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Study of Trace Metals Concentration in Local Whey Cheese Southern Iraq and Comparison with Guideline of WHO

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Abstract. The present study was conducted to estimate the level of concentrations of 12 trace metals and some other chemical element in Local Whey Cheese (LWC) samples, that locally manufactured in southern Iraq and to compare it with the guideline of the World Health Organization (WHO). LWC samples were taken randomly to be digested and the concentrations of dangerous trace metals **(**Arsenic, Beryllium, Bismuth, Cadmium, Cerium, Copper, Lanthanum, Lead, Nickel ,Selenium, Uranium, and Vanadium) were measured using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) device in Zarazma Company for Mineral Studies Tehran – Iran. The results showed statistically significant difference $P < 0.05$ for the concentrations of the 12 trace metals and some other chemical element in LWC samples. All the studied trace metals and chemical elements recorded low concentrations, consistent with the guidelines of WHO in LWC used, where Selenium recorded the highest concentration (3.47 µg L^{-1}), followed by Vanadium (2.3 µg L^{-1}) and about (0.9 µg L^{-1}) for Cadmium, Copper and Uranium. On the other hand, the concentrations of Bismuth, Nickel and Lead metals recorded very low values of (0.1 µg L^{-1}).

Keyword.:Trace metals ,Cheese whey, Guideline of WHO.

INTRODUCTION

Nowadays, trace metals pollution has become a major concern around the world, as many of them enter the environment through various human activities [1-4]. They are part of the trace minerals that found in small amounts in plant and animal cells and tissues as a very necessary part of nutrition and physiology .However, many bio metals are toxic trace metals or toxic heavy metals when exposure to excessive quantities or ingested [5-7]. Furthermore, toxic metals may also called trace metals, irrespective of their atomic weight and density [8]. A deficiency of trace metals in plasma or tissues can cause diseases, as in case of iron ,where a trace element inside the human body include iron, copper, molybdenum , cobalt, vanadium, zinc, nickel, manganese, lithium, and chromium, among others. In contrast, some of the trace metals exhibit severe toxicity and dangerous effects on human upon increased concentration, as well as they are often considered environmental pollutants[9]. For example an increase in the concentration of arsenic at levels greater than 150 parts per billion (PPB) can cause many diseases such as cancer that lead to death [10]. Along with a 2009 American–Canadian research had concluded the fact that even at the levels that have been considered to be posing little or no risk, that a trace amount of the metals could result in causing negative mental health consequences, such as the lead [11].

On the other hand, literature Indicated that some trace metal compounds have less toxicity for the humans through ingestions, such as bismuth compared to the other heavy metals like (arsenic and lead) [12] .As well as, the beryllium in workplaces may result in sensitization immune responses and might over the time develop chronic

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beryllium disease (CBD) that can be defined as an occupational lung disease, beginning as a cell-mediated immune response to the beryllium[13]. The maximum cadmium concentration is absorbed in human kidneys, which causes the toxicity, which could affect the mechanisms and risks of cancer, osteoporosis and cardiovascular diseases [14] . Over and above all vanadium compounds considered toxic [15].

The normal brain, kidney, heart, liver, and other systems functioning may be influenced by the exposure to the uranium, due to the fact that, in addition to being weakly radioactive, the uranium is a toxic metal [16] , it is a reproductive toxicant as well [17].

Furthermore, the average daily exposure of the trace metals poses no threat to the human health this is due to its removal mechanisms from the Body for example, the majority of nickel that is absorbed daily by the humans is eliminated by kidneys and eliminated from the body with the urine or gastrointestinal tract without being absorbed. The nickel isn't a cumulative poison, however, chronic inhalation exposure or higher doses could be toxic, or even cancer-inducing, and represent occupational hazards [18].

Dairy products and milk are an important food of the human diet, which can contain different concentrations of trace metals such as lead, cadmium, zinc, copper, etc. [19]. Local cheese is soft cheese made in southern Iraq from buffalo milk. Local whey cheese (LWC) is the product of liquids associated with its manufacture, this whey is mainly used to soften these cheeses by saturating them with whey fluids . The whey used in saturating local cheese may be a carrier of toxic trace minerals because it is produced from buffalo milk and tap water that can enter directly into the human digestive system when consuming this type of cheese. Therefore, the present study aimed to studying the trace metals and some other chemical elements concentration in whey of local cheese and comparing their concentrations with guideline of World Health Organization in drinking water.

MATERIALS AND METHODS

- **Sampling, digested, measured and analyzed statistically**

Randomly, three Local Whey Cheese (LWC) samples, that locally manufactured in southern Iraq-Basra province were taken, then, digestion was used by using acids in Zarazma Company for Mineral Studies according to [20]. In order to measure the concentrations of dangerous trace metal and some other chemical element (Arsenic, Beryllium, Bismuth, Cadmium, Cerium, Copper, Lanthanum, Lead, Nickel ,Selenium, Uranium, and Vanadium), the samples were stored in sealed plastic tubes .Then, by Zarazma Company for Mineral Studies Tehran - Iran, the trace metals (microgram per liter $\mu g\ L^{-1}$) were measured in Inductively Coupled Plasma Mass Spectrometry (ICP-MS) device .Finally,using the software Minitab ver.17 ,all data were statistically analyzed using the analysis of variance (ANOVA) at the probability level of 0.05.

RESULTS AND DISCUSSION

The results of this research showed that there have been statistically significant difference values $P < 0.05$ for the concentrations of (Arsenic, Beryllium, Bismuth, Cadmium, Cerium, Copper, Lanthanum, Lead, Nickel, Selenium, Uranium, and Vanadium) in (LWC) samples. Where, all the studied metals were recorded low concentrations (safe determinants) comparison with guideline of (WHO) and the different international determinants, table (1) in the used (LWC). However, the highest concentration was (3.47 $\mu g\ L^{-1}$) for Selenium , followed by (2.3 $\mu g\ L^{-1}$) for Vanadium. While, Cadmium, Copper and Uranium were recorded at (0.9 $\mu g\ L^{-1}$) . Nonetheless, the concentrations of Bismuth, Nickel and Lead elements recorded very low values by (0.1 $\mu g\ L^{-1}$) figure (1) .

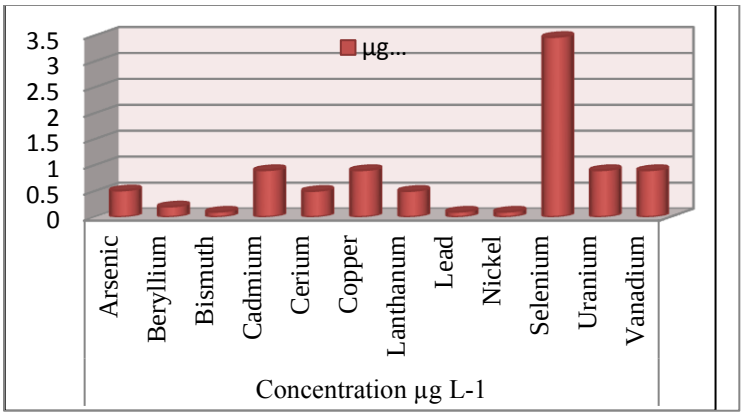

FIGURE 1. Concentrations of the dangerous trace metals and other chemical element (µg L^{-1}) in LWC.

Industrial processes, sewage and agricultural pesticides are among the main sources of pollution with trace elements as well as their presence in pigments ,plastic and paper components[21]. Naturally, trace elements are added to the aquatic environment through erosion of soil and washing [22], also air pollutants have a role in adding trace elements [23].

Excess of trace elements above their normal levels (safe determinants) leads to significant physiological damage[24]. Humans attempt to maintain the quality of their nutrition by regularly detecting pollution levels [25], such as trace elements [26] . In the present, all of the studied chemical elements were recorded low concentrations consistent with the guidelines of WHO for (LWC). The concentration of Arsenic did not exceed the guideline of WHO, where, its concentration was a good indicator for the non-toxicity of this element at these limits, this finding is consistent with the results of [27] .

Although, the low concentration of Beryllium in the current study, did not exceed the guideline according to WHO [27], the human body contains about 35 Beryllium micrograms, which is not considered harmful because there is a chemical similarity between the Beryllium and Magnesium so, it may be eliminated by enzymes to be inactivated[28]. The concentration of Lead and Cadmium were also at levels not harmful to the health according to the guidelines of the WHO [27].

This is consistent with the current study in avoiding the pathogenic hazards of the two components .Where, Lead can lead to severe damages to kidneys, brain and, eventually, death. By mimicking, Lead may cross to the brain by the blood as well as Lead can reduce numbers and degrade the neurons' myelin sheaths, inhibits the neuro-transmission routes, and decrease the neuronal growth[29]. While, Cadmium is considered an environmental pollutant that causes health hazard to living organisms [30,31].

Although, Bismuth was reported at very low concentration in studying LWC , scientific literature has indicated that some Bismuth compounds have less toxicity to the humans compared to the other trace metal types such as Arsenic, Lead and others. [32] and this can be attributed to rather low Bismuth salt solubility, this result is consistent with the finding of [12].

In the current study Selenium was shown the highest concentration by (3.47µg L^{-1}) compared to other elements in LWC , and it was less than the guideline of WHO [27]. On the other hand, Selenium levels in public water supplies of tap water samples in the world are usually at 10 µg/l or much less but may exceed 50 µg L^{-1} in some cases and 2 µg L^{-1}in drinking water [33].

TABLE 1. Comparison of the dangerous trace metals and other chemical element (µg L^{-1}) with the WHO guideline.

Trace metals	Concentrations of trace metals µg L^{-1}				References
	Present study (mean)	SD	Guideline of WHO	Other	
Arsenic	0.5[a]	0.0252	10		[27]
Beryllium	0.2[a]	0.0	12		[27]
Bismuth	0.1[a]	0.0	-	0.7	[33]
Cadmium	0.9[a]*	0.09	3		[27]
Cerium	0.5[a]*	0.0551	-	22.1	[34]
Copper	0.9[a]*	0.0551	2000		[27]
Lanthanum	0.5[a]	0.00557	-	2	[35]
Lead	0.1[a]	0.0	10		[27]
Nickel	0.1[a]	0.0	70		[27]
Selenium	3.47[a]*	0.165	40		[27]
Uranium	0.9[a]	0.0153	30		[27]
Vanadium	2.31[a]*	0.0551	-	50	[36]

a = presence of significant differences with other elements.
* = presence of significant differences at the same element.

CONCLUSIONS

In the present study, all the studied trace metals and other chemical element recorded low concentrations, which were in consistent with the guideline of WHO in the study of (LWC). Where, Selenium was showing the highest concentration by (3.47 µg L^{-1}), followed by Vanadium (2.3 µg L^{-1}), while the concentrations of Bismuth, Nickel and Lead recorded very low concentrations by (0.1 µg L^{-1}).

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