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Determination of Certain Chemical Elements in Cheese as Dairy Product from Local Producer Southern Marshes of Iraq

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Abstract

Locally produced cheese samples were investigated for the concentrations of certain major chemical elements, Ca, Na, and K as well as heavy metals; Cr, Cu, Fe, Ni, Pb, and Zn. Samples of cheese were collected randomly from inhibitors at southern Iraqi marshland, Al-Hammar Marsh, first cut into small pieces, freeze dried, crushed and a certain amount was weighted and wet digested by 3:1 acid mixture of HNO_3:HCl. After complete digestion , samples were poured in to 50 ml volumetric flask and volume completed to 50 ml by distilled water and divided into two 25 ml portions, one used for the determination of major elements, Ca, Na, and K by adopting Flame photometric technique, and the other portion used for the determination of heavy metals, Cr, Cu, Fe, Ni, Pb, and Zn by adopting the Atomic Absorption Spectrophotometry. Levels recorded for Ca, Na, and K were in the order Na > Ca > K. Values recorded for Ca ranged between 27.24 –46.67 mg/g, for Na ranged 42.21 –69.34 mg/g being the highest, while K the lowest ranged 8.76 –32.85 mg/g. On the other hand levels of heavy metals recorded were lower than major ions, the lowest for Pb ranged ND-2.6074 µg/g and moderate for Cr, Cu, and Ni ranged ND -3.536 µg/g, 1.20 - 6.68 µg/g, and 0.61 - 2.245 µg/g respectively, while Fe and Zn recorded the higher values ranged 18.93 - 64.76 µg/g and 43.94- 59.33 µg/g respectively.

Keywords: Dairy products; Cheese; Major ions; Heavy metals; Flame Photometry; Atomic Absorption Spectroscopy.

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1. Introduction

Certain chemical elements are playing a great roll for human body, some are known as essential elements such as Fe, Cu, Ca, Mg, Na, K, … etc. , other which represented as nonessential or pollutant, such as Cd, Pb, Co, Ni … .etc

Among the essential elements which play a great roles in human body is calcium with main roles as regulation the contraction and relaxation of muscles and the function of the nerve tissues and responsible for the clotting of blood and taking part in the regulation of blood pressure which mentioned by Marjanović-Balaban, and her colleagues [1].

For determination of main chemical elements in cheese samples, three types of digestion were employed, microwave, wet and dry processes. Compared to wet and dry digestions, microwave is found to be fast, simple, reliable , and excellent as reported by Bakircioglu, and her colleagues [2].

Dry ashing is usually in electric furnace, wet digestion in $HNO_3 – H_2O_2$ mixture, and microwave digestion with $HNO_3 – H_2O_2$ in microwave oven. For the determination of chemical elements in cheese samples, there are different methods were used among which are plasma ICP spectrophotometry, atomic absorption, and titrimetric method by Ramadan and his colleaques [3].

Levels of concentration in μg/g recorded for major elements Na, K, Ca, and Mg as well as heavy metals Cr, Cu, Fe, Mn, Ni, Pb, and Zn in cheese samples from Turkya were as follows: 3957-6558 for Na, 305-362 for K, 3473-4556 for Ca, 28.9-127 for Mg, 0.02-0.62 for Cr, 0.10-0.27 for Cu, 4.1-12.5 for Fe, 0.28-1.1 for Mn, 0.18-0.34 for Ni, 0.14-1.2 for Pb, and 8.8-13.2 for Zn as reported by Mendil, [4]. On the other hand Dağcılar and his colleaque [5] determined the concentrations of As, Cd, Pb, Cu, and Hg in milk and milk dairy products produced at Northern Cyprus, the reported levels in μg/g for these elements were ND –0.025, ND –0.058, ND –0.081, ND –0.738 and ND –0.24 respectively. Most studies for different types of cheese indicated that Zn is the highest in concentration among other heavy metals precisely in white cheese packed in tin containers, and crème cheese samples packed in plastic containers as explained by Bakircioglu and her colleaques [2], as well as for local and imported cheese samples from Sharkia Governorate markets (Egypt) as reported by Abdelfatah and her colleaques [6]. Cupper, Cadmium, and Lead in cheese were reported higher than in milk as most of these elements are bound to casein fractions as explained by Amer, [7].

The aim of this study was to investigate whether the local produced cheese at Southern Iraqi marshland is suitable for human consumption or not. This could be achieved by determination of concentrations of chemical elements in cheese samples of different production agent.

Experimental

Samples of cheese from different manufacture origin were collected from local manufacturers, store in plastic bags in fridge prior to analysis. Before analysis, samples were cut into small pieces, figure 1 , freeze dried, Figure 2,and crushed in mortar and homogenized.

Figure 1: Samples of cheese ready for freeze drying. **Figure 2:** Freeze drier.

2 gm cheese samples were digested with 8 ml 3:1 HNO_3: HCl (6 ml HNO_3: 2 ml HCl) mixture on a hot plate, Figure 3, for 4 hours following Bakircioglu [2]. The digestion is repeated once more after the addition of 8 ml HNO_3:HCl (3:1 mixture) for another 4 hours. The mixture is cooled and 25 ml distilled water is added and filtered by Whatman filter paper, the solution is transferred to 50 ml volumetric flask and completed to the mark with distilled water. Each sample is divided into two portions each of 25 ml, one is used for major elements (Ca, Na, and K) analysis by flame Photometry Model Jenway PFP7 flame photometer, Figure 4, and the other portion is used for heavy metals (Fe, Cu, Pb, Ni, Cd, and Zn) analysis by atomic absorption spectrophotometer(Model AA 700 Shimadzu AAS), Figure 5.

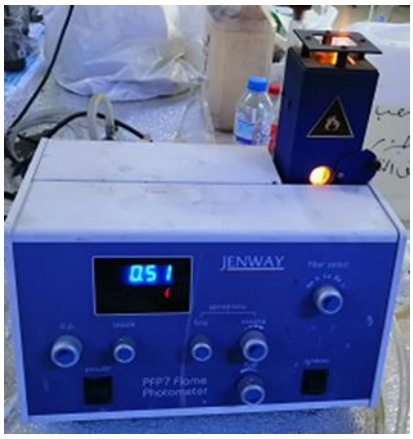

Figure 3: Digestion of cheese samples on hot plate. **Figure 4:** Flame photometer used for major elements detection.

Figure 5: Atomic absorption spectrophotometer (Model AA 700 Shimadzu AAS) used in this study for determination of heavy metals.

2. Results

Levels of major elements and heavy metals determined in the cheese samples from Southern marshland of Iraq are listed in tables 1 and 2 respectively.

Table 1: Levels of major ions (mg/g)in cheese sample from Southern marshes of Iraq.

Samples	Na	K	Ca
	Garmat Ali		
Buffalo	54.27	8.76	46.47
Cow	54.27	32.85	33.21
	El-Deyer		
Buffalo	42.21	12.05	27.24
Cow	49.35	18.62	40.06

Table 2: Levels of heavy metals (µg/g) in cheese sample from Southern marshes of Iraq.

Samples	**Cr**	**Cu**	**Fe**	**Ni**	**Pb**	**Zn**
	Garmat Ali					
Buffalo	**1.396**	**1.94**	**64.76**	**0.6525**	**ND**	**59.33**
Cow	**3.536**	**1.36**	**28.46**	**2.245**	**0.165**	**43.94**
	El-Dayer					
Buffalo	**1.490**	**6.68**	**38.76**	**1.2425**	**2.6074**	**57.04**
Cow	**ND**	**1.220**	**18.93**	**0.61**	**ND**	**54.047**

3. Discussion

Tables 1 and 2 reveal that concentrations of major elements in studied cheese samples are greater than concentrations of heavy metals. Levels recorded for Ca, Na, and K were in the order Na > Ca > K which were in accordance with the findings of Mendil [4]. Values recorded within this study for Ca were ranged between 27.24 – 46.67 mg/g which is comparable to levels reported by Ramadan, and his colleaques [3] which were in the range 2.858 –45.00 mg/g. Highest levels recorded for Na in the range 42.21 –54.27 mg/g, Na reported in this study higher than literature in which levels reported for Na in Cottage cheese from Tennessee state /USA were averaged as 4.57 mg/g, added NaCl during cheese production leading to salty cheese with high levels of Na which is not preferred by sodium restricted diets as mentioned by Demott and his colleaques [8]. Levels of K recorded in the range of 8.76 –32.85 mg/g which was higher than reported values in the range 0.305 –0.362 mg/g by Mendil [4], and 0.6 mg/g by Bruhn and his colleaque [9].

Salt is widely used in food for dairy products such as cheese. The main additive salt is sodium chloride to give acceptable taste. On the other hand, consumers of cheese treated with NaCl face a great health effect due to the relation between hypertension and ingestion of sodium. Therefore, it is preferable to use KCl as a salt instead of NaCl during the manufacturing of cheese as suggested by Lindasy and his colleaques [10].

Ca, Na, and K mineral elements even if they exist in minor quantity are essential due to their vital functions in the organism Demott, and his colleaques [8]. Ca is the most abundant mineral constitute of human body. Excess levels of Ca in the body can cause constipation and high risk of kidney stone and prostate cancer in adults, moreover excess Ca may interfere with the ability of the body to absorb Fe and Zn. The benefit of Na in human body is activates amylase enzyme. Excessive levels of Na causes hypertension. On the other hand K is most common element in the intercellular fluid which regulate the osmotic pressure in the cell.

Cheese is produced from milks of buffalo and cow's, therefore pollution of cheese by chemical elements is expected for which those animals are feed upon plants in the marshland which receive chemical elements from the soil and water. Existence of chemical elements as a pollutants in water and soil of the marshland became as a source for contamination of plants growing their which are consumed by animals transferring chemical elements as a contaminants to the animals accumulating them in their tissues and mammary glands. Then milk and dairy products became at high risk food after being consumed by human being as reported by Younus and his colleaques [11]. Lead one of the most toxic heavy metal which threatens the human health was detected in certain low concentration in cheese produced locally at Southern Iraqi Marshland. It may contaminates food specially milk which used for processing of cheese which in turn transfer by containers coated with lead, on the other hand , Cu was detected in a certain moderate level in studied cheese samples contaminated with Cu, could be arises from using cupper alloy coated containers during the production of cheese, as mentioned by Dagciler and his colleaques [5]. Levels of heavy metal concentrations recorded in cheese samples of local production at Southern Iraqi Marshland were within the permissible levels or even less according to international laws, IDF Standard [12]. It revealed that the consumption of cheese does not pose a direct and a series threat to the health of consumers, moreover,the slight differences in heavy metal concentrations could be due to different methods of cheese production, which determined by Al-Sidawi and his colleaques [13].

4. Conclusion

Cheese as a dairy product is quite important in the marshland region of Southern Iraq. The analyses results for cheese revealed the presence of major elements Na, K, and K as well as heavy metals Cr, Cu, Fe, Ni, Pb, and Zn in all studied cheese samples. The presence of these chemical elements will affect the daily metals intake and potential health risk.

The order of levels of the chemical elements in the cheese samples were determined to be Na > Ca > K > Zn > Fe > Cr > Cu > Ni > Pb. Pb recorded the lowest concentration so it has no effect during consumption by human being. The results of this study revealed that continuous monitoring of chemical constituents in dairy products manufactured locally should be regularly done by local scientific laboratories.

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Experience Prof. Dr. Faris J. M. Al-Imarah,

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Born on 4th of September 1951 in Basrah Governorate of Iraq, studied for primary(1963), secondary(1966) and higher preparatory (1969) schools at Basrah province, then he obtained his B.Sc. in Chemistry at Basrah University 1973, M.Sc. in Physical Chemistry at Baghdad University 1976, and finally received his D. Phil. As a laser spectroscopic at Sussex University/The United Kingdom 1984, Back to Basrah joined the staff of Basrah University as a lecturer. Dr. Imarah received his first promotion to Ass. Prof. at Marine Science Centre/Basrah University during 1990, then he received his second promotion to Prof. during 1995 at the same Centre. Prof Imarah supervised 20 students as M.Sc. and Ph. D. and he involved in different fields of research mainly Chemistry, and Environment and Pollution of different media, air, water, soil, sediments, and biota of Southern Iraqi Marshlands, Southern Iraqi waterways, and Northern West Arabian Gulf. He has 190 research papers published in local, national and international journals.

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