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Evaluation of some Mineral Concentrations of Cheese using Inductively Coupled Plasma Atomic Emission Spectrometer

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Abstract: In this work concentrations of ten different minerals were evaluated in commercial white cheese, pigtail cheese and triangles cheese. Minerals were analyzed by an Inductively Coupled plasma-Atomic Emission Spectrometer (ICP-AES). Respective mean mineral concentration (ppm) of white cheese, pigtail cheese and cheese triangles were: Al 94.125, 73.75, 64.0; Cr 0, 0, 0 ; Mn 1.40, 1.2875, 0.6875; Fe 13.075, 16.45, 6.675; Ni 8.6125, 8.8, 6.925; Cu 0, 0, 0; Zn 22.4125, 22.9125, 14.7875; Cd 1.2, 0.6625, 0.4375; Ba 0, 0, 0; Pb 16.375, 4.9, 4.6125. These results show that there is some minerals (Cr, Cu and Ba) were not exist and other found with high concentration in comparison with the standard specification.

Keywords: Inductively coupled plasma (ICP), Minerals, Pigtail cheese, Triangles cheese, White cheese.

INTRODUCTION

Atomic emission spectroscopy is a chemical analysis that uses the intensity of light emitted by flame, plasma, arc, or spark at a given wavelength to determine the amount of an element in the sample. The wavelength of the atomic spectral line gives the identity of the element while the intensity of the emitted light corresponds to the number of atoms of the element. Atomic emission spectroscopy that concerns the emission of radiation by the suitably excited atomic vapors of the analyte [1].

This work is focus on determination of Mineral contents in different types of cheeses using ICP-AES analysis.

ICP-AES analysis is an emission spectrophotometric technique and powerful tool for determination of concentration of elements in sample. Strictly speeding, it is used rarely in food analysis, to make sure that it is free from contamination.

Although a few studies may have been reported, very limited research data have been available on mineral profiles. González-Martín, *et al*. studied the effect of different factors on the mineral composition and the correlation between minerals (Ca, Fe, Mg, K, Na, and Zn) and the type of milk used for manufacturing cheese, they found that the percentage of cow's cheese was positively correlated with K and P; the percentage of ewe's cheese was negatively correlated with K, Mg, Na, and P and the percentage of goat's cheese was negatively correlated with Na, and P [2]. Mustafa W, A. *et al*. determined the chemical composition of white cheese produced at small scale-level in Dueim city, the largest market of white cheese in Sudan, their results show that the ash content of cheese samples ranged from 3.77 ± 0.012% to 5.60 ± 0.087%, with an average of 4.45%. The macro-elements sodium, potassium, calcium, lead and phosphorus where found in relatively high concentrations, whereas concentration of micro-elements was very low. The fatty acids content varied, and the most abundant were palmitic (C16: 0), stearic (C18: 0) and myristic (C14: 0) acids), which ranged between 14.56 to 39.41, 0.04 to 19.31, and 0.59 to 1.30 g/100 g, respectively [3]. Hernandez, K. and Park, Y.W. evaluated twenty macro and trace mineral concentrations in commercial goat milk yogurt and its cow milk counterpart in reference to goat milk yogurt analyzed by an Inductively Coupled Plasma Optical Emissions Spectrometer [4].

MATERIALS AND METHODS

Procedures

Inductively coupled plasma-Atomic emission spectrometer-1

For all measurements ICP-AES spectrometers known ICPE 9000 was used, the ICP-AES provides a method for chemical analysis or sample identification (sorting) directly from samples in various forms.

Cheese samples-2

The samples of white cheese, pigtail cheese and triangles cheese were commercial samples taken randomly with 150 grams weight of each sample.

DATA ANALYSIS

Accurately weighed three samples of 0.2 g from the homogenous mixture, each; were drawn from white cheese, pigtail cheese and triangles cheese, Sample were put in bowls and transferred to an oven adjusted at 550°c for eight hours, to get rid of organic compounds and to estimate the mineral content in ash, then adding 5ml of concentrated nitric acid (HNO3) to the bowls to transfer the elements in the ash to dissolving nitrate salt.

A little mount of deionized water (ultra pure water) was added for dilution, then to be filtered with a funnels (with filter paper) in 25ml standard flasks, then the flask was filled up to25ml with deionized water (ultra pure water) then the solution was injected in inductively coupled plasma-atomic emission spectrometer (ICP-AES).

RESULTS AND DISCUSSIONS

ICP-AES analysis results-1

Table 1shows the experimental results data of the white cheese result obtained from ICP-AES. Full informations about the Pigtail Cheese results obtained from ICP-AES (Table 2). Full informations about the cheese triangles results obtained from ICP-AES (Table 3).

Table-1: Elements concentration of white cheese

Element	Atomic number	Concentrations/ppm	Standard specification
Al	13	94.125	10
Cr	24	0.0	0.05
Mn	25	1.40	0.3
Fe	26	13.075	0.3
Ni	28	8.6125	1
Cu	29	0.0	1
Zn	30	22.4125	5
Cd	48	1.2	0.1
Ba	56	0.0	1
Pb	82	16.375	0.5

Table-2: **Elements concentration of pigtail cheese**

Element	Atomic number	Concentrations/ppm	Standard specification
Al	13	73.75	10
Cr	24	0.0	0.05
Mn	25	1.2875	0.3
Fe	26	16.45	0.3
Ni	28	8.8	1
Cu	29	0.0	1
Zn	30	22.9125	5
Cd	48	0.6625	0.1
Ba	56	0.0	1
Pb	82	4.9	0.5

Table-3: **Elements concentration of cheese triangles**

Element	Atomic number	Concentrations/ppm	Standard specification
Al	13	64.0	10
Cr	24	0.0	0.05
Mn	25	0.6875	0.3
Fe	26	6.675	0.3
Ni	28	6.925	1
Cu	29	0.0	1
Zn	30	14.7875	5
Cd	48	0.4375	0.1
Ba	56	0.0	1
Pb	82	4.6125	0.5

Heavy metals comparison results-2

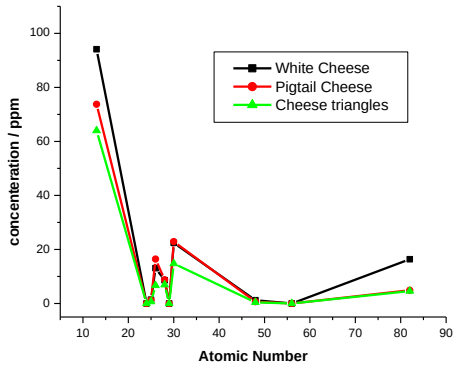

Fig-1: **Elements concentration/ppm in the three cheeses sample**

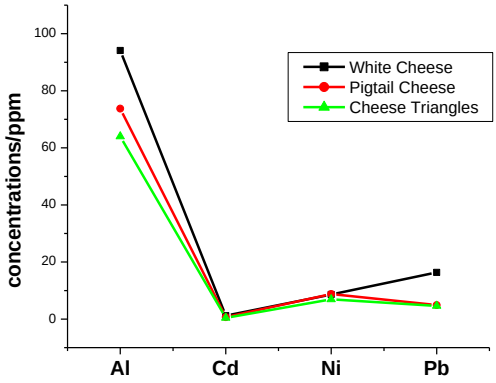

Fig-2: **Comparison of concentrations (ppm) of heavy metals among three types of white and pigtail cheese, and cheese triangles**

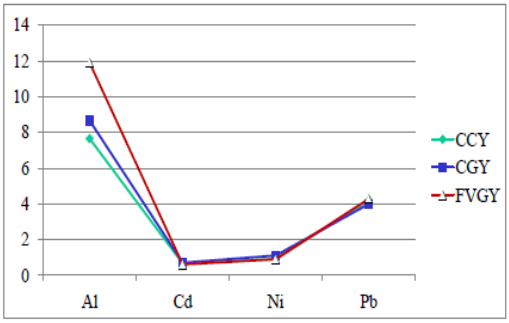

Fig-3: **Comparison of concentrations (ppm) of heavy metals among three types of cow and goat milk yogurts, Hernandez and Park** [4]

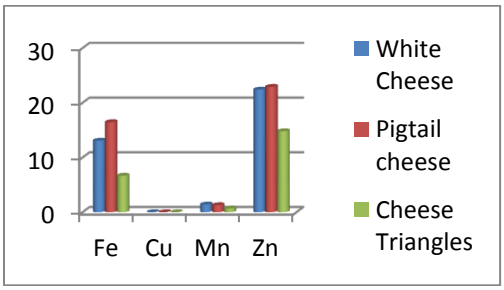

Fig-4: **Profiles of Zn, Fe, Cu and Mn concentrations (ppm) in commercial whitecheese, pigtail cheese and cheese triangles**

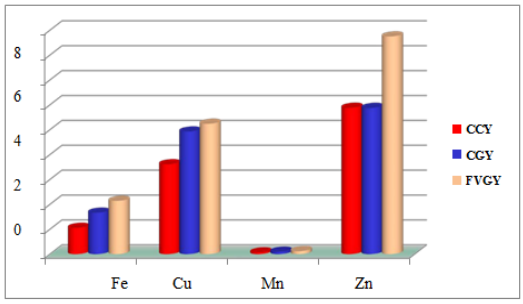

Fig-5: **Profiles of Zn, Fe, Cu and Mn concentrations (ppm) in commercial cow and goat milk yogurts and fort valley goat yogurt, Hernandez and Park** [4]**.**

DISCUSSIONS

In light of mineral concentrations, all minerals were lower in commercial products of cheese triangles than both white cheese and pigtail cheese. Average mineral concentrations/ (ppm) of Al, Cr, Mn, Fe, Ni, Cu, Zn, Cd, Ba and Pb for white cheese and pigtail cheese and cheese triangles were: 94.1, 0, 1, 13, 9, 0, 22.4, 1, 0, 16.4; 74, 0, 1, 16, 9, 0, 23, 0.7, 0, 5; 64, 0, 0.7 ,7 ,7 , 0 , 15, 0.4, 0 and 5 respectively. These data indicate that white cheese contained higher values of all minerals except Fe, Ni and Zn which is lower than pigtail cheese. Figure 1 clearly displays that white cheese had approxmatly higher levels of the minerals than the pigtail cheese and cheese triangle. Among the ten trace elements, Al is the highest mineral among all for all products. The differences in Al contents among the three products were greater than the other heavy metals, whereas the differences in Mn, Cd and Ni contents between the products were negligible. The respective Al contents of white cheese, pigtail cheese and cheese triangle were 94.125, 73.75 and 64.0 suggesting that there were some differences in Al levels in all tested cheese product. The results also show that all samples there are no Cr, Cu, and Ba in white cheese, pigtail cheese and cheese triangles. These results are agreed with the observations on Al contents in the previous studies [5, 6, 4]. Figures 2 and 4 show that there a great agreement with previous study figures 3 and 5 [4]. The comparison also showed that Cu in yogurt is existing with quit amount, while there is no Cu in cheese.

CONCLUSION

ICP appears to be a powerful technique for determination of elements and different cheese types. The results show that there is some minerals (Cr, Cu and Ba) did not exist and other found with high concentration in comparison with the standard specification.

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