

Health Risks Linked to Heavy Metal Contamination in Buffalo and Cow Milk in PeshawarDr. Zahin Anjum^{*1}, Dr. Shaista Ali², Dr. Razia Khan³, Maria Khan⁴, Faryal Yousaf⁵

Original Article

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Abstract

Nowadays, lot of food products are manufactured in industrial settings. Milk is among the most important and widely recognized thing that may be addressed. The most major pollutants, known as heavy metals, affect the composition of dairy and milk products. The current study estimates the effects of selected heavy metals on human health as well as their concentration ranges in cattle (Buffalo, Cow) milk, with a focus on heavy metals in milk procedures and regulatory limits. The collected data was analyzed in statistical software package SPSS. In order to check the significant differences among the samples LSD test was applied along with one-way ANOVA. According to the localities the most contaminate samples were listed from the Ring Road (0.8945) as compared to others ($p < 0.05$) whereas, the minimum contamination was recorded in the milk samples collected from Sadar Bazar (0.2796). Concentration of selected metals in all samples exceeded the maximum permissible limit established by codex standard. The values of zinc were significant ($P < 0.05$). Hazard to target When the quotient number is larger than 1, it suggests that there are certain health hazards related with consumption of milk.

Keywords: Milk, Peshawar, Heavy metal contamination, Health risk Assessment.

Introduction

Milk is the fluid released by mammary glands in animals, including humans. Several important minerals, such as calcium, protein, and vitamin D, are abundant in milk. Many consider it to be an essential component of a balanced diet. Cows, sheep, camels, goats, and many more animals are among the sources of milk and milk products. Soy, almond, flax, coconut, and hemp milk are among the milk substitutes (Ware Megan, 2019).

Heavy metals are compounds that can affect human wellbeing and unsafe for human health. For the most part, people are uncovered to these metals by ingestion (drinking or eating) or inward breath (Sabine martin et al., 2009). The commonly known carcinogens are recognized and there is constant exposure to heavy metals which leads to health hazards. (Manavi Yadav et al., 2019). The heavy metals can be comprehensively characterized into two classifications:

Essential and non-essential heavy metals.

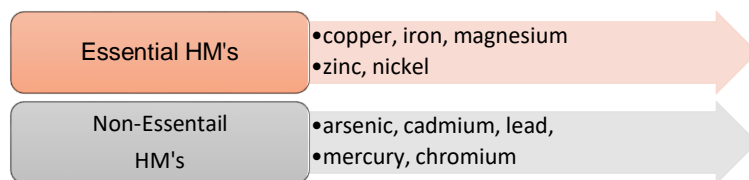


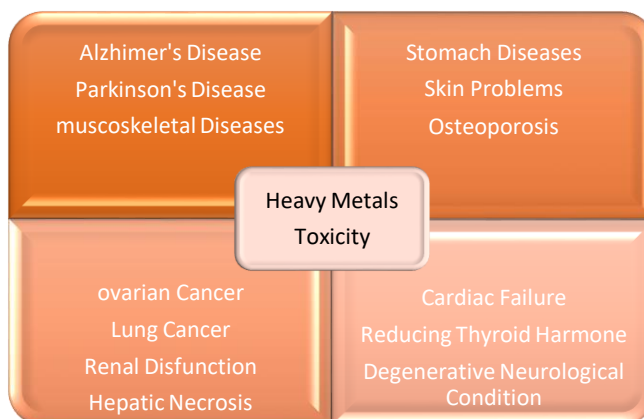
Table no 1. Maximum Permissible level (MPL) in mg/kg

Metals	MPL mg/kg	Reference
Copper (Cu)	0.05-0.5	FAO/WHO (2000)
Iron (Fe)	0.01	FAO (1982)
Lead (Pb)	0.1	FAO (1983)
Cadmium (Cd)	0.5	FAO (1983)
Mercury (Hg)	0.1	FAO (1983)
Zinc (Zn)	0.3-1.0	FAO (1982)
Chromium (Cr)	0.05	Codex Alimentarius Commission, 1994

The Fundamental risks to human wellbeing from heavy metals are connected to exposure to Pb, As and Cd which have been intensively researched and their impacts on human wellbeing routinely recognized by global agencies like the World Health Organization (WHO). Although the negative health consequences of heavy metals have been recognized for a long time, exposure to heavy metals persists and is even growing in certain locations (Lars Jarup 2003).

Milk and dairy products can include chemical hazards and pollutants. Lead and Cadmium accumulates in drain and dairy products are of particular worry since they are commonly consumed by newborns and babies (Ghosia Lutfullah et al., 2014).

Health hazards associated with HM's



Risk Assessment

Estimated daily intake (EDI) of heavy metals and trace elements

The daily intake of metals is influenced by both the amount of metal present in the diet and how much food is eaten each day. The human's body weight can also affect how well they tolerate pollutants. The equation below was used to calculate the metals' EDI.

$$EDI = (C_{\text{metal}} \times W_{\text{food}}) / BW$$

Where W food stands for the average daily calorie intake, BW stands for body weight, and C_{metal} (mg/kg, on fresh weight basis) indicates the number of heavy metals contained in contaminated foods. 200 mL of milk was determined to be the typical daily intake for an adult (60 kg BW). (FAO (2009) and M.A.M. Al-Ashmawy (2011)). The daily intake of trace elements (mg/day) was compared with the recommended permissible limits established by the World Health Organization and Codex Alimentarius.

Target Hazard Quotient (THQ)

The THQ for the local inhabitants through the consumption of contaminated milk and dairy products were assessed based on the food chain and the reference oral dose (RFD) for each metal. The $THQ < 1$ means that the exposed population is assumed to be safe. (N. Bilandzic et al., 2011).

$$THQ = \frac{EDI \left(\frac{mg}{kg} - day \right)}{RFD \left(\frac{mg}{kg} - day \right)}$$

Reference doses of heavy metal (RFD)

Metal	RFD (mg/kg/day)
Lead (Pb)	0.0035
Cadmium (cd)	0.0010
Chromium (Cr)	0.0003
Zinc (Zn)	0.03

Comparison of estimated daily intake (EDI) of metal with the tolerable daily intake (TDI) via consumption of milk

Food	Elements			
	Pb	Cd	Cr	Zn
Buffalo milk	0.04	0.23	0.026	8.81
Cow milk	0.05	0.203	0.023	23.2
Total EDI	0.09	0.433	0.049	32.0
TDI	0.02	0.05	0.05	1.0
THQ	2.5	4.3	1.6	10.6

To appraise the health risk associated with heavy metal contamination of buffalo and cow milk samples, EDI has been compared with the TDI. The world health organization (WHO) and codex Alimentarius established the permissible intakes for all human groups. The EDI of Pb was calculated as $0.09 > 0.02$ TDI, which assess the $THQ 2.5 > 1$ RFD. The EDI of Cd, Cr and Zn were calculated as $0.43 > 0.05$, $0.049 > 0.05$ and $32.0 > 1.0$ interpreting the $THQ 4.3, 1.6$ and 10.6 which were > 1 .

Health risks associated with the detected heavy metals

a. Lead (Pb)

The mean and standard deviation of lead were unlike crossways in the universe. The highest values of Pb were found in Ma2, Mb6, Me2, Me6, Mc1 and Mc7 milk samples. The mean and standard deviation of Pb were in sequence detected as $0.016 \pm 0.041 > 0.012 \pm 0.056 > 0.012 \pm 0.052 > 0.011 \pm 0.054 > 0.009 \pm 0.096 > 0.007 \pm 0.053$. Lead is a powerful neurotoxin that

may disrupt the neurological system, cause reproductive issues, and even cause renal failure, especially in young children. Lead does not degrade in the environment. Particularly susceptible to gastrointestinal discomfort, constipation, the inability to have children, a headache, irritation, memory issues, and tingling in the hands and feet, hearing loss and a range of behavioral issues (Miller GT., 2009 & Whitney EN., 2005).

b. Cadmium (Cd)

The highest mean concentration and standard deviation of Cd heavy metal in Ma1, Ma3, Ma4, Ma5, Ma7, Mb5, Mc8, and Me7 milk samples were observed during this research were in sequence detected as $0.069 \pm 0.0090 > 0.061 \pm 0.0038 > 0.064 \pm 0.0060 > 0.057 \pm 0.0014 > 0.052 \pm 0.0041 > 0.051 \pm 0.010 > 0.045 \pm 0.021 > 0.043 \pm 0.0013$. When the Cadmium levels are above from the permissible limits, can cause Hepatic and Renal brokenness and Testicular harm (Atikpo et al., 2021).

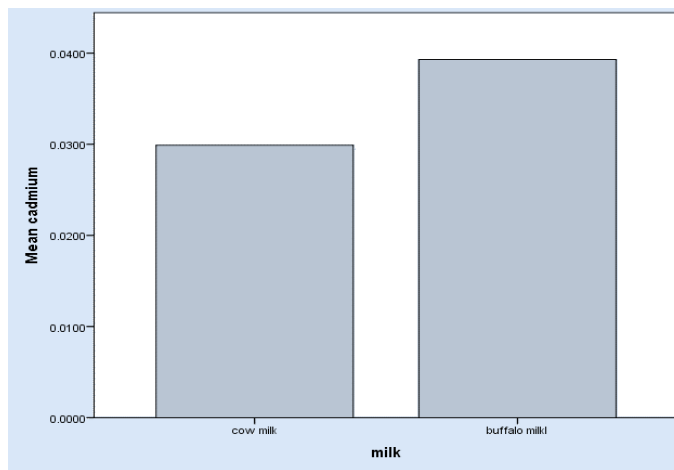


Figure 1. Estimation of mean concentration of Cadmium (Cd) in buffalo and cow milk samples from various urban areas of Peshawar.

The graph given in figure 1 inferred that the concentration of cadmium is higher in a buffalo milk as compared to cow milk. The overall highest mean concentration of Cd is observed in the milk samples (0.039) which is above the detection limit (0.01-0.05 ppm) prescribed by the World Health Organization (WHO).

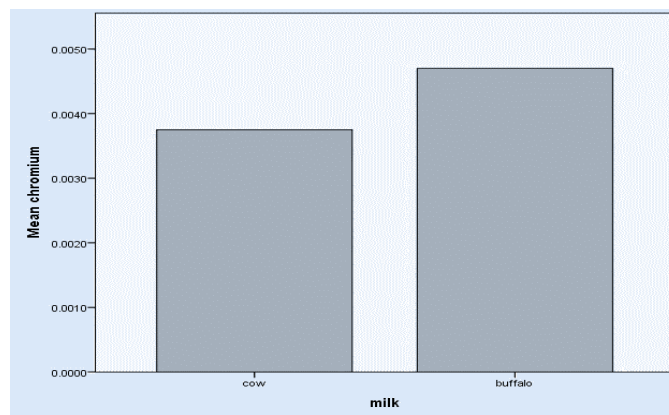


Figure 2. Estimation of mean concentration of Chromium (Cr) in buffalo and cow milk samples from various urban areas of Peshawar.

The graph given in figure 2 indicated that the concentration of chromium (Cr) is higher in a buffalo milk as compared to cow milk. The overall highest mean concentration of Cr is observed in the milk samples (0.049) which is above the detection limit (0.05 ppm) prescribed by the World Health Organization (WHO).

Conclusion

The research carried out on an analysis of selected heavy metals contamination in cattle milk and their risk assessment on human health in district Peshawar. Consuming milk of different locations can lead to health hazards due to the unwanted contaminants presents around them. The results obtained after the experimentations were compared with the standard values set by WHO and Codex Alimentarius. The recorded data shows that the contamination ranges were above from the permissible limits set by WHO.

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