Diyala Journal of Medicine

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

# Review : The Health risks caused by heavy metals contamination of milk products

Moutaz A W Abdul Mounam (PhD)[1]
Department of Veterinary Public Health, College of Veterinary Medicine, University of Baghdad, Iraq

## Abstract

**Background:** Nowadays, a lot of food products are produced in large quantities in factories. Milk and its derivatives are among the most important and well-known things that may be mentioned. Due to the industrialization of many nations, heavy metals are regarded as the most significant contaminants and have an impact on the presence of these substances in milk and dairy products. The toxicity of different heavy metals on human health, as well as their sources in milk and other dairy products are all represented in the current review paper, which focuses on methodologies and regulatory constraints for heavy metals in milk. The study also examines the frequency of heavy metals detected in milk samples from Iraq, a few other nations in Asia, South America, the United States, and Africa, as well as a few instances from Europe. strategies to lessen the number of heavy metals in milk and its products or stop them from contaminating such foods.

**Conclusion:** Heavy metals have several health risks. Heavy metal exposure is especially prevalent in young age and the elderly due to milk drinking. Due to rapid industrialization and urbanization, law enforcement, and less restrictions, developing countries have high heavy metal levels in milk. Wealthy countries have less heavy metal pollution. Milk samples had significant lead and cadmium levels, requiring strict environmental and health protections.

**Keywords:** Pollution; Heavy Metals; Milk; Dairy Products; Food Safety

OPEN ACCESS

**Correspondence Address:** Moutaz A W Abdul Mounam
Department of Veterinary Public Health, College of Veterinary Medicine, University of Baghdad, Iraq
**Email:**moataz.ab@covm.uobaghdad.edu.iq
**Copyright:** ©Authors, 2023, College of Medicine, University of Diyala. This is an open access article under the CC BY 4.0 license (http://creativecommons.org/licenses/by/4.0/)
**Website**:
https://djm.uodiyala.edu.iq/index.php/djm

**Received:** 4 May 2023
**Accepted:** 30 May 2023
**Published:** 30 June 2023

## Introduction

The long-term and low-level pollution that exists in our environment, such as that which is present in the air we breathe, the water we drink, the food we consume, and other locations [1], is the root cause of the toxicity of heavy metals to both people and animals. A metal element is considered to be a heavy metal if it has both a low toxicity level and a reasonably high density. In every cubic meter of it, there is more than 6 grams of lead (Pb), mercury (Hg), copper (Cu), cadmium (Cd), zinc (Zn), arsenic (As), chromium (Cr), and iron (Fe) [2].

Due to the rise of industrial activity from the late 19$^{th}$ and early 20$^{th}$ centuries, heavy metal contamination has expanded globally [3]. Heavy metal deposits offer serious health dangers, hence it is crucial to accurately identify them. The brain system, renal failure, genetic mutations, various cancers, the immunological system, the cardiovascular system, and the reproductive system may all

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

suffer from heavy metal toxicity. [4] Lead causes anemia, illnesses of the central nervous system, damage to the kidneys, liver, heart, and blood vessels, as well as harm to the immunological system, genital system, digestive system, and blood vessels [5]. It also causes a variety of malignancies to develop.

As a primary carcinogen, cadmium is particularly dangerous to the prostate and lungs, where it promotes the growth of tumors. The kidneys, bones, lungs, liver, heart, and vascular systems are all negatively affected by cadmium. Cancers of the bone, brain, and blood, in addition to infections seen locally, are all brought on by nickel exposure. The toxic effects of nickel included growth retardation, reduced hematuria, and disruptions in cell biology [6]. Nickel also interfered with iron absorption. When they enter the circulation, nickel salts cause damage to the cardiovascular and pulmonary systems.

The level of toxicity is determined by a number of elements, including the route of administration, the volume of use, the solubility, the condition of metal oxidation, the maintenance percentage, the duration of application, the age, the sex, the frequency of use, the absorption rate, and the effectiveness of excretion mechanisms [7].

There are a variety of various routes and entry points through which heavy metals can make their way into the food chain. Wastewater, byproducts of industrial processes, dust, and heavy metals found in food are some examples of usual sources. In addition to this, contaminated soil has a significant influence. The primary purpose of this article is to draw attention to the presence of heavy metals in milk and its products as a high-consumption category in the food business. This is because there are many issues that can arise as a result of the possibility for these metals to be present in milk and the products that are derived from it.

Milk and its derivatives include a wide variety of components, many of which are essential and extremely fundamental. As an example, these metals function as cofactors in enzymes, which is one of their critical roles in several processes. The concentration of metals may be significantly changed by the manufacturing and packaging processes, despite the fact that the amount of metals in non-contaminated milk is remarkably precise. Additionally, a variety of contaminants that may harm cows and other environments, such as lead, cadmium, chromium, nickel, and cobalt, can adversely harm milk [8]. Heavy metals enter the plants through being absorbed through the roots. Contaminated soils have the potential to transfer these substances into aquifers and groundwater. The plant becomes poisoned as a consequence, and after being consumed, it enters the bodies of both people and animals [9].

According to recent studies, pollution may contaminate both water and plants by moving from the soil to the plant. As a result, their concentration increases in the bodies of their pets and in related items like raw milk, which causes poisoning [10]. Variables including plant practices, the number of raw materials utilized [11] Cadmium, lead, and mercury are exceedingly hazardous to people when used industrially and are seen as a serious danger to food. Animals utilize metals when they

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

graze on polluted pastures and consume contaminated food. In the case of cows, the transfer of nutrients to milk is highly unexpected.

Two typical airborne pollutants that are released into the atmosphere by several industrial operations are lead and cadmium. Due to the contamination of various industrial settings in the soil, water, food, and plants, these metals reach the food chain [12]. Lead and cadmium levels in milk and dairy products are a particular concern since these food groups are mostly eaten by newborns and young children. Lead and cadmium are predominantly consumed via food in the general population (food accounts for 90% of all cadmium in non-smokers), Lead and cadmium have been connected to a number of diseases that impact the kidneys, skeletal system, nervous system, blood [13]. Because of fertilizer, atmospheric effects, and erosive natural weathering, they are present in the soil. There are several methods to get rid of animal waste, including via milk contamination, urine, and feces. Additionally, equipment, utensils, and food-processing containers, as well as (ii) cooking, storing, and packing all have the ability to transmit contamination, might cause metal stains in milk to come from other foods that we consume [14].

## Heavy metals Toxicity

Metal toxicity refers to the harmful effects on the body that may occur when an excessive quantity of a certain metal is taken. Metal poisoning via milk is a more significant concern than through other meals because to the increased intake of milk by the most susceptible age groups, namely infants and the elderly, which varies between 30-150 kg/capita/year. This is due to the fact that milk is consumed between 30-150 kg/capita/year. Ni, Co, and Cu are claimed to give some benefits for human health, in contrast to Pb, Cd, and Hg, which have no documented positive effects on human health. On the other hand, these drugs could be harmful to one's health if excessive amounts of them are ingested. Intakes cannot be differentiated from one another with any degree of precision at this time. amounts for hazardous and necessary health effects of mineral elements [15].

The quantity of heavy metals in animal milk, such as lead and cadmium, is said to grow as the age of the animal does, according to certain sources. Metal toxicity is determined by a number of factors, including the amount of the metal consumed, the age and gender of the person who is exposed to it, the state of the metal [16].

Lead is one of the heavy metals that may be found in food that is considered to be the most dangerous. Because of rising rates of urbanization and industrialization, the nation's food supply is becoming more tainted with lead [17]. A lack of essential elements in the diet, such as zinc, calcium, and selenium (Se), is known to enhance lead absorption in humans [18]. The rate of lead absorption in children is about forty percent greater than that of lead absorption in adults. Lead poisoning primarily affects the nervous system, making it a threat to children and young adults, whose bodies are still maturing and forming at an accelerated rate.

According to the findings of the International Agency for Research on Cancer (IARC), lead has been classified as a category 2 A probable human carcinogen.

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

Anemia, hyperactivity, and a diminished immune system are just some of the numerous adverse impacts that lead may have on one's health [19].

Ni is a trace element that plays a significant role in maintaining human health. On the other hand, consuming an excessive amount of Ni compounds may also result in neurotoxicity, oxidative stress, and harm to the male reproductive system.

**Table (1):** Particular source of heavy metals found in milk

| heavy metals | Sources | References |
|---|---|---|
| Lead(Pb) | PVC pipes are utilized in jewelry, lunchboxes, batteries, paints, agricultural instruments, and sanitary products, air pollution | [18] |
| Cadmium(Cd) | pigments, photovoltaic cells, electroplated components, batteries, paints, plastics, photoconductors, synthetic rubber, and engraving and photographic processes. | [18] |
| Arsenic(As) | Water, soil, herbicides, insects, sanitizers for the environment, metal alloys, etc. | [19] |
| Mercury(Hg) | soil, water, fertilizers, caustic soda, batteries, smelters, coal, and volcanoes | [19] |
| Copper(Cu) | solar panels, tanning beds, fertilizers, etc. | [19] |
| Nickel(Ni) | Soil, air, water, pans & pots etc. | [18] |
| Cobalt(Co) | Tools made of metal, electrodeposited alloys, varnishes, printing inks, oil-based paints, and other materials burned in the air commercially. | [19] |

## Heavy metals in milk sources

Heavy metals are often found in the environment, and since crops are increasingly being irrigated with untreated wastewater from sewage treatment plants and industrial effluents, the levels of these metals in the food supply are steadily rising. It is believed that animals are efficient metal filters; as a result, trace levels of metals may sometimes be found in milk while passing through the bodies of animals [20]. Metals have the potential to contaminate cow milk due to the machinery and tools that are used in the processing and distribution of milk. According to the study, processed milk has been discovered to contain a greater concentration of heavy metals than raw milk.

## Heavy metal contamination of milk across the world

Metals have been turning up more often in food items over the course of the last several decades. This is most likely the result of increasing industrial activities, the creation of more kinds of processed meals utilizing many machinery, and the transportation of food over vast distances, all of which enhance the likelihood that metallic pollutants may be introduced into food items at various stages. Although there have been fewer reports of mercury and lead contamination in milk and milk products, there have been numerous reports from different parts of the world showing that milk and milk products contain significant amounts of lead and cadmium. It is essential to keep in mind that the findings of metal contamination in milk as well as the milk products described below are the results of

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

several studies carried out by researchers from all over the world using a variety of analytical techniques with differing limits of detection. It is for this reason that it is so important to remember this fact. The following information is provided only for the purpose of providing a broad idea of the quantities of various metallic contaminants that may be found in milk and milk products sourced from various locations of the world.

## Lead (Pb) content in milk

ICP - OES :Inductively coupled plasma optical emission spectroscopy; GF-AAS: graphite furnace atomic absorption; FAAS : Flame Atomic Absorption Spectrophotometer Lead, a widespread environmental contaminant, has been identified in food samples gathered from a number of different countries. Renal failure and damage to the central nervous system are two of the worst effects that lead exposure may have on a person's body. Lead exposure also has other severe effects. Table 2 displays the percentage of instances when lead was found in milk samples collected from various countries. Lead was identified as the heavy metal that was detected in milk samples the majority of the time. The researchers observed that the average concentration of it in milk samples collected in various nations ranged from 0.002 to 3.152 mg/ml. According to the findings in Table 2, consuming milk can lead to dangerous levels of lead in the body. [35] Research found that drinking polluted milk accounted for 72% of the average daily consumption of lead that Brazilians received from all of their meals. Milk samples from underdeveloped nations, such as Egypt, Serbia, and Poland, had lead at a level of one hundred percent. contamination that is higher than the allowed level. On the other hand, it was discovered that the levels of lead contamination in milk were significantly lower in rich nations compared to impoverished nations. This was the case in every single comparison that was made. This was demonstrated to be the case in part as a result of the more effective application of rules in countries with a higher standard of living. In addition, the methods of detection that are utilized in underdeveloped nations have a lower degree of precision when compared to those that are utilized in developed nations [21].

## Content of cadmium (Cd) in milk

The kidneys, bones, and liver are the primary organs that are most harmed by the very toxic metal cd [23]. The reports of Cd contamination in milk samples from numerous countries are included in Table 3 and span the years 2012 through 2018. The amounts of Cd that were discovered to be present in milk samples from a variety of countries ranged from 0.002-0.250 mg/ml on average. One hundred percent of the milk samples taken from needy countries such as Pakistan, Nigeria, the Philippines, Hungary, and Egypt showed levels of Cd contamination that were above the permissible limit. This raises the likelihood of catastrophic liver and kidney disorders. In contrast, more industrialized nations such as Spain, Croatia, and Korea demonstrated either no contamination of Cd exceeding the permitted level or very little contamination, indicating that controls had been effectively applied in these countries.

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

**Table (2):** Pb prevalence in milk samples from several nations between 2012 and 2018

| Study Years | Country | Studied Sample | Test Method | Researchers |
|---|---|---|---|---|
| 2018 | Mexico | cow's milk and cheese produced | ICP - OES | [35] |
| 2017 | Brazil | raw milk | GF-AAS | [22] |
| 2016 | Iran | Raw milk | FAAS | [21] |
| 2015 | Pakistan | Milk | AAS | [23] |
| 2014 | Egypt | Milk | FAAS | [36] |
| 2013 | Spain | Organic milk | ICP-MS | [23] |
| 2012 | Palestine | cow's milk | GF-AAS | [35] |
| ICP - OES :Inductively coupled plasma optical emission spectroscopy; GF-AAS: graphite furnace atomic absorption; FAAS : Flame Atomic Absorption Spectrophotometer | | | | |

## Content of nickel (Ni) in milk Table (4)

Nickel (Ni) is a metal that is used in a few different manufacturing processes and has the potential to contaminate food. Ni is another component that is necessary for human health, however it is important to note that it may be toxic in high enough doses. There is now no clear legal limit for the amount of nickel (Ni) that may be found in milk; nonetheless, researchers continue to pay attention to this fact despite the fact that Ni contamination in milk has the potential to create health problems [23].The recommended range for the highest possible daily intake of nickel from food sources is between 0.3 and 1 mg/ml. The levels of nickel contamination in milk samples were found to be lowest in France, Spain, and Korea, all of which are more industrialized countries.

## Content of cobalt (Co ) in milk Table (5)

Co is a component of vitamin B12 and contributes to the regular functioning of the pancreas as well as other body systems. However, when ingested in large quantities, co becomes hazardous to a person's health. As indicated in Table 5, there is very little information available about the prevalence of Co in milk.

## Content of copper (Cu) in milk: Table (6)

Humans need the element copper in order to develop normally, despite the fact that consuming an excessive amount of it has been associated to negative effects on health, most notably problems with the digestive system. Microelements such as copper (Cu), iron, selenium (Se), and zinc (Zn) are recognized as being essential for a variety of biological processes.Human growth, A necessary trace element, copper is a regular component of animal tissues and fluids found within the body. It plays an essential role in the production of hemoglobin as well as other enzymes. Toxic amounts of copper may be the root cause of Wilson's disease and Menkes' disease, both of which are characterized by an abnormal accumulation of copper in the organs including the liver, brain, kidneys, and cornea. Copper is a

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

fascinating and required trace element micronutrient.

**Table (3):** Cd prevalence in milk samples from several nations between 2012 and 2018

| Country | Studied Sample | Test Method | Researchers |
|---|---|---|---|
| Egypt | Raw Cow Milk | FAAS | [23] |
| Iran | Milk | FAAS | [23] |
| Bangladesh | Cow milk | FASS | [35] |
| Egypt | Raw milk | FAAS | [24] |
| Serbia | milk fermented | Potentiometric | [28] |
| Poland | Bovine milk | ICP-MS | [23] |
| Hungary | Ewes milk | ICP-MS | [23] |

## Content of copper (Cu) in milk Table (4)

Humans need the element copper in order to develop normally, despite the fact that consuming an excessive amount of it has been associated to negative effects on health, most notably problems with the digestive system. It is common knowledge that copper (Cu), iron, selenium (Se), and zinc (Zn) are among the essential trace elements for human development. Copper, which is an essential trace metal, is found in the tissues and fluids of living organisms on a consistent basis. It plays an essential role in the production of hemoglobin as well as other enzymes. Toxic amounts of copper may be the root cause of Wilson's disease and Menkes' disease. Wilson's disease is characterized by an abnormal accumulation of copper in the liver, brain, kidneys, and cornea. Menkes' disease affects the cornea. Copper is a fascinating and required trace element micronutrient. Both a lack of consumption and an excess of it may bring on a variety of clinical symptoms, with the hematological system, the bone, the liver, and the brain being the primary targets [25].

**Table (4):** (Ni) prevalence in milk samples from several nations between 2012 and 2018

| Country | Studied Sample | Test Method | Researchers |
|---|---|---|---|
| Egypt | Raw milk | FAAS | [23] |
| Bangladesh | cow's milk | GF-AAS | [35] |
| Bangladesh | cow's milk | ICP-MS | [35] |
| Iran | Cow milk | FAAS | [20] |
| Korea | Commercial milk | ICP-MS | [8] |
| Spain | Organic and Commercial milk | ICP-MS | [5] |
| France | Raw milk | ICP-MS | [9] |

## Effects heavy metals on human health

A variety of different heavy metals are considered to be dangerous metals because of the negative impact that they have on human

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

health when taken in excessive amounts. Heavy metals are harmful to human health due to the fact that they have a propensity to accumulate in biological systems and that they are pervasive in nature. The significance of heavy metals on one's health allows for the possibility of categorizing them into four distinct groups. (1) Important metals include copper, zinc, cobalt, chromium, manganese, and iron. (2) metals that aren't required, such barium, aluminum, lithium, and zirconium (3) metals with a lower potential for danger, such as tin and aluminum, and (4) elements with a high potential for harm, such as lead, cadmium, and mercury. Heavy metals may cause damage to human organs, and particular types of heavy metals have been linked to an increased risk of cancer in humans. The following is a discussion of the adverse effects that several heavy metals have on human health:

(a)Lead: People in the general population are exposed to lead via the air and the food they eat. Children are more susceptible to the neurotoxic effects of lead exposure, which may occur even at low exposure levels [24], because of their quick gastrointestinal absorption and porous blood brain barrier. This makes children especially sensitive to the neurotoxic effects of lead exposure. The potentially harmful effects of lead may be broken down into two categories: direct interference with the activity of certain enzymes and displacement of essential metal ions from metalloenzymes. It is believed that the kidney and the liver are particularly vulnerable to the negative effects of lead exposure [25].

(b) Copper: Copper is required for the formation of enzymes in human bodies and is an essential trace element. Copper at very high doses may induce severe mucosal irritation, corrosion, extensive capillary damage, liver and kidney damage, irritation of the central nervous system, and depression [26]. Copper can also cause liver and kidney damage in lower doses. Copper poisoning is characterized by a number of symptoms, including blue-green diarrhea, acute hemolysis, and impaired renal function. Wilson's disease is an inborn metabolic mistake that inhibits the capacity of the liver to eliminate copper into the bile. This causes copper to build up in the tissues of the liver, brain, kidney, and cornea, which in turn causes damage to those organs. Wilson's disease is an inherited condition. The hereditary inability to properly incorporate copper (Cu) into apocerplasmin in order to produce ceruloplasmin is the root cause of Wilson's illness [27].

(c) Cadmium: The primary sources of cadmium include, in addition to drinking water, eating certain foods and smoking cigarettes. Cancer and cardiovascular disease may both be caused by chronic exposure to low levels. It is well knowledge that this has a significant impact on the renal tubules' capacity to reabsorb sugar, protein, and amino acids. Osteomalacia and bone fractures were seen in postmenopausal women in the polluted Jintsu valley in Japan [28].

(d) Nickel: The average person takes in around 300 g of nickel per day via their diet.Nickel is known to trigger a variety of adverse health effects, including contact dermatitis, allergic reactions, nephrotoxicity, and Embryotoxicity [29].Nickel sensitization may be caused by exposure to nickel from a

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

variety of sources, including coins, jewelry, watchcases, clothes, and fasteners. Nickel sensitization affects the whole population. It is the cause of conjunctivitis, eocinophilic pheumonites, asthma, and local or systemic responses to prostheses containing nickel, such as dental inlays, joint replacements, pins, heart valve replacements, and pacemaker wires .

(E) cobalt: Studies on both animals and humans have been conducted to investigate the toxicity of cobalt as well as the health hazards that are linked with it. Previous studies often focused their attention on a single exposure situation, discussing the Co ingestion routes, toxicity mechanisms, and clinical consequences related with that context [29]. Understanding how different co-exposure circumstances influence the functioning of a certain physiological system [30]. Co may be found in varying concentrations in literally thousands of different foods. The foods with the greatest mean concentrations of cobalt were found to include chocolate, butter, coffee, seafood, almonds, green leafy vegetables, and fresh cereals [31]. Because individuals who are iron deficient have a greater rate of cobalt absorption, the processes involved in the gastro-intestinal absorption of cobalt are comparable to those involved in the absorption of iron. After absorption, the majority of co is sent to the serum, whole blood, liver, kidneys, heart, and spleen (regardless of the mechanism by which it was obtained). [32] Research has shown that the pancreas, the brain, the lymphatic system, hair, and the bones all have lower amounts. The kidneys are responsible for excreting the vast majority of the cobalt that has been consumed by the body.

**Table (5):** (Co) prevalence in milk samples from several nations between 2012 and 2018

| Country | Studied Sample | Test Method | Researchers |
|---|---|---|---|
| Iraq | cow milk | GBC SensAA | [33] |
| Tanzania | cow's milk | FAAS | [35] |
| Italy | Sheep milk | ICP-MS | [22] |
| Pakistan | Raw milk | FAAS | [17] |
| Korea | Commercial milk | ICP-MS | [17] |
| Spain | Organic milk | ICP-MS | [18] |
| France | Milk | ICP-MS | [18] |

**Table (6):** (Cu) prevalence in milk samples from several nations between 2012 and 2018

| Country | Studied Sample | Test Method | Researchers |
|---|---|---|---|
| Iraq | buffalo's **milk** | GBC SensAA | [35] |
| Pakistan | milk | FAAS | [35] |
| Iran | Raw milk | Voltametric method | [20] |
| Ethiopia | Cow milk | FAAS | [23] |
| Ethiopia | Bovine milk | FAAS | [23] |
| Poland | Bovine milk | ICP-MS | [23] |
| Egypt | Bovine milk | FAAS | [23] |

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

## Conclusions

Heavy metals have been connected to a broad range of negative effects on both the health and well-being of humans. Because children and the elderly consume more milk than adults do on average, they are more susceptible to the adverse effects of heavy metal contamination. Researchers have shown that milk in developing nations has significant quantities of heavy metals as a result of fast industrialization and urbanization, laxer enforcement of rules, and less stringent monitoring. All of these factors contribute to a less stringent environment for protecting public health. On the other hand, the findings of the study showed that nations with higher levels of income had a lower incidence of problems connected with heavy metal pollution. As a result of the very high levels of lead and cadmium that were discovered in milk samples, strict efforts are necessary in order to protect the environment and maintain public health.

## Recommendations

In the upcoming years, more people are anticipated to consume milk and milk-related goods. Additionally, implementing food laws in full compliance with their letter and spirit at every stage of milk handling and processing may help keep heavy metal levels within acceptable ranges.

**Source of funding:** The current study was funded by our charges with no any other funding sources elsewhere.

**Ethical clearance:** Ethical approval was obtained from the College of Medicine / University of Diyala ethical committee for this study.

**Conflict of interest:** Nil

## References

[1] Ghaderpoori, M., Kamarehie, B., Jafari, A., Alinejad, A. A., Hashempour, Y., Saghi, M. H., ... & Ferrante, M. (2020). Health risk assessment of heavy metals in cosmetic products sold in Iran: the Monte Carlo simulation. *Environmental Science and Pollution Research*, *27*, 7588-7595.

[2] Fatahi, A., Ziarati, P., Jafarpour, A., & Cruz-Rodriguez, L. (2020). Heavy metal removal from edible leafy vegetable by low cost novel adsorbents: Hazelnut Shell. *J Sci Discov*, *4*(2).

[3] Alimardan, M., Ziarati, P., & Jafari Moghadam, R. (2016). Adsorption of heavy metal ions from contaminated soil by B. integerrima barberry. *Biomedical & Pharmacology Journal*, *9*(1), 169-75.

[4] Aazami, J., Moradpour, H., & KianiMehr, N. (2017). A Review of Biotic Indices for Heavy Metals in Polluted Environment. *Human & Environment*, *15*(1), 13-24.

[5] Ziarati, P., Moslehishad, M., & Mohammad-Makki, F. M. (2016). Novel adsorption method for contaminated water by wild endemic almond: Amygdalus scoparia. *Biosciences biotechnology research asia*, *13*(1), 147-153.

[6] MASOUD, H. R. E., & DANESH, P. M. (2009). Measuring the lead, arsenic, cupper, zinc, selenum, sodium, potassium, nickel, and magnesium ions in black tea.

[7] Bilandžić, N., Sedak, M., Đokić, M., Božić, Đ., Solomun Kolanović, B., & Varenina, I. (2014). Trace elements content in cheese, cream and butter. *Mljekarstvo: časopis za unaprjeđenje proizvodnje i prerade mlijeka*, *64*(3), 150-158.

[8] Lahiji, F. A. S., Ziarati, P., & Jafarpour, A. (2016). Potential of Rice

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

Husk Biosorption in Reduction of Heavy Metals from Oryza sativa Rice. *Biosciences Biotechnology Research Asia*, *13*(4), 2231-2237.

[9] Gholizadeh, E., & Ziarati, P. (2016). Remediation of contaminated rice farmlands soil and Oryza sativa rice product by apple pomace as adsorbent. *Biosciences Biotechnology Research Asia*, *13*(4), 2245.

[10] Gholizadeh, E., & Ziarati, P. (2016). Remediation of contaminated rice farmlands soil and Oryza sativa rice product by apple pomace as adsorbent. *Biosciences Biotechnology Research Asia*, *13*(4), 2245.

[11] Razafsha, A., & Ziarati, P. (2016). Removal of heavy metals from Oryza sativa rice by sour lemon peel as bio-sorbent. *Biomedical and Pharmacology Journal*, *9*(2), 543-553.

[12] Konikowska, K., & Mandecka, A. (2018). Trace elements in human nutrition. *Recent Advances in Trace Elements*, *10*, 9781119133780.

[13] Jurowski, K., Krośniak, M., Fołta, M., Tatar, B., Cole, M., & Piekoszewski, W. (2019). The analysis of Cu, Mn and Zn content in prescription food for special medical purposes and modified milk products for newborns and infants available in

[14] Htwe, K. M., Ko, W., & Naing, T. H (2012). *Estimation of heavy metals pollution in farm soil and nearby coal mine soil* (Doctoral dissertation, MERAL Portal).

[15] Cempel, M., & Nikel, G. J. P. J. S. (2006). Nickel: A review of its sources and environmental toxicology. *Polish Journal of Environmental Studies*, *15*(3).

[16] Ismail, A., Riaz, M., Akhtar, S., Goodwill, J. E., & Sun, J. (2019). Heavy metals in milk: global prevalence and health risk assessment. *Toxin Reviews*, *38*(1), 1-12.

[17] Muhib, M. I., Chowdhury, M. A. Z., Easha, N. J., Rahman, M. M., Shammi, M., Fardous, Z., ... & Alam, M. K. (2016). Investigation of heavy metal contents in cow milk samples from area of Dhaka, Bangladesh. *International journal of food contamination*, *3*(1), 1-10.

[18] Iqbal, Z., Abbas, F., Ibrahim, M., Qureshi, T. I., Gul, M., & Mahmood, A. (2020). Human health risk assessment of heavy metals in raw milk of buffalo feeding at wastewater-irrigated agricultural farms in Pakistan. *Environmental Science and Pollution Research*, *27*(23), 29567-29579.

[19] Santos, E. E., Lauria, D. C., & Da Silveira, C. P. (2004). Assessment of daily intake of trace elements due to consumption of foodstuffs by adult inhabitants of Rio de Janeiro city. *Science of the total environment*, *327*(1-3), 69-79.

[20] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, World Health Organization, & International Agency for Research on Cancer. (2006). *Inorganic and organic lead compounds*. IARC.

[21] Anetor, J. I. (2012). Rising environmental cadmium levels in developing countries: threat to genome stability and health. *Nigerian journal of physiological sciences*, *27*(2), 103-115.

[22] Muhib, M. I., Chowdhury, M. A. Z., Easha, N. J., Rahman, M. M., Shammi, M.,

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

Fardous, Z., ... & Alam, M. K. (2016). Investigation of heavy metal contents in cow milk samples from area of Dhaka, Bangladesh. *International journal of food contamination*, *3*(1), 1-10.

[23] Mahmoudi, R., Kazeminia, M., Kaboudari, A., Pir-Mahalleh, S., & Pakbin, B. (2017). A review of the importance, detection and controlling of heavy metal in milk and dairy products. *Malaysian Journal of Science*, *36*(1), 1-16.

[24] Suturović, Z., Kravić, S., Milanović, S., Đurović, A., & Brezo, T. (2014). Determination of heavy metals in milk and fermented milk products by potentiometric stripping analysis with constant inverse current in the analytical step. *Food chemistry*, *155*, 120-125.\

[25] Pilarczyk, R., Wójcik, J., Czerniak, P., Sablik, P., Pilarczyk, B., & Tomza-Marciniak, A. (2013). Concentrations of toxic heavy metals and trace elements in raw milk of Simmental and Holstein-Friesian cows from organic farm. *Environmental monitoring and assessment*, *185*(10), 8383-8392.

[26] Póti, P., Pajor, F., Bodnár, Á., & Bárdos, L. (2021). Accumulation of some heavy metals (Pd, Cd and Cr) in milk of grazing sheep in north-east Hungary. *Journal of microbiology, biotechnology and food sciences*, *2021*, 389-394.

[27] Russell, R., Beard, J. L., Cousins, R. J., Dunn, J. T., Ferland, G., Hambidge, K., ... & Yates, A. A. (2001). Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. *A report of the panel on micronutrients, subcommittees on upper reference levels of nutrients and of interpretation and uses of dietary reference intakes, and the standing committee on the scientific evaluation of dietary reference intakes food and nutrition board Institute of medicine*, 797.

[28] Rehman, K., Fatima, F., Waheed, I., & Akash, M. S. H. (2018). Prevalence of exposure of heavy metals and their impact on health consequences. *Journal of cellular biochemistry*, *119*(1), 157-184.

[29] Kabir, A., Khan, K., Khan, I. H., Jubair, T., & Jhahan, E. (2017). A study of heavy metal presence in cow milk of different dairy farms near Karnafuli paper mills, Chittagong, Bangladesh. *Am J Eng Res*, *6*(9), 329-33.

[30] Shaheen, N., Ahmed, M., Islam, M., Habibullah-Al-Mamun, M., Tukun, A. B., Islam, S., & MA Rahim, A. T. (2016). Health risk assessment of trace elements via dietary intake of 'non-piscine protein source'foodstuffs (meat, milk and egg) in Bangladesh. *Environmental science and pollution research*, *23*(8), 7794-7806.

[31] Arianejad, M., Alizadeh, M., Bahrami, A., & Arefhoseini, S. R. (2015). Levels of some heavy metals in raw cow's milk from selected milk production sites in Iran: is there any health concern?. *Health promotion perspectives*, *5*(3), 176.

[32] Khan, N., Jeong, I. S., Hwang, I. M., Kim, J. S., Choi, S. H., Nho, E. Y., ... & Kim, K. S. (2014). Analysis of minor and trace elements in milk and yogurts by inductively coupled plasma-mass spectrometry (ICP-MS). *Food chemistry*, *147*, 220-224.

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

[33] No€el, L., et al., 2012. Li, Cr, Mn, Co, Ni, Cu, Zn, Se and Mo levels in food stuffs from the Second French TDS. Food chemistry, 132, 1502–1513.

[34] Al-Naemi, H. S. (2018). Residual Distribution Of Lead, Chromium And Cobalt In Dairy Products And Their By-Products Manufactured From Milk Spiked With These METALS. *Basrah Journal of Veterinary Research.*, *17*(1).

[35] Ismail, A., Riaz, M., Akhtar, S., Ismail, T., Ahmad, Z., & Hashmi, M. S. (2015). Estimated daily intake and health risk of heavy metals by consumption of milk. *Food Additives & Contaminants: Part B*, *8*(4), 260-265.

Diyala Journal of Medicine

Review RESEARCH
Published: 30 June 2023
Doi: 10.26505/DJM.24027530504

# مراجعة: المشاكل الصحية الناتجة عن تلوث منتجات الحليب بالمعادن الثقيلة

معتز عبد الواحد عبد المنعم [1]

## الملخص

**خلفية الدراسة:** في الوقت الحاضر ، يتم إنتاج الكثير من المنتجات الغذائية بكميات كبيرة في المصانع. يعتبر الحليب ومشتقاته من أهم وأشهر الامور التي يمكن ذكرها. نظرًا للتصنيع في العديد من الدول ، تعتبر المعادن الثقيلة من الملوثات الأكثر أهمية ولها تأثير على وجود هذه المواد في الحليب ومنتجات الألبان. يتم تمثيل سمية المعادن الثقيلة المختلفة على صحة الإنسان ، وكذلك مصادرها في الحليب ومنتجات الألبان الأخرى في ورقة المراجعة الحالية ، والتي تركز على المنهجيات والقيود التنظيمية للمعادن الثقيلة في الحليب. تبحث الدراسة أيضًا تواجد المعادن الثقيلة المكتشفة في عينات الحليب من العراق ، وعدد قليل من الدول الأخرى في آسيا ، وأمريكا الجنوبية ، والولايات المتحدة ، وأفريقيا ، بالإضافة إلى حالات قليلة في أوروبا. واستراتيجيات لتقليل عدد المعادن الثقيلة في الحليب ومنتجاته أو منعها من تلويث مثل هذه الأطعمة.

**الاستنتاجات:** المعادن الثقيلة لها العديد من المخاطر الصحية. ينتشر التعرض للمعادن الثقيلة بشكل خاص بين الشباب وكبار السن بسبب تناول الحليب وبسبب التصنيع السريع والتحضير وضعف تنفيذ القانون ، وتتميز البلدان النامية بمستويات عالية من التلوث بالمعادن الثقيلة في الحليب. الدول الغنية لديها نسبة أقل من التلوث بالمعادن الثقيلة. وعينات الحليب احتوت على مستويات عالية من الرصاص والكادميوم ، مما يتطلب حماية بيئية وصحية صارمة.

**الكلمات المفتاحية:** التلوث ، المعادن الثقيلة ، الحليب، منتجات الالبان ، سلامة الغذاء

**البريد الالكتروني:** moataz.ab@covm.uobaghdad.edu.iq

**تاريخ استلام البحث:** 4 آيار 2023

**تاريخ قبول البحث:** 30 آيار 2023

---

[1] كلية الطب البيطري- جامعة بغداد - بغداد – العراق