Determination of Some Trace Metals in Canned and Fresh Beans from Basrah Markets- Iraq

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Abstract
In present study, three heavy metals (Lead, mercury and copper) in (60) canned Beans samples were determined by atomic absorption spectrophotometer. The trace metal contents, expressed in ppm (mg/ kg), varied from (1.07-1.22 mg\kg) dry weight in fresh samples and from (1.09-1.42 mg\kg) in canned samples for Copper (Cu) and from(1.22 - 1.67 mg\kg) in fresh samples and from (1.41 - 2.181 mg\kg) in canned samples for a Lead, and from (0.05 - 0.19 mg\kg) in fresh samples and from (0.07 - 0.55 mg\kg) in canned samples for Mercury. The results of this study showed the concentration of mercury in summer samples exceed normal levels, and statistical analysis of results by ANOVA showed significant seasonal variation between samples. The study showed that summer season had the highest recorded concentrations of trace elements in canned Beans samples.
Keywords: Canned and Fresh food, Contamination, heavy metals.

1. Introduction

Several toxicological and environmental studies were conducted to examine the toxic effect of different types of pollutants present in foodstuffs due to continuously increasing levels of contamination in agriculture and seafood sources (Milam *etal.* 2015; Al-Mutarri 2015; Özdemir *etal.* 2017). Heavy metals are considered to be the most dangerous form of pollutants when consumed excessively over a long time period through food or water (Mendil *etal.* 2013). Toxic Heavy metals are commonly defined as those metals having a specific density of more than 5 g/cm3 (Järup, 2003). The human body is usually requiring the essential trace elements such as copper and manganese in milligrams per day (mg \ day) amounts, because it have beneficial bioactivity in humans, but not generally accepted as essential because they lack a defined biochemical function (Nielsen, 2014). Copper is an essential trace element vital to the health of all living organisms. Copper enhances bone strength, red and white blood cell maturation, iron transport, cholesterol and glucose metabolism, heart muscle contraction, and brain development. Moreover, Cu has a major role in oxygen transport, bone development, and protein synthesis and is an essential component of countless enzymes (Soylak et al. 2005). On the other hand, acute Cu toxicity is associated with nausea, vomiting, and epigastric pain (Nolan, 2003). Pb is known to increase blood pressure and cardiovascular disease in adults, and to induce reduced cognitive development and intellectual performance in children (Malakootian *etal.* 2011). The name "canned food" means the food product enclosed in metal cans, glass jars, or plastic containers, the long shelf life of which is ensured through the process of pasteurization and airtightness of the packaging, providing protection against the access of air and contaminants. Some canned foods contain also chemical pre- serving additives, e.g., sodium nitrate or potassium nitrate. The main threats to human health from heavy metals are associated with exposure to lead, cadmium, mercury and arsenic which is a metalloid but usually classified as a heavy metal (Järup, 2003). Canned food products, in spite of their taste and nutritive values, can also contain chemical contaminants, the primary source of which is the environment, as well as incorrect technological processing or incorrect packaging. In fact, heavy metals pose a serious threat to human health. Heavy metals and trace elements such as mercury, arsenic, cadmium, and lead entry into the human body, that can diminish mental and central nervous system function; elicit damage to blood composition as well as the kidneys, lungs, and liver; also reduce energy levels (Hajeb et. al, 2014).

Nowadays, the assessment of heavy metal contamination in canned foods has been an important topic, since canned foods are popular food sources all around the world and widely consumed by people. Therefore, careful preparation of these products is highly recommendable (Iwuoha etal. 2013). Solder, used in the manufacture of cans, is a recognized source of contamination of food by different toxic metals during canning This is because solder is mostly composed of tinplate (tin-coated steel), chromium-coated steel, or aluminum. (Gebregziabher etal. 2014). High levels of metals may be found in canned foods due to corrosion and leaching of the metals from un lacquered cans, or from tin foils used in packaging. These canned containers have a high potential of releasing metals into the foods (Korfali and Hamdan, 2013).

The major routes of toxic metals / metalloids for general population over a lifetime are the food and globalization of food sources that coupled with applications of metal-contaminated, which increased the importance of foodborne exposures to metallic in both developed and developing countries (Fowler & Oskarsson, 2015). Nowadays, many studies confirmed that increasing levels of those metallic in

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human body lead to harmful diseases and often may cause death.

Commission Regulation (EC) No 1881/2006 sets maximum levels for certain contaminants in food stuffs (Berry and flug, 2003). The following limits apply: 200 mg kg−1 for tin in canned foods; 0.2 mg kg−1 for lead in legume vegetables, cereals and pulses; and 0.05 mg kg−1 for cadmium in vegetables and fruits. All values refer to wet weight.

Exposure to toxic elements by oral passage and through the gastrointestinal tract plays a fundamental role in their entry into the organism where they exert their toxic effect, although the digestive system can decline the crucial importance of their toxicity. In the most cases, the events that occur during the passage of these elements through the gastrointestinal tract is unknown. as well as the ascertaining whether that they may have some kind of toxic effect on it (Vázquez *etal*., 2015). Chemistry of human body is very complex, and the different organisms require some of heavy metals in exacted and limited levels per day (Brown, et.al, 2015). The limits set by US- EPA for mercury was 0.50 µg/g (Neilsen, 2014), whereas the limits of heavy metals for Pb and Cu as showed in table 1.

Table 1. FAO/WHO guide line values for maximum limit of heavy metals in vegetable (Gebregziabher *etal*. 2014)

Heavy metals	Maximum concentration level (mg/kg)
Pb	0.3
Cu	73.3

Aim of study

This study aims to determine the levels of some trace elements in canned beans and compare their levels in fresh and canned samples and determine its suitability for human consumption.

2. Materials and methods:

Sixty cans of Beans samples were dried in oven at 1050C for 24h, then samples were transferred to desiccators, to remove moisture, then samples leaved to matching with room temperature.

The tissue crush by ceramic mortar, then 1g weight from tissue powder and put it in 25 ml glass volumetric flasks and vent closed by a glass plug during digestion. The sample is then taken and digested promptly as follows, the 1gm was weighed into a 25ml glass volumetric flask, and 4.5ml of concentrate HNO3 and 1.5ml of concentrate HClO4 were slowly added, the flask was then shaken well to blend between powder of tissue and acids, the flask was covered by watch glass and left for 24h under the exhaust fan to complete the digestion process.

After that, samples were warm at 700C for 2-3h in block digestion, the flasks take out block the digestion, 2-3ml of deionized distilled water was added.

Then the opening flasks warmed again in block digestion at 700C until the volume of solution reduced to 2ml

The samples transferred to a flask (50 ml) and complete the volume of deionized distilled water. The solution put in clean plastic tube and centrifuge was used with 3500r/m to 30m, the filtered solution put again in flask (50 ml) and this solution was ready for measurement by atomic absorption spectrophotometer. (ROPME,sited in Areej *etal*,2012)

Analysis

A Shimadzu Model 12-630-AA Atomic Absorption/ Flame Emission equipped was used to determine mercury concentration, while copper and nickel concentrations determined by CO- LTD (UK) Model 986- AA Atomic Absorption Spectrophotometer.

3. Statistical Analysis

Data collected were subjected to one way analysis of variance (ANOVA) ($P<0.01$) to assess where heavy metals varied significantly between standard solution and samples.

4. Results and Discussion

Table 2 shows the mean concentration of Copper Cu, Lead Pb and Mercury Hg in fresh and canned foods. Trace elements Cu, Pb and Hg were determined in (60) samples of canned Beans. Statistical analysis showed significant difference ($P<0.01$) between fresh and canned samples, the values for maximum limit of pb and Cu in table 1.

Copper (Cu) concentrations

Copper is an important metal for human body; however, its higher concentration causes serious health problem The main source of contamination of foods with copper was copperware used to store or cook foods, it is released into the environment primarily through mining, sewage treatment plants, solid waste disposal, and industrial wastewater. The results of current study ranged from (1.07 – 1.22 mg\kg) dry weight in fresh samples and from (1.09 – 1.41 mg\kg) in canned samples, these concentrations were within the permissible limit according to FAO / WHO guideline for maximum limits of heavy metals in vegetables.

Figure 1 showed the compares between the concentration of fresh and canned samples for Cu at all seasons

Lead (Pb) Concentrations

Food items should be lead free because it is a toxic metal, it bio-accumulate in the human body and poses serious impacts on the human health. Its long-term exposure can permanently damage human liver. The current study reveals that Lead Pb concentrations were within the allowed limit in all fresh and canned samples were the results ranged from (1.22-1.67 mg\kg) in fresh samples and from (1.41 - 2.181 mg\kg) in canned samples.

Table (2): Concentrations of Trace elements (mg\kg) in fresh and canned samples in beans. During Summer and Autumn 2019 to Winter and Spring 2020.			
Trace elements	Seasons	Average Conc. In fresh samples (mg/kg)	Average Conc. in canned samples (mg/kg)
Cu	Summer	1.22	1.41
	Autumn	1.17	1.19
	Winter	1.09	1.09
	Spring	1.07	1.13
Pb	Summer	1.67	2.81
	Autumn	1.44	1.52
	Winter	1.39	1.45
	Spring	1.27	1.41
Hg	Summer	0.07	0.32
	Autumn	0.05	0.07
	Winter	0.19	0.17
	Spring	0.11	0.55

Figure 3 showed the compares between the concentration of fresh and canned samples for Pb at all seasons

Mercury (Hg) Concentrations

The lab analysis of canned samples for Hg showed that it,s values exceeded the permissible limit, the results ranged from (0.05 - 0.19 mg\kg) in fresh samples and from (0.07 - 0.55 mg\kg) in canned samples.

Figure 3 showed the compares between the concentration of fresh and canned samples for Hg at all seasons

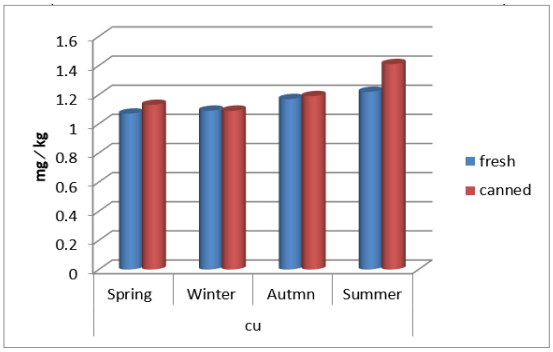

Figure 1: Cu Concentration in canned and fresh samples at four seasons

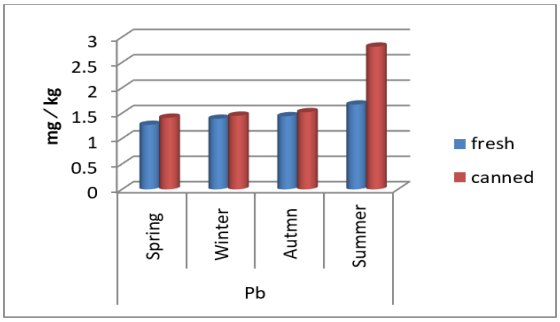

Figure 2: Pb Concentration in canned and fresh samples at four seasons

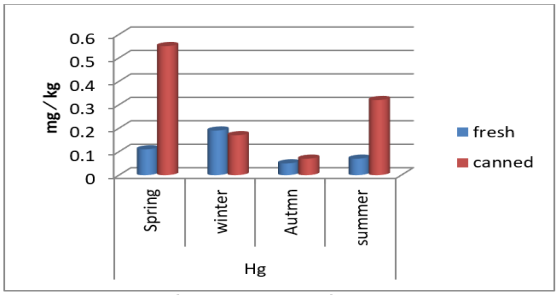

Figure 3: Hg Concentration in canned and fresh samples at four seasons

These findings were comparable to an Egyptian study that found very high levels of Cu in fruits and vegetables (Radwan etal., 2006). Sobukola etal. in 2010 reported lower Cu content i.e., 0.003 mg/kg in canned orange and 0.015 mg/kg in pineapple. Areej etal., 2012 study showed the concentration of copper in fish and meat canned samples don't exceed normal levels.

AL-Rajhi (2014) found that the average value for Pb was lower than the maximum level of Pb 0.5 mg kg−1 permitted by (Joint FAO/WHO, 2011).

Any study doesn't record mercury exist in vegetable samples. The results that recorded by Areej etal., 2012 indicate the concentration of mercury in canned fish and meat samples exceed normal levels.

A study conducted in Saudi Arabia to measure the concentration of 27 elements of mineral and toxic heavy metals in fresh and canned food, the results showed that the mean ranges of the elements analyzed in mg/kg -1 between fresh – canned food are as followed: Lead 2.31 – 7.11 mg/kg, Copper 6.22 – 8.03 mg / kg. (Palestinian Food Industry Union., 2014)

Another study conducted in Lebanese market to assess heavy metals in canned food, Lead had the highest levels in corn and fava beans. (Al – Thagafi etal., 2014)

A study in Riyadh city to determine Lead concentration in beans and canned beans, the concentration obtained were, 0.014 for beans and 0.019 for canned beans mg / g dry weight food. (Korfali and AbuHamdan 2013)

Another study in Turkey performed on 10 canned food from Turkish markets, the contents of the investigated trace elements in canned foods were found to be in the range of 2.85 – 7.77 µg/g for copper, whereas the amount detected by Egyptian study in legumes were 0.013 – 0.281 mg.kg-1 for Pb and 2.839 – 8.012 mg.kg-1 for Cu, in the case of cereals, they ranged from 0.116 – 0.398 mg.kg-1 for Pb and 0.241 – 1.962 mg.kg-1 for Cu (Othman, 2010)

5. Conclusions

Based on the obtained result of the Elemental analysis, the concentrations of mercury in canned beans samples which is hazardous metal, exceeded the normal levels. But none of the samples of lead and copper content had exceeding the acceptable level. The canned samples for Cu and Pb generally,

recorded lower concentration of heavy metals as compared with the fresh food samples and could be considered safer for consumption. The study showed that summer season had the highest recorded concentrations of trace elements in canned Beans samples. Hence the results of this study demonstrate the need for a systemic control of toxic heavy metals in canned food before and after canned and determine other toxic metals in canned food specially in canned vegetables and fruits because the human consumed these types of foods directly.

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