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Monitoring of Heavy Metals in Raw Milk of Vet Husbandries in Industrial Regions of Isfahan Province of Iran

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In this study the concentration of heavy metals in raw milk samples collected from 10 vet farms with 1000 number of vets near Isfahan city and pollutant industries like steel and iron factories, cement, tile and petroleum plants were determined using atomic absorption spectrometry after wet digestion method. According to the obtained results the mean concentrations that identified of Cu, Pb, Zn, Ni and Cd were 343.35, 1021, 2806.65, 275.15 and 192.27 μg/L, respectively.

Key Words: Heavy metals, Milk, Isfahan, Iran.

INTRODUCTION

Health and welfare of humans are affected of different things like industrialization and development of industries. While industrial factories with several production processes and use of raw and synthetic materials produce other unwanted harmful and toxic byproducts like wastewater, solid wastes and pollutant gases. Heavy metals are one of toxic materials that exist in many of these industrial byproducts and potentially can cause cancers and have adverse effects on physical and psychological life of humans. High toxicity of different concentration of these elements like Hg, Pb and Cd and As has identified[1].

Heavy metals can enter to human body through different ways. The most important one of them is entrance with food chain. Food consumption is the main way for the contact between human being and heavy metals such that in comparison to other methods, like skin contact and breathing, 90 % is allocated[2].

Milk and dairy products are one of most important components of human diet. Milk as a food that is extracted from breast can transport many external materials like pesticides, detergents, drugs, heavy metals and other environmental contaminations. Therefore, it is a risk for consumer health[3].

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So this is the best reason for measuring and analyzing amount of heavy metals in raw milk. Milk and dairy products used by child and babies in wide range[4]. Heavy metals enter to plants by absorption *via* their roots, also under special hydrological situation; polluted soils with these agents can pollute underground waters and aquifers. These kinds of pollutants are very harmful for vet farms and therefore human health especially in industrial regions. In these regions feed harvesting in farms is usual, therefore contamination enters to the plants and after consumption these plants contamination enter to human and animal bodies. In a recent research it is shown that contamination is transported from soil to plants and, therefore, with consumption of water and plants the contamination enters to body[5]. Cui *et al.*[6] reported their studies on heavy metals and their impacts on human health and measured concentration of heavy metals with sampling of plants, soils, urine and blood of people. Measuring of urine factors and renal failures showed that contaminated soils with heavy metals cause renal failures in people who live in contaminated regions. With entrance of these agents to vet's food chain they can accumulate in their body because of bioaccumulation property of these agents. So the concentration of them rises up in vet's body and their byproducts like raw milk and causes those being toxic. Moreover toxicity range of these agents depends on different factors like factories process and amount use of raw materials that have these agents[7]. The measurement of the amount of heavy metals in vet farms in industrial regions is very important. Researchers showed that concentration of heavy metals in contaminated places like places with high traffic and industrial region is higher than other places[8-10].

In this study, farms are selected that is nearby factory with high contamination. Therefore we can understand influence of industrial contamination on environment and so contamination of milk is produced in these regions (that provide milk for near province of Isfahan, also).

As Isfahan is one of the industrial provinces of Iran and according to above reasons this province selected for research. It has been already shown that concentration of Pb is higher in Isfahan compared to other regions of the Iran[11] and seems that its main reason is industrial conditions of that province. Existence of many industrial factories in Isfahan province and evidences of pollution of milk, as an important part of human diet, in industrial regions with heavy metal agents makes it necessary to measure the amount of these agents in vet farms. In this study using atomic absorption unit to measure the amount of Pb, Cd, Ni, Zn and Cu in 10 main vet farms of Isfahan province. This study measure the amount of pollution, with accurate precision, in one of the main industrial regions of Iran for the first time.

EXPERIMENTAL

Area of study: The province of Isfahan covers an area of *ca.* 105937 km and is located at equator 30°43′-34°27′ N and Greenwich 49°36′-55°31′ E.

Isfahan province is one of the biggest provinces of Iran and is one of the industrial poles. There are many factories that cause industrial pollutants in this region. 7098 Industrial units are working in this province and 932 units of them are in Isfahan city. Some of the main pollutant industries are steel and iron factories, petroleum plant, tile and cement factories, plastic and chemical factories with harmful byproducts such as wastewater, solid waste and polluted gases. In this study we analyze samples on 10 main vet farms (averagely with 1000 vets) in this province, near industrial factories.

Protocol: Samples have been taking of vet farms that they have same weather and same water and feed. For milk samples we used polyethylene container that washed with acid and hydrogen peroxide according to standards milk sampling protocol. Samples were collected in summer, autumn and winter of 2007-2008 (Aug and Sep 2007), (Oct, Nov and Dec 2008), (Jan and Feb 2008) from the milk reservoirs of vet farms which were equipped by mixer and their milk temperature was 4 ºC. The sealed samples were reserved on ice and were transferred to laboratory in less than 24 h. 20 mL of milk samples became dried by putting them in microwave in 70 ºC. After that we mixed the 0.3 g of the dried material with 6 mL, HNO (65 %) and 1 mL H_2O_2 (30 %). The liquid mixture was filtered and then diluted with deionized water. The amount of heavy metals was measured with using Unicam 919 AA spectrometer[7]. The recovery values for Pb, Cu, Zn, Ni and Cd were 91.6, 84.2, 119.6, 81.2 and 99.8 %, respectively. The experimental conditions adopted for each metal are reported in Table-1.

TABLE-1
WORKING CONDITIONS ADOPTED FOR DETERMINATION OF Pb, Cu, Zn, Ni AND Cd IN FAAS

Element	Wavelength (nm)	Band pass (mm)	Flame composition	Lamp current (mA)
Lead	217.0	0.2-0.5	Air-acetylene	10
Copper	324.8	0.2-0.5	Air-acetylene	5
Zinc	213.9	0.2-0.5	Air-acetylene	10
Nickel	232.0	0.0-0.2	Air-acetylene	15
Cadmium	228.8	0.2-0.5	Air-acetylene	8

RESULTS AND DISCUSSION

The results are presented in Table-2. Samples have been collected and analyzed in three periods with one month interval. Also vet farms named by digits from 1 to 10. According to these data zinc has the highest concentration, followed by lead, copper, nickel and cadmium. Now, there is no standard limit for many heavy metals in milk.

The results shows that Zn has higher and Cd has lower (N.D.) concentration in raw milk samples, also results shows that the concentration of as we look in table, other pollutants are high and the amount of heavy metals in samples are valuable,

TABLE-2
CONCENTRATION OF HEAVY METALS IN RAW MILK SAMPLES (μg/L)

Element	Minimum	Maximum	Mean ± SD	Number
Cu	75	520	343.35±24.22	30
Pb	255	1670	1021±79.03	30
Zn	1280	4170	2806.65± 31.37	30
Ni	ND	565	275.15±154.09	30
Cd	155	255	192.27± 10.8	30

which is related to metallic and nonmetallic industries that are near the vet farms, the pollutant of these factories can effects the ground water. The all measured level of Pb in present research (1021 μg/L) was higher than the Codex standard for Pb level in milk that is 0.02 mg/kg. The minimum level of this experiment is over than standard limit.

Permitted limit of Cd in milk is 0.002-0.005 mg/kg and 7 μg/kg of body weight or 0.42 mg for weigh 60 kg is allowable[12,13]. Tolerable daily intake for cadmium is 57-71 μg/day[14]. So our results about Cd are high for milk as a part of daily intake. Present Cd values were higher than other literature values[3,8,15]. There isn't permitted level for Zn in milk. Therefore results of Zn compared with same investigation. Zinc content of the raw milk samples varied from 1280 to 4170 μg/L. Zinc content in the samples higher than that reported by Licata *et al.*[9] and lower than that reported by Baldidni *et al.*[2] and Simsek *et al.*[13].

Simsek *et al.*[13] demonstrate that the average amounts Zn in milk samples collected from three different regions, an industrial region, a heavy traffic region and a rural region is 5010, 4490 and 3770 μg/L, respectively. It is necessary to know that tolerable daily intake for Zn is 65 mg/day[14]. The concentration of Cu ranged from 75 to 520 μg/L. Present Cu values is higher than those reported earlier[3,8,15]. Standard limit of Cu in many foods is 20 mg/kg in almost countries. Two mg/kg of this element in milk or butter reduces the shelf life.

Simsek *et al.*[13] demonstrate that level of Cu in milk from industrial region, heavy traffic region and rural region is 960, 580 and 390 μg/L, respectively. It is important to know that tolerable daily intake for Cu is 3000 μg/day[14].

There is no investigation about amount of Ni in milk. Environmental Protection Agency (EPA) stated that the maximum permitted level of Ni in day is 20 ng/kg therefore this amount of Ni for daily use milk, is high. Because there is some ways for entrance of this metal to human body (inhalation, skin contact and other foods).

In the study of Tajkarimi *et al.*[14] about samples of milk in some province of Iran demonstrate that especially in Isfahan, Tehran and west Azerbaijan regions have high contamination. The indicated regions seem to be more industrialized than other regions. These regions, especially Isfahan state are more important because of the new infant formula plant being established in this state. In this article recommended that more research in regard to lead contamination sources, to control the residue of heavy metals in milk, based on the pertinent FAO/WHO guideline, is necessary.

Research on production process of main industries in this region that most of them are chemical and metallic showed that many of their raw materials have these agents (heavy metals). High levels of these agents stay at their factories wastewater, solid waste and gases. It is the main reason for pollutant of milk in this region and this point shows that these factories do not have waste water treatment plant or inefficiency those or do not have suitable tools for filtering or control the polluted gases. Therefore heavy metals cause air and underground water pollutants in this region. These underground waters use for vets. The farm lands of this region that harvest feed for vet's feed, use of surface water and waters of deep wells for irrigation therefore the plants of these farms will be polluted. It means that a part of milk pollutant refer to it. Cui *et al.*[6] showed in their research that plants heavy metals pollution came from polluted soil and water.

Conclusion

According to present results awful condition of this region about heavy metals seem clearly so attention to this point and use of effective method for control of these pollutants in the first step, then decrease amount of them in next step are necessary. For example controlling of factories wastewater treatment plants and check the filtering systems for polluted gases monthly so monitoring of water and feed that use by vet farms and make the certain management system for produce pollutants in this region are necessary. This problem needs strategic and effective management of government and related organizations.

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