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Original article

Using Atomic Absorption Spectrometry (AAS) for the Determination of Aluminum and Zinc in Wrapped Chocolate and Chips samples

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Keywords.
AAS, Chips, Chocolate, Aluminum, Zinc.

ABSTRACT

This study was carried out to determine the contents of Aluminum and Zinc in wrapped Chocolate and Chips sample by atomic absorption instrument. Ten different samples of Chocolate collected from local markets in some Libyan cities. The concentrations of Aluminum in the selected samples in this study fluctuated in the range of 1.658 and 5.433 ppm. Whereas the concentrations of zinc ranged between 3.540 and 7.723 ppm. The higher concentration of Aluminum was recorded in sample No 10, whereas the lower concentration of Al was recorded in sample No 1. On the other side, the low contents of Zinc were recorded in sample 1. The results of this study recorded that most of the selected samples containing high values of Aluminum and Zinc than reported by the World Health Organization (WHO).

Introduction

Rarely, aluminum can lead to changes in the central nervous system, erythropoietin-resistant microcytic anemia, and vitamin D-resistant osteomalacia. Individuals who have renal impairment are more vulnerable. Long-term ingestion of hydrated aluminum silicates for the control of excessive stomach acidity may lead to aluminum binding with the contents of the intestinal tract and increased excretion of other metals, such as iron or zinc; dosages over 50 g/day could potentially result in anemia.
[1]. Water, food, drinks, medications, food additives, and leaching from aluminum cookware are some of the ways that aluminum (Al) enters the human body. These days, there is no denying Al's neurotoxic potential. When administered directly to animals or inadvertently to people during dialysis, it can be harmful. Because aluminum accumulates in the brain, bones, and liver, it has also been linked to several illnesses, including bone abnormalities and dialysis encephalopathy. Aluminum has been considered a neurotoxic [2]. A few studies conducted in the Middle East link daily aluminum consumption patterns to Al toxicity. An earlier study found a correlation between the daily behaviors of elementary school girls and the amount of aluminum in their blood serum. Later, a different study used camel's milk to try to prevent aluminum chloride-induced toxicity in the kidney and liver of white albino rats. Regarding the use of aluminum cookware in cooking, there is substantial debate. According to certain research, they are dangerous and should not be used, particularly with acidic foods. According to other research, cooking with aluminum utensils and foils is safe [3].
The Provisional Tolerance Weekly Intake (PTWI) for aluminum set by the FDA and WHO was 7 mg/kg body weight. Numerous analytical techniques, such as atomic absorption spectrometry (AAS), flame atomic absorption spectrometry (FAA), and inductively coupled plasma-optical emission spectrometry (ICP-OES), can be used to evaluate low-level metals. Nevertheless, these devices are costly and have considerable running costs. The UV-Vis spectrophotometric method is a well-known analytical approach that offers a wide range of applications, low cost, and simplicity for very accurate Al^{3+} assessments in food and water. Aluminum dissolution is known to be strongly influenced by pH, temperature, and the presence of complexing agents [4]. The analysis of Al $^{3+}$ ions and some trace elements using Eriochrome Cyanine R (EC). Fish, shrimp, chicken, and meat stakes are frequently baked in various nations by wrapping them in aluminum foil. Because of the most significant qualities of aluminum foil, its ease of handling, and the capacity to transfer heat. Many of heavy metal can be detecting by different methods as atomic absorption, Ionic coupling plasma, X ray and Spectrophotometer in different samples [5-49], the toxic compounds and metals was measured in many samples by using different instruments as HPLC, GC mass and others to detect low contents in different samples as food, Fishes, vegetables and others [50 -101]. The purpose of this study is to ascertain the amounts of zinc and aluminum in numerous chocolate goods, and metal samples were gathered from various Libyan markets.

Methods

Sampling

Ten different chocolate samples were gathered from several Libyan markets; Table 1 shows the samples.

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Table 1. The studied chocolate samples

Sample No	Sample Type
1	Crazy
2	Snickers
3	Tiger (Chips)
4	Quattro
5	Kitkat
6	Smax (Chips)
7	Kamara
8	ETi Karam
9	Cono (Chips)
10	Ono

Samples preparation

0.5 gram of each sample was transferred to clean and dry conical flasks. Then, 5 ml of nitric acid and 25 ml of distilled water were added to the samples.

Digestion of the metals

The samples were designed after adding nitric acid, by used hot plate at 85 ^{0}C, where the samples were left for two hours and then allowed to cool. The samples were filtered, and the volume was adjusted to 100 mL

Determination of Aluminum and Zinc

The lead metal contents were measured by atomic absorption (Type Thermo) at the central laboratory of Omar Al-Mukhtar University. The contents of the studied metals were measured according to the Hollow cathode lamps of each one, the optimum wavelength

Results

The concentrations of Aluminum in the selected samples in this study fluctuated in the range of 1.658 to 5.433 ppm. Whereas the concentrations of zinc ranged between 3.540 and 7.723 ppm. The higher concentration of Aluminum was recorded in sample No 10, whereas the lower concentration of Al was recorded in sample No 1. On the other side, the low contents of Zinc were recorded in sample 1, (Table 2) and (Figures 1&2).

Table 2. The concentrations (ppm) of Al and Zinc in the studied samples

Sample No	Aluminum Concentrations	Zinc Concentration
1	1.658	3.540
2	2.963	4.110
3	2.573	4.88
4	3.846	4.606
5	3.892	5.277
6	4.935	5.690
7	3.740	7.723
8	3.392	7.690
9	4.766	6.683
10	5.433	7.212
Average	4.07	6.22
±SD	0.924	1.264

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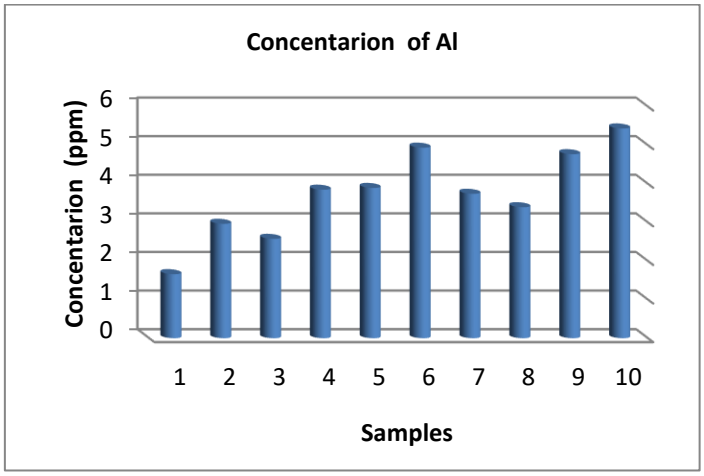

Figure 1. The concentrations of Aluminum in the samples

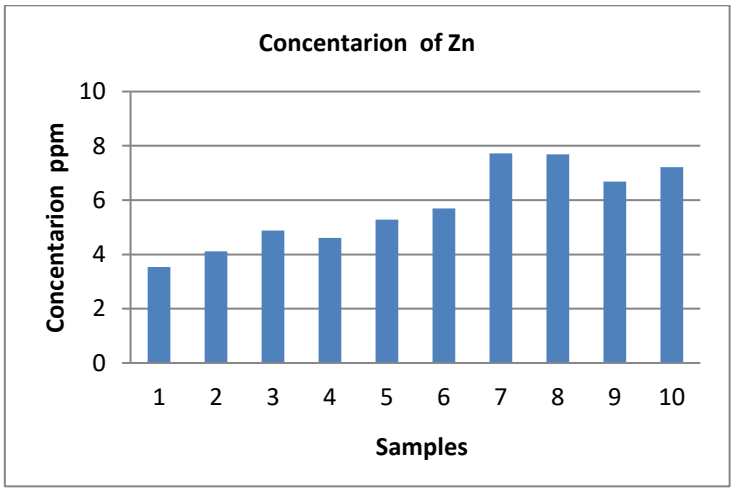

Figure 2. The concentrations of Zinc in the samples

Discussion

This study recorded high values of Aluminum and zinc in the studied chocolate samples. The contents of Al ranged between 1.658 and 4.935 ppm are higher than the values recommended by WHO of 0.5 ppm. Also, the contents of Zinc of3.540 and 7.723 ppm are higher than the values of 0.1 ppm recommended by WHO in foods. Aluminum exposure to our bodies is negligible. The World Health Organization (WHO) of the United Nations (UN) has determined that an acceptable daily intake of aluminum is 1 mg/kg body weight [102-103]. Human bodies can eliminate small amounts of aluminum quite effectively. Unfortunately, most of us are exposed to and consume more than our bodies can process for a variety of reasons [94]. According to reports, the intestines can absorb aluminum salts and concentrate them in the brain, parathyroid, and bone, among other human tissues.

Aluminum has been found in high amounts in the brain tissues of Alzheimer's sufferers. High aluminum intakes may be detrimental to certain people with bone disorders or renal impairments, according to several reports. The impacts of aluminum on health are too numerous to be list. Human brain cells grow more slowly when exposed to aluminum. Higher concentrations of aluminum cause a more noticeable decline in growth rate. For many years, wrapping food before baking is a standard procedure. Determining the content of aluminum in food wrapped in aluminum is crucial because of the potential link between aluminum uptake and the diseases indicated in numerous publications [104-105].

Conclusion

This study showed the presence of residual aluminum and zinc the studied samples (pocketed chocolate) collected from Al Bayda city local Markets, Libya, the (Al) values were high, exceeding those of WHO (0.5 ppm), whereas the concentrations of Zn were higher than the values of WHO (0.01 ppm).

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Conflict of interest. Nil

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