

## Determination of heavy metals in some Cakes types collected from markets in the City of Al-Bayda – Libya

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### Abstract

Heavy metals are chemical elements with high density and atomic weight. Despite their widespread use in various industries and applications, they pose significant risks to the environment and public health if not handled properly. This study was conducted to estimate the concentration of some different elements in different types of cakes, where cake samples were collected from different shops from Al-Bayda city, the study dealt with six types of cakes. Flame photometer was used to estimate sodium and potassium salts and spectrophotometer to estimate heavy elements. The samples were digested using the digestion method using HNO<sub>3</sub> and HCl and heating until the brown oxides evaporate and we get half the amount. The results showed that the concentration of sodium, chromium, iron and copper is below the permissible limits and the concentration of potassium is higher than the permissible limits and the results also showed that the collected cake samples do not contain lead and a discrepancy was observed. The potassium concentration ranged from (541.50 to 763.25), sodium concentration ranges from (1.34 to 3.52), iron concentration ranges from (1.72 to 7.16), copper concentration ranges from (44.36 to 67.62), and chromium concentration ranges from (0 to 0.25). The study could be expanded to include other types of cakes, such as filled cakes to provide a more comprehensive picture of heavy metal contamination in these products. More heavy metals, such as mercury, arsenic, and cadmium, could be analyzed to more accurately assess health risks.

**Keywords:** Heavy metals, Cakes types, market and Al-Bayda – Libya.

## تقدير المعادن الثقيلة في بعض أنواع مختلفة الكعك المجمعة من اسواق

### مدينة البيضاء - ليبيا

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### الملخص

العناصر الثقيلة هي عناصر كيميائية ذات كثافة عالية ووزن ذري مرتفع. وعلى الرغم من استخدامها الواسع النطاق في العديد من الصناعات والتطبيقات، إلا أنها تشكل مخاطر كبيرة على البيئة والصحة العامة إذا لم يتم التعامل معها بشكل صحيح. تم إجراء هذه الدراسة لتقدير تركيز بعض العناصر المختلفة في أنواع مختلفة من الكعك، حيث تم جمع عينات الكعك من محلات مختلفة في مدينة البيضاء، وتناولت الدراسة ستة أنواع من الكعك. تم استخدام جهاز الفوتومتر اللهب لتقدير أملاح الصوديوم والبوتاسيوم، وتم استخدام جهاز الطيف الضوئي لتقدير العناصر الثقيلة. تم هضم العينات باستخدام طريقة الهضم باستخدام حمض النيتريك HNO<sub>3</sub> وحمض الهيدروكلوريك HCl والتسخين حتى يتبخر أكاسيد البني ونحصل على نصف الكمية. أظهرت النتائج أن تركيز الصوديوم والكروم والحديد والنحاس أقل من الحدود المسموح بها، وأن تركيز البوتاسيوم أعلى من الحدود المسموح بها، كما أظهرت النتائج أيضًا أن عينات الكعك التي تم جمعها لا تحتوي على الرصاص وتم ملاحظة وجود تناقض. تتراوح تركيز البوتاسيوم بين (541.50 إلى 763.25)، وتراوح تركيز الصوديوم بين (1.34 إلى 3.52)، وتراوح تركيز الحديد بين (1.72 إلى 7.16)، وتراوح تركيز النحاس بين (44.36 إلى 67.62)، وتراوح تركيز الكروم بين (0 إلى 0.25). يمكن توسيع الدراسة لتشمل أنواع أخرى من الكعك، مثل الكعك المحشو لتوفير صورة أكثر

شمولية عن تلوث المعادن الثقيلة في هذه المنتجات. يمكن تحليل المزيد من العناصر الثقيلة، مثل الزئبق والزرنيخ والكاديوم، لتقييم المخاطر الصحية بشكل أكثر دقة. الكلمات المفتاحية: المعادن الثقيلة، انواع الكعك، الاسواق، البيضاء- ليبيا

## Introduction

Desserts are one of the foremost prevalent confectioneries devoured by all age groups. Among them, children are the foremost pulled in bunch of consumers of desserts and, at the same time, the foremost defenseless for poisonous metals. Harmful metals amass within the body; indeed, utilization of little amount of metals can lead to neurotoxin, carcinogens and brain clutter [1]. Desserts are sugar confectionary of the *obromea Cacao* Seeds. The flavor of desserts contrasts depending on the fixing utilized and the arrangement strategy of cake. Since cake is more well known among children, they are exceptionally concerned around their competitors within the advertiser. Due to this reason, desserts and other confectionaries are sold in a really alluring manner, wrapped in colorful bundling materials. In later times, there's an expanding concern approximately the quality of imported nourishments and nourishment related items in a few parts of the world [2]. This perception was due to the expansive measure of shipments, the numerous distinctive courses of passage, the assortment of nourishments imported, and the huge numbers of potential contaminants that compelling interdiction of sullied nourishments troublesome [3].

Cakes are more often than not sweet, brown nourishment arranged of simmered and ground cocoa seeds that's made within the shape of fluid, past or in a piece: It is consumable but in the event that is in fundamental may cause a few sides impact on human e.g. Diabetic [4]. Cakes could be an ordinary illustration of nourishment related items sold in a few parts of the world and hence, the need for genuine concern. It usually comes in the shape of fluid glue or in squares. Cake may be an immensely nutritious vitality source, with a fast digestion system and great digestibility. The nearness of cocoa, drain and sugar in its composition can be

the guarantee of appropriate ingestion of proteins, carbohydrates, fats, minerals and vitamins [5]. It is of foremost need in this manner, to screen human presentation to overwhelming metals shown within the nourishment chain [6].

Heavy metals are among essential toxins in civil environment, and getting to be a seriously open well-being issue due to their extraordinary poisonous quality and carcinogenicity [7]. People are exposed to the risk of metals all through various pathways since these metals are broadly conveyed within the environment and started from both human exercises and common sources [8][9]. There are a few dissemination sources of overwhelming metals within the environment counting normal climate conditions of the earth's outside, soil disintegration, mechanical effluents, sewage release, mining, urban runoff, applying control specialists on crops illness or creepy crawlies, warming sources and many others. The wide conveyance of overwhelming metals within the human environment can moreover be alluded from broadly chemical applications in businesses, horticulture, pharmaceuticals, homes, and more others [8][9][10][11]. Most overwhelming metals have affirmed to be a poisonous and major wellbeing hazard connected with them since they tend to be bio accumulated interior organ tissues [12][13]. They some of time act as meddled with the human metabolic forms and are destructive to their body. The retained dosage, introduction term and the way of introduction of metals by the human body are the most likely components to be metal harmful. Human inward breath, ingestion and dermal retention are known as primary presentation courses for overwhelming metal contact [14]. A few metals are harmful, get gather red within the body and have a few wellbeing dangers. Metals of poisonous quality can cause an assortment of disarrangements and harm human organs all through oxidative stress produced by free radical arrangement. A few persisting tissues connected with long-term overwhelming metal exposures are metal pass caused by lead presentation. Other that cadmium has impacts on the liver, kidney and gastrointestinal tract [15]. The suggestions of metals harmfulness results on children's wellbeing have been recognized

to be more serious compared to grown-ups. The resultant dangers of these elements' harmfulness on children's wellbeing incorporate behavioral disarray, neurocognitive clutter, mental hindrance, respiratory issues, cardiovascular and cancer maladies [16][17]. One of the basic pathways of intimation to overwhelming metal for people is through suspended or built up tidy within the environment. Clean is by and large characterized as a strong matter composed of soil, common biogenic and anthropogenic metallic constituent materials [18]. Evaluation of Cadmium (Cd), Copper (Cu), Chromium (Cr), Lead (Pb), Nickel (Ni), and Zink (Zn) overwhelming metals' level and conveyance in tidy tests around our environment such as inside, outside, roads, schools, markets, rural areas, and working places has as of late gotten much consideration. In this way, analysts have broadly concerned this issue through examination of different natural tests to survey their characteristics and wellbeing chance appraisal introduction to the human [8][19][20][21][22][23]. Unrefined oils are by and large characterized as a complex blend of inorganic and natural matter. Showing overwhelming metals in unrefined oils can be categorized as inorganic compounds [24]. The nearness of follow metals level can be utilized to classify the quality of unrefined oils in terms of remaining, light, medium, and overwhelming division [25]. The refining treatment of overwhelming unrefined oil could be a constable in comparison to light rough oil due to the tall substance of metals substance [26]. Lead retained from the nourishment and the climate is held in tissue like lungs, liver, kidney, and bones. The brief term and long-term presentation to a high level of lead can cause brain harm, loss of motion, stomach torment, frailty, renal maladies, memory misfortune, harm to kidney, and a regenerative and resistant framework (Toxicology reality sheet arrangement Nourishment Security Specialist of Ireland, 2009). Chromium can exist as Cr (III) or Cr (VI). Cr (IV) frame is profoundly harmful. Chromium (IV) introduction has been known to be related with cancer acceptance in people, particularly bronchial carcinoma and lung cancer [19]. Nickel is additionally a well-known carcinogen to human, by modifying the DNA

capacities. Indeed, through their Deoxyribonucleic acid (DNA) -harming possibilities are or maybe powerless, they meddled with the nucleotide and base extraction repair at nontoxic concentrations. For illustration, both water-soluble Ni (ii) and specific dark NiO significantly diminished the repair of DNA. Ni (ii) aggravated the exceptionally to begin with step a nucleotide extraction repair [16]. Numerous distinctive ponders and strategies for heavy metals assurance in numerous nourishment stuffs have been detailed in the writing. Concentration of chosen metals in candies and chocolate expended in southern Nigeria product examined, the result in chocolate level of Ca, Cd, Ni, Cr, Cu, Pb, Mn, Zn, Fe, Co, and Mg, in candies and chocolate with cruel concentration of metals in both confectionaries which extended between 7.7- 1405  $\mu\text{g/g}$  [27][28]. This study was conducted to estimate the concentration of some different elements in different types of cakes that were collected from different shops in Al-Bayda City.

### Material and Methods:

Chemical Solution that used in the Experiment: Nitric acid ( $\text{HNO}_3$  65%), Hydrochloric acid (HCl, 37%) and Distilled water ( $\text{H}_2\text{O}$ ) obtained from the store of Omar al Mukhtar university.

### Samples Collection

Samples were collected in the period between May and June 2024, from commercial markets as well as shops selling cakes in the city of Al-Bayda. Six samples were taken for each type of cake from different shops and the data for these samples is as follows: Rolls cake (CR), Monalisa cake, (CM), Porto cake (CP), Kamara cake (CK), Pacito cake (CPa) and home cake (CH)[14]( as shown in table 1).

### Sample preparation

All tools and glassware used for preparing samples were washed thoroughly with distilled water and then immersed in a concentrated nitric acid solution and then washed again and several times with water distilled, then samples were digested

American Society for Testing and Materials International (ASTM International).

**Table (1): Shown the cakes' name, nation and manufacturing Date**

Name	Country of Manufacture	Manufacturing data
Rolls cake (CR)	Turkey	2024
Monalisa cake (CM)	Egypt	2024
Porto cake (CP)	Egypt	2024
Kamara cake (CK)	Egypt	2024
Pacito cake (CPa)	Morocco	2024
Home cake (CH)	Libya	2024

### **Samples Digestion**

0.5 g of dry sample was taken, and placed in a 250 ml glass beaker, then 5 ml of HNO<sub>3</sub> conc., was added to it and heated (180<sup>0</sup>C for 15min ) until the brown oxides evaporated, then 5 ml of HCl was added and after that , the solution was evaporated . Then it was filtered into a volumetric flask of 100ml and the volume was completed up to the mark by adding distilled water according to American Society for Testing and Materials International (ASTM International)[29].

### **Instrumentation**

UV-Visible spectrophotometer (DU 800, BECKMAN Coulter) was used to determine the heavy metals and Flame photometer, Located in chemistry department laboratories of Omar al Mukhtar university, was used to determine the mineral metals in the cakes samples under study.

### **Standard preparation**

According to Chukwujindu [27], The standard stock solution was prepared of (iron, copper, chrome and lead) at 1000 ppm, then a serial working solution was made at (2, 4, 6, 8 and 10 ppm) and 1000 ppm for (Sodium, Potassium) at (2, 4, 6, 8 and 10 ppm) concentration for the flame photometer. The averages and graphs were employed by using Excel.

## Results and Discussion:

The presence of mineral elements and heavy metals in nature and in the life's of humans and animals within the permissible limits is desirable, but increasing their concentrations beyond the permissible limits is undesirable due to the presence of the characteristic bioaccumulation of these metals. This study included the determination of heavy metals and mineral elements in different types of cakes. Statistically significant differences were obtained between the mineral contents in the studied samples compared to the maximum permissible limit for mineral contents in cakes according to the World Health Organization and the Food and Agriculture Organization (W H O \ F A O).

**Table 2. Permissible limits for mineral in cakes, estimated in ppm according to WHO / FAO**

The studied metals	Permissible concentration for metals in Cake ( ppm)
Sodium	732
Potassium	196
Iron	4.83
Copper	0.26
Lead	0.38
Chrome	0.30

The results showed that the concentration of potassium in the studied cakes ranged between (763.25 to 541.50) parts per million. The highest concentration value was observed at 763.25 while the lowest concentration value was observed in 541.50[5]. Where all the results were high over the permissible limits allowed by the World Health Organization / Food and Agriculture Organization, which is 196 parts per million (as shown in Table 3 and Figures (1-2)).

The results showed that the concentration of sodium in the studied cakes ranged between (1.34 to 3.52) parts per million. The highest concentration value was observed in 3.52 while the lowest concentration value was observed in 1.34[8]. Where all the results were low over the permissible limits allowed by the World Health



Organization / Food and Agriculture Organization, which is 732 parts per million (as shown in Table 3 and Figures (3-4)).

**Table 3. The Concentration of mineral metals in cakes samples**

Name of Samples	Concentration of potassium g/ml	Concentration of sodium g/ml
CR	665.1017	2.91
CM	763.2540	1.85
CP	723.8651	1.52
CK	645.8791	2.47
CPa	541.5014	1.34
CH	706.7677	3.52
WHO	196	732

**Note** ; CR- Rolls cake, CM- Monalisa cake, CP-Porto cake, CK- Kamara cake, CPa- Pacito cake, CH- Home cake, WHO- World Health Organization

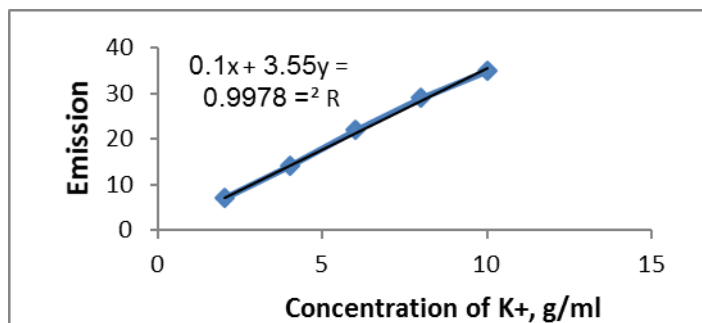


Figure 1. The standard Calibration curve of absorbance of potassium

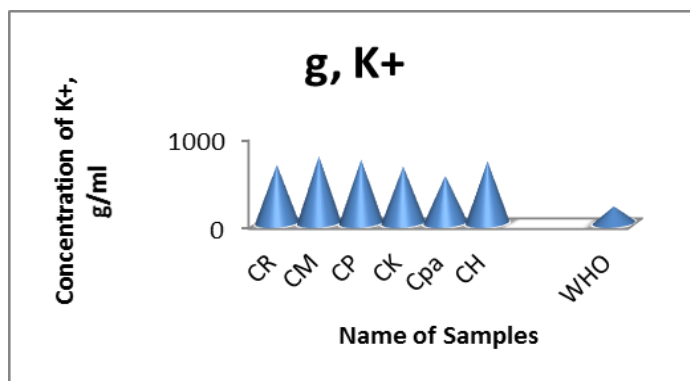


Figure 2. Concentration of Potassium in cakes

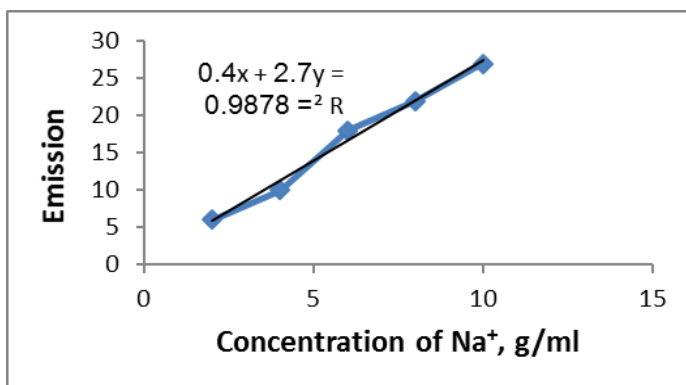


Figure 3. The standard Calibration curve of absorbance of Sodium

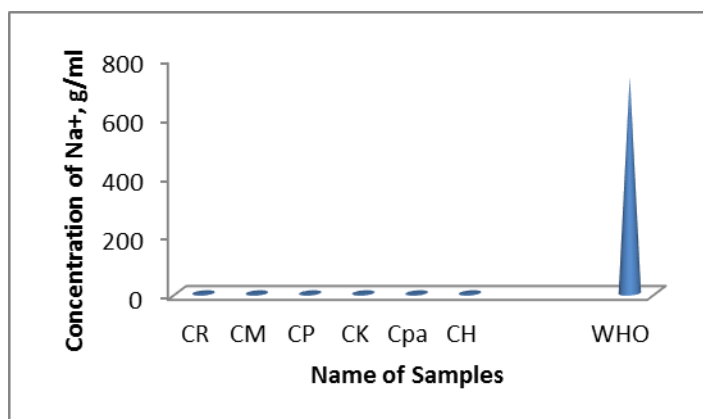


Figure 4. Concentration of Sodium in Cake

Iron is one of the important nutrients for the human body, and its deficiency in the blood causes many health damages, including anemia, and an increase in its concentration leads to iron poisoning, stomach pain, nausea, and vomiting [18]. The figure shows the concentration of iron in the cakes studied in this work. The results showed that the concentration of iron in the studied cakes ranged between (1.71 to 7.16) parts per million. The highest concentration value was observed in 7.16 while the lowest concentration value was observed in 1.71 all the results were low over the permissible limits allowed by the World Health

Organization / Food and Agriculture Organization, which is 4.83 parts per million ( as shown in Table 4 and figures 5- 6). The difference in the iron concentration is likely due to the wide spread of iron in the soil as well as air pollution with this metal which varies from place to place.

If the concentration of copper in the human body exceeds the permissible limit, this leads to health problems, including high blood pressure, anemia and nervous system disorders [8]. It can cause cancer and cause behavioral disorders in children, dermatitis, and liver damage. The results showed that the concentration of copper in the studied cakes ranged between (44.36 to 67.62) parts per million. The highest concentration value was observed in 67.62 while the lowest concentration value was observed in 44.36 all the results were high over the permissible limits allowed by the World Health Organization / Food and Agriculture Organization, which is 0.26 parts per million (as shown in Table 4 and figures 7- 8).

In current study that was conducted to estimate lead in some type cakes, Lead is a toxic substance that affects many body systems, and because of its high toxicity, it affects young children. Due to its serious impact on the health and safety of living organisms, very small concentrations of it are considered very dangerous. Lead poisoning is concentrated in the bones, blood, kidneys, brain, and thyroid gland, and causes deficiencies in their work and leads to death and Mental retardation in children [21]. The results showed that the studied cakes samples did not contain lead and therefore this heavy metal does not have a toxic effect and does not cause any harm to the health of the consumer in the long run (as shown in Table 4 and figure 9).

Chromium is a chemical substance that the body needs in a small amount, but it is of great importance to the body, and this important element plays a major role in health, especially for diabetics, as chromium plays a vital role in the level and activity of the hormone insulin, and a lack of chromium concentration in the body leads to an increase in the rate of stress and nervousness and a decrease in levels Energy in the body, a feeling of general weakness, weakness in the muscles, delay in the stages of growth

and development, especially in young children, and the inability of the body to produce the hormone insulin[30]. One of the reasons for the lack of chromium in the body is the lack of eating foods rich in chromium. Advances in age weaken the body's rate of absorption of the element chromium from foods and taking some medications such as cortisones and antacids. Although chromium is present in many foods, it is found in very small concentrations that may reach 2 micrograms of chromium in one serving. Among the most important foods rich in chromium are red meat, whole grain products, some types of vegetables, fruits, coffee, fish, eggs and nuts. The results showed that the concentration of chromium in the studied cakes ranged between (0 to 0.25) parts per million. The highest concentration value was found in (0.25) while the lowest concentration value was observed [24]. Where all the results were low over the permissible limits allowed by the World Health Organization / Food and Agriculture Organization, which is 0.3 ppm (as shown in Table 4 and figures 10).

**Table 4. The Concentration of heavy metals in cakes samples**

Concentration of Chromium , ppm at $\lambda$ max =542	Concentration of Lead, ppm at $\lambda$ max =514	Concentration of Cupper , ppm at $\lambda$ max =651	Concentration of Iron, ppm at $\lambda$ max = 472	Name of Samples
0	0	55.24455	3.9028	CR
0	0	44.79391	3.0553	CM
0	0	67.27656	1.7162	CP
0	0	67.62283	1.8778	CK
0	0	59.93825	7.1643	CPa
0.245037	0	44.36405	2.6818	CH
0.3	0.382	0.26	4.83	WHO

**Note:**  $\lambda$  max - wave length. , ppm- parts per million, CR- Rolls cake, CM- Monalisa cake, CP-Porto cake, CK- Kamara cake, CPa- Pacito cake, CH- Home cake, WHO- World Health Organization

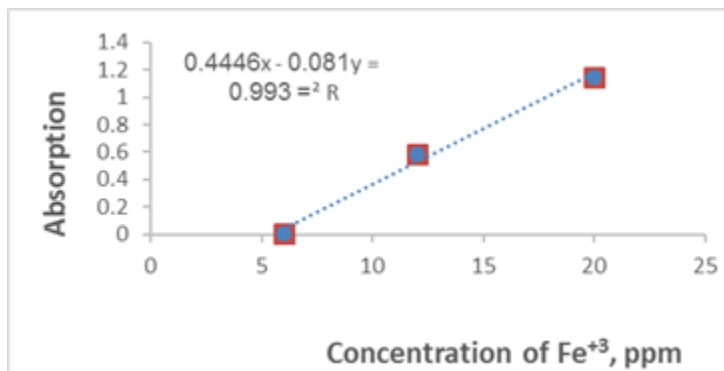


Figure 5. The standard Calibration curve of absorbance of Iron

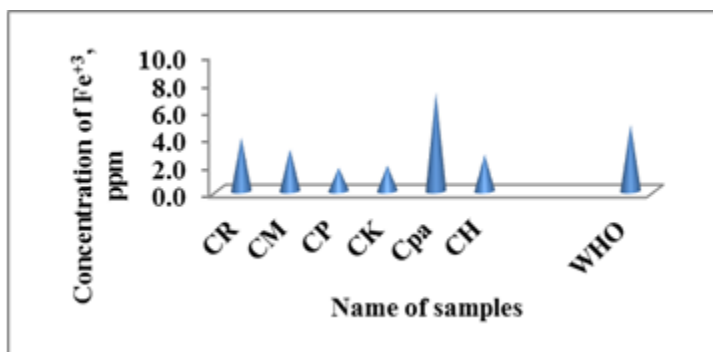


Figure 6. Concentration of Iron in cakes

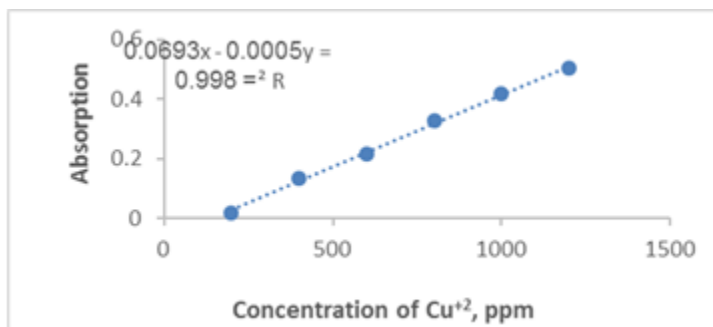


Figure 7. The standard Calibration curve of absorbance of Copper

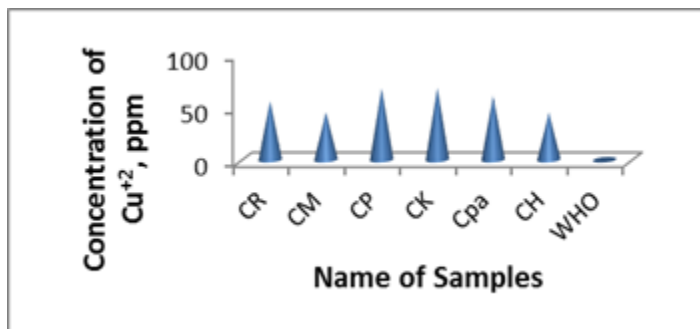


Figure 8. Concentration of copper in cakes

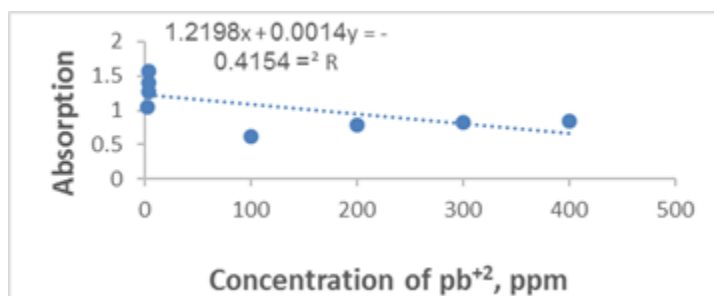


Figure 9. The standard Calibration curve of absorbance of Lead

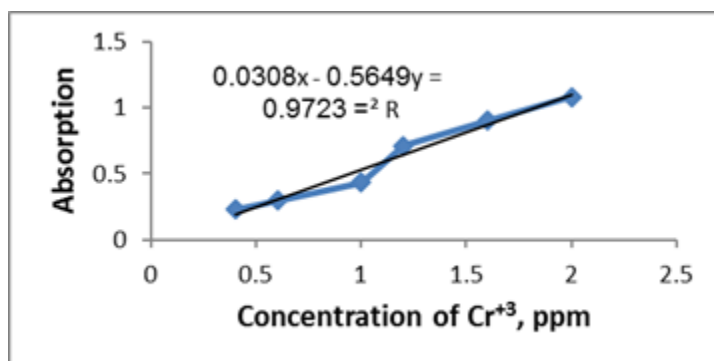


Figure 10. The standard Calibration curve of absorbance of Chrome

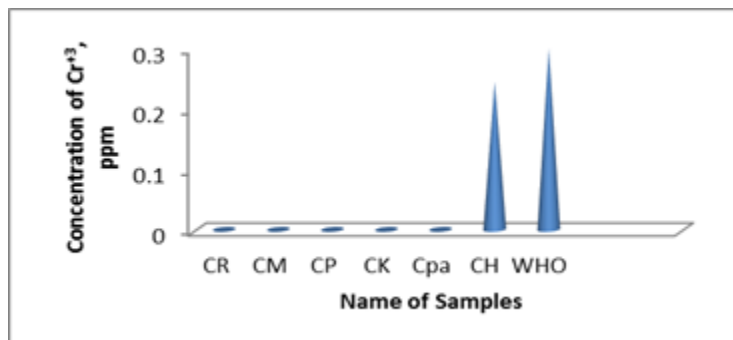


Figure 11. Concentration of Chrome in cakes

## Conclusion

The study dealt with estimating the concentration of some elements for six different types of cakes that were collected from different shops in Al-Bayda city, and a flame photometer was used to estimate sodium and potassium salts and a spectrophotometer to estimate heavy elements. The results showed that the concentration of sodium, iron, copper and chromium is below the permissible limit, and the concentration of potassium is above the permissible limit. The cake samples do not contain lead.

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