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Lead and Cadmium Levels in Some Commercially Available Local and Imported Peach Juice Samples in Alkoms City

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ABSTRACT

This study reports the levels of lead and cadmium in local and imported peach juice samples commercially available in Alkoms city in Libya**.** The levels of the metals were determined in six varieties of juice samples collected from local supermarkets by flame atomic absorption spectrometry (FAAS) after digesting the juice samples with HNO_3 and H_2O_2. The average levels of Pb and Cd found in and the local samples, were in the ranges: 0.004 and 1.22 mg/kg, and in the imported were; 0.004 and 1.36 mg/kg, respectively. Comparison between levels of Pb and Cd in local and imported samples showed that the difference in the levels is not significant. However, the levels of Pb were under the limits of the maximum permit (MPL), while the levels of cadmium were higher in four samples.

INTRODUCTION

Peach fruit juice became an important component of the daily diet around the world. Contamination of fruits and fruit juice with harmful metals may cause serious problems to our health, children are more susceptible to that risk as they like drinking juice compared to the adults. Contamination of plants with heavy metals may occur during growing, processing, and handling, this effect can be toxic and should have high quality in order to protect users from contamination side effects [1].

Heavy elements are those have a density of or more than 5gcm^{-3}. Plants and living organisms need heavy metals in different concentrations, some of them are essential in very low concentrations because of their essential nutritious value but they may have harmful effects if they exceeded the permissible doses [2].

Heavy metals that come from soil, atmosphere and water pollution contaminate our food and beverages which in turn affect our health [3]. Cadmium comes to our body from different vegetables and crops because when in the cadmium contaminated soil the crops grow then it becomes a part of that foodstuff and will affect our health and induces toxicity symptoms like gastrointestinal pains, nausea, respiratory distress, diarrhea, impaired reproductivity, kidney damage and hypertension [4]. Cadmium is a toxic and carcinogenic element; the International agency for research on cancer has identified cadmium as a known human carcinogen [5]. Introduction of lead or lead salts to the human body can occur mostly through inhalation or ingestion. Lead intake accumulates in the different organs of the body and affects all ages [6].

Serious effects associated with lead can damage the brain and peripheral nerves, disrupt the function of mitochondria in the developing brain. Exposure to lead has been associated with reduced IQ, learning disabilities, slow growth, hyperactive, antisocial behavior and impaired hearing. Lead is known to damage the kidney, liver and reproductive system, basic cellular processes and brain function [7].

The present study aims to determine the concentration of toxic elements, Cd and Pb in local and imported manufactured peach fruit juice commercial samples in Alkoms city. This work will be followed by extensive research to prepare a full profile of heavy metals contamination in commercial fruit juice in Alkoms local markets.

MATERIALS AND METHODS

Sample collection and preparation

Commercially available peach fruit juice samples of six different brands were obtained from the local market; three of them manufactured in Libya and the rest were imported. Prior to atomic absorption analysis, fruit juices samples were digested according to the Official method of analysis [8].

10.0 ml of juice sample (digestion step was performed in triplicate) was accurately weighed and transferred to a conical flask and digested with 25.0 mL of HNO_3 acid and 2.0 mL of H_2O_2 then heated on a hot plate for 60 minutes at 105 °C, disappearing of brown fumes and the formation of a clear solution following the optimized digestion procedure. The mixture was cooled to room temperature, filtered, washed, and then diluted to 100 ml in a volumetric flask with deionized water and the sample was then kept in the refrigerator until analysis. All the chemicals used were Analytical Grade Reagents. The element standard solutions used for creating the calibration curves were prepared from 1000 mg/L Merck stock solution of the relevant element.

For heavy metals concentration assessment ContrAA 700 High-Resolution Continuum Source Atomic Absorption Spectrometer from Analytik Jena AG company using furnace graphite technique (Figure 1).

Figure 1: Atomic Absorption Spectrophotometer AA-700 (Furnace Model)

RESULT AND DISCUSSION

Analysis of the data in Table 1 showed that the concentrations of lead in all juice samples were the same and near the detection limits (DL) (0.004 mg/kg, Figure 2). However, these levels could be differentiated by ICP-OES technique which has lower DL. The levels of lead in fruits and vegetables generally are stringently regulated in the European Union [9]. Also, the Lead concentrations in the studied samples were less than Maximum Permissible Limit (MPL), 0.05 mg/kg.

A possible source of lead in the diet is from food containers containing lead, e.g. storage in lead-soldered cans, ceramic vessels with lead glazes and leaded crystal glass, also use of lead as a material for water pipes in many old factories may result in unacceptably high levels in water, subsequently effecting fruit juice production process. Generally, lack of production and filling and packing and even storage conditions data make the diagnosis of contaminations sources difficult.

Table 1: Levels of Pb and Cd (ppm) in Juice Samples

Sample No.	Pb, mg/kg	Cd, mg/kg
S1 (L)	0.0004	1.49 ± 0.006
S2 (L)	0.0004	1.34 ± 0.003
S3 (L)	0.0004	0.84 ± 0.003
S4 (I)	0.0004	2.09 ± 0.006
S5 (I)	0.0004	0.66 ± 0.001
S6 (I)	0.0004	1.34 ± 0.005
MPL	0.0500	1.00

L: Local, I: Imported, MPL: Maximum Permissible Limit (Punjab)

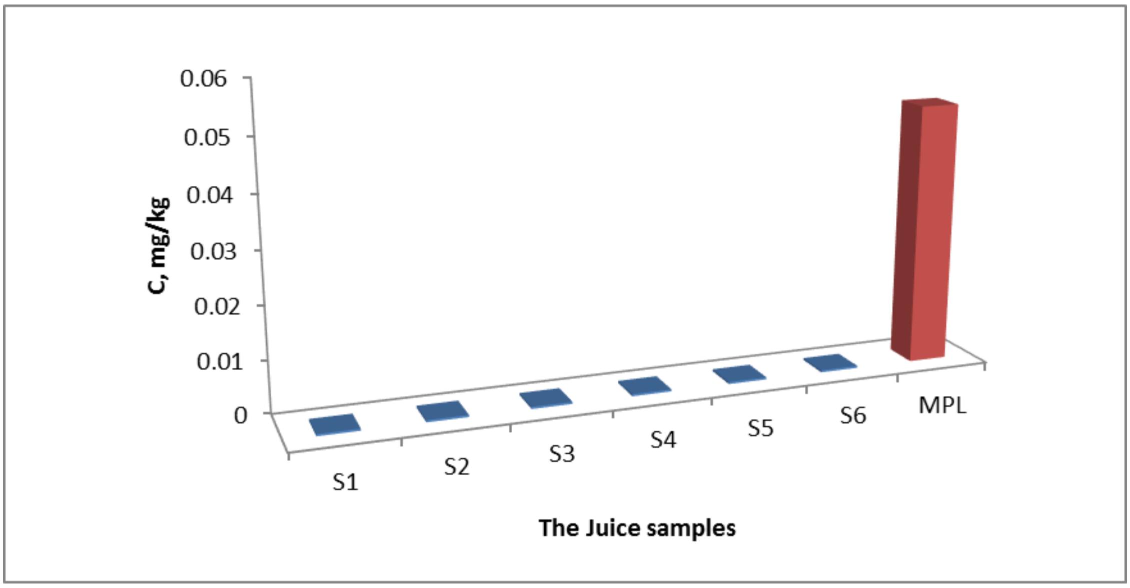

Figure (2) Concentration of lead in juice samples (mg/kg)

As shown in table 1, the concentrations of cadmium were in the range of 0.66-2.09 mg/kg (Figure 3). According to Punjab Pure Food Rules 2011 [3], the maximum permissible limit (MPL) in fruit juices for Cadmium (Cd) is 1.00 mg/kg, while MPL set by European Union Fruit Juice Directive 2001/112/EC & 2009/106/EC was 0.05 mg/kg. Only S3 and S5 samples are below the MPL (0.84 and 0.66 mg/kg respectively) whereas the rest are higher than MPL, the highest and lowest concentrations of cadmium in the studied samples were imported samples, the highest value (S4, 2.06 mg/kg) was as much as doubled the permitted value. The high concentration of cadmium in the juice samples may be attributed to the melting of cadmium from the walls of the cans and the length of the storage period or the contamination of the fruit by fertilizer or water contaminated by cadmium.

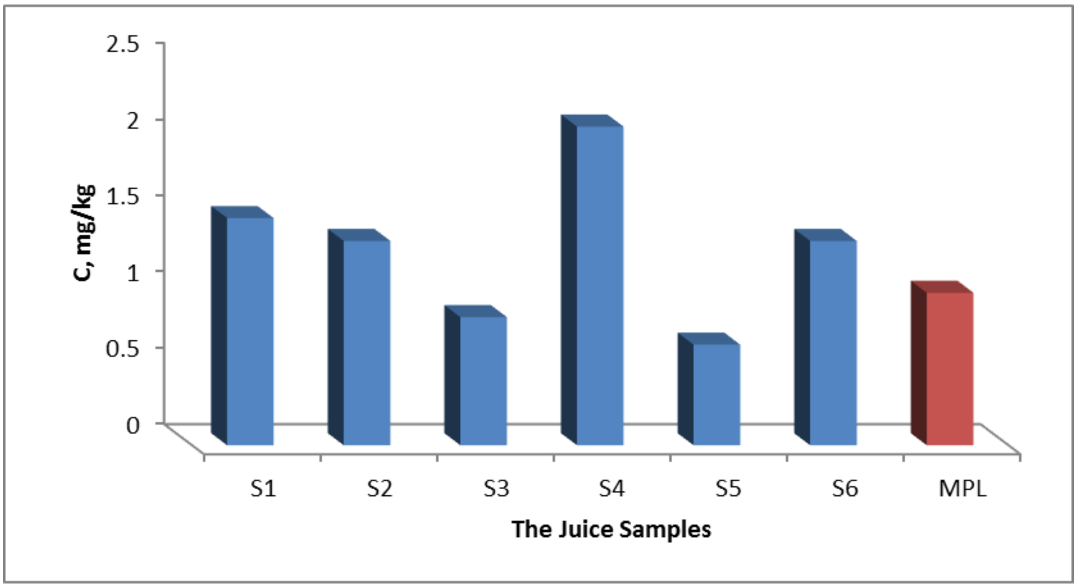

Figure (3) Concentration of Cadmium in juice samples mg/kg

CONCLUSION

The fruit juice samples in Alkoms local market still save as levels of toxic metal lead were under MPL, whereas some fruit juice samples were clearly contaminated with toxic metal cadmium and this may cause some danger to the public health.

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