology have led to an increase in the quality of life. This has resulted in an increased pollution and environmental problems. For instance, industrial pollution can create risks for human health (Çelik & Oehlenschläger, 2007). Many dangerous elements or compounds, such as dioxins, pesticides, metals, and metalloids, may end up along the food chain (Tajkarimi et al., 2008). Among the pollutants that enter the human food chain we can point out heavy metals such as lead which can unintentionally be present in milk. As milk and dairy products contain high nutritious element, they make up an important part of human diet worldwide and especially are consumed in infancy and childhood. There are studies which report that Lead residues in milk are concerned because milk is largely consumed by infants and children (Jeng, Lee & Lin, 1993; Lee et al., 2006 ; Tripathi et al., 2005). Many reports indicate the presence of heavy metals in milk, so we need to assess the levels of heavy metals in food (Caggiano et al., 2005; Fayed, Zidan, Abou-Arab & Magdoub 1995; Licata et al., 2004; Raghunath, Ripathi, Khandekar & Nambi, 1997). Some of these studies show relevance among industry growth, urbanization and mechanization of agricultural production with high levels of lead residue detectable in milk (Tajkarimi et al., 2008). Some of researches have focused on heavy metal and their adsorption by plants and the effect of soil pH on adsorption of these elements by plants and entrance into the human food chain (Moberg, Hallmans, Sjostrom & Wing, 1987). The main aim of this study is to investigate the amount of lead residue in raw milks in different regions of a western province (Hamadan) in Iran. In this study the effect of population, number of petrol consumer automobiles and industrial factories on the lead residue in milk has been studied.

+ Corresponding author. Tel.: +98 811 2511450; fax: +98 811 2512241
E-mail address: moradiava@gmail.com

2. Materials and Methods

2.1 Sampling Sites

Considering the ecological divisions and amount of milk production the province was divided into five regions. Table 1 shows the number of milk samples and the relevant data about sampling regions.

Table 1 The number of samples and sampling regions

Region	Number of samples	Factories	Population	Automobile
Asadabad	**8**	**45**	**105799**	**7198**
Toserkan	**5**	**49**	**110498**	**8564**
Malayer	**10**	**266**	**289570**	**25880**
Nahvand	**8**	**85**	**180658**	**12567**
Hamadan*	**17**	**1022**	**1013064**	**123268**

* Hamadan contains of Hamadan, Kabodarahng, Razan, Bahar and Famenin cities

2.2 Sampling

Frothy-eight raw milk container samples containing 500 ml were collected from tankers arriving at processing facilities in 5 areas which are shown in Table 1.The samples were collected in sterile polyethylene containers.

2.3 Preparation of the samples

All the samples were held at 4 ° C and arrived at the analytical laboratory within and after their collection. They were held at room temperature (20° C) for 48 hours to reduce the pH bellow 4.6 and separate the casein and fat. After separation the milk from serum , the samples were heated at 90 ° C for 5 minutes with 5 ml 65 wt% nitric acid (Merck _ KgaA,64271, Darmstadat.Germany). Then 20 ml de-ionized water was added to each sample and was centrifuged for 10 minutes at 1000 rpm.

2.4 Measurement of lead

In order to increase accuracy and eliminate the chemical digestion of the samples during this study, the Standard addition method was used and then the samples were injected into the graphite furnace atomic absorption spectrophotometer (Termo Electron Spectroscopy Ltd, Registration No. 441506 Camridge ,SOLAAR House). Measurement of lead was performed accordance the method was proposed by ümit Ay & Seda Karayünlü (Ay & Karayu¨ nlu, 2008).

2.5 Statistical analysis

Kolmogorov-smirnov test showed that sample data had normal distribution (p-value=0.265). We used one-way analysis of variance (ANOVA) and tukey HSD for detecting the differences among regions. We considered 0.05 or significance level.

3. Reasult and Discussion

Table 2 shows the number of samples, mean, standard deviation and %95 confidence interval of Lead within regions.

Figure 1 shows that the mean value of Lead residue in the samples which were collected from all regions were below the permissible level of lead in milk established by codex standard: 20 ng/ml (Codex, 2003).

The highest and the lowest values of Lead mean values were found to be from Malayer and Hamadan regions. The ANOVA also showed that there was statistical differences among regions ($P<0.01$). The tukey HSD confirmed that Lead in the Malyer region was higher than Asadabad

(p=0.02), Nahavand (p=0.002) and Hamadan (P<0.001) regions. In other words Malyer had higher Lead than other regions of province.

Table 2 Lead residues (μg/ L milk) in samples from various factories

Regions	Number of samples	Pb		95% Confidence interval	
		Mean	Standard deviation	Lower limit	Upper limit
Asadabad	**8**	4.1	**2.32**	**2.34**	**8.22**
Toserkan	**5**	**5**.5	**2.23**	**2.52**	**8.21**
Malayer	**10**	**8**.3	3.**14**	**2.31**	**14.57**
Nahvand	**8**	**3.1**	**1.58**	**2.39**	**7.02**
Hamedan*	**17**	**2**.8	1.**7**	**2.27**	**4.32**

* Hamadan contains of Hamadan, Kabodarahng, Razan, Bahar and Famenin cities

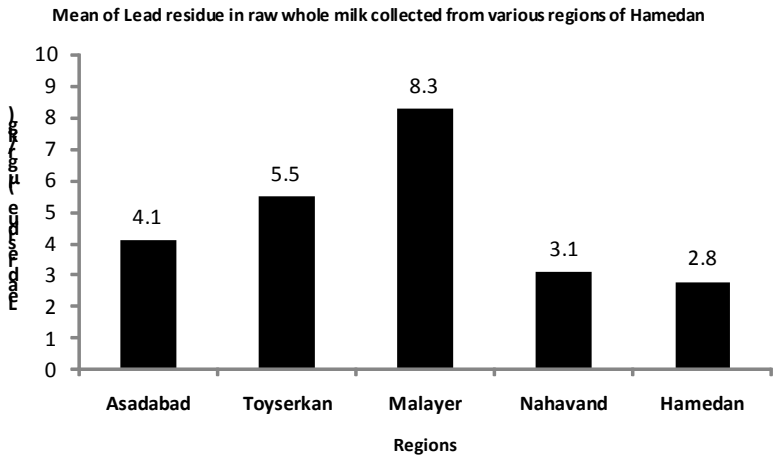

Fig. 1: Mean of Lead level residue in raw milk collected from various regions of Hamadan

Pearson correlation of Lead with population, number of cars and industrial factories were 0.374, 0.392, 0.331 respectively and those were not significantly difference with zero.

Considering the statistical analysis results, it can be concluded that there is no significant correlation between lead residues in raw milk with population, number of fuel consumer automobiles and the number of industrial factories in the regions. The lack of correlation between the lead residues in raw milk with number of fuel consumer automobiles can be explained to be the consequence of replacing the traditional lead containing fuel with a new lead free fuel in Iran. The fact that population of the regions cannot be correlated to the measured lead residue is expected to be the results of farness of urban areas from the farms. Additionally, a proper disposal procedure of the wastes has also helped to decrease the amount of residual lead which may present in the produced dairy products. Considering the effect of the number of industrial factories, it needs to be considered that the number of industrial factories with lead containing wastes are quite limited. This explains the weak correlation between the lead residue and the number of industrial factories which present in the region.

The obtained surprising result has asked for further investigation of the potential sources for the lead residue in the dairy products from the regions. The presence of lead containing mines and distribution of these mines around the regions under investigation are considered to be an important

parameter to be studied. In line with this, further investigation on the mines map in the Hamadan province were performed. It was found that there is a high density of metal mines in a hypothetical belt which has been shown in figure 2.

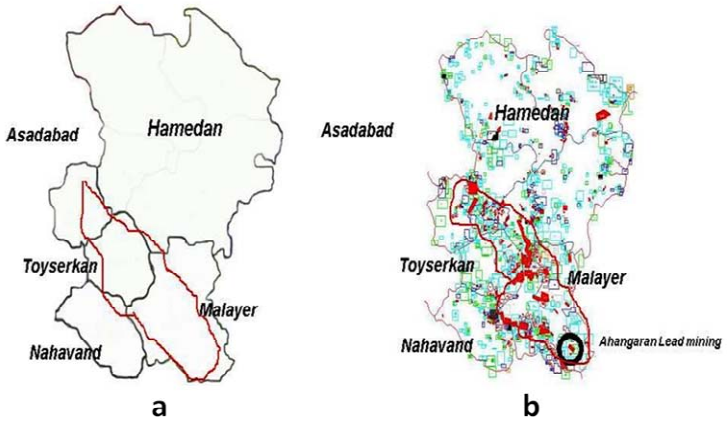

Fig. 2: a) Areas with high lead levels b) Areas with high numbers of metallic mineral mining

This region includes parts of Malayer, Toyserkan and Asadabad. The geographical location of places that have high Lead levels residues (Malayer, Tuyserkan and Asadabad) show that these areas are located on referred belt. Further studies revealed the presence of a lead mine located in Malayer (Ahangaran) .This reinforces the hypothesis that the high amount of lead in soil in this area can enter into the animal's milk. In earlier studies the effect of soil composition has been investigated. Even in some studies has been referred to the effect of soil pH on rate of Lead absorption (Moberg,, Hallmans, Sjostrom & Wing, 1987). Other researches have proven the heavy metals including lead, cadmium and thallium uptake by the tobacco from the soil. The tobacco grown in soil containing heavy metals lead to the production of cigarettes with high levels Lead and cadmium residues. Some factors such as soil pH can influence the uptake of metals by plants (Pappas et al., 2006).

4. Conclusions

In this study the effect of number of fuel consuming automobiles, population and number of industrial were investigated. The statistical analysis results showed that there exist no significant correlation between these parameters and the amount of lead residue. Further investigation on the existing mines around the investigated areas showed a strong correlation between the lead residue and the number and the type of the mines close to the areas under investigation.

5. Acknowledgement

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6. References

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