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Original article

Determination of Heavy Metals in the Fruit of Date Palm (Phoenix Dactylifera) From Different Locations in Tripoli, Libya

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Abstract
In this paper, we present results of the measurement of some heavy metals in 20 samples of Date palm (Phoenix dactylifera) fruit during the summer of 2024. Date palm is an important source of nutritional elements for people in Libya. This study aims to determine the concentration of Mn, Fe, Zn, Cd, Pb, and Cr. In Date palm fruit and we using Inductively Coupled Plasma-Optical Emission Spectrometry (5110 ICP-OES) the concentration Ranges in the Date palm samples were: 2-7, <0.002-110, <0.002, <0.002-5, <0.002-40, <0.002-2.5 ppm for manganese, iron, zinc, cadmium, lead and chromium, respectively.
Keywords. ICP-OES, Heavy Metals, Date Palm, Health Risk.

Introduction

Date palm (Phoenix dactylifera L.) is one of the oldest cultivated trees, and its fruit (dates) has been used as a foodstuff for about 6,000 years. Nowadays, date palm is one of the most consumed fruits in the Arab countries [1]. World dates production has increased from 4.4 million tons in 1993 to 7.5 million tons in 2012, and it is expected to continue increasing in the future [2]. Several studies about date palm composition have been recently reviewed [3]. The heavy metals (Cadmium, Lead, and Chromium), which are natural components of the Earth's crust, are usually associated with toxicity. Exposure to heavy metals, even at trace levels, is known to be a risk for human beings [4]. The presence of zinc, cadmium, nickel and others metals in the aqueous environment has a potentially damaging effect on human physiology and other biological systems when the acceptable levels are exceeded [4].

The exisistance of heavy metals in date palm at impermissible level can cause many diseases at the human body such as kidney failure, infertility, many kinds of cancers, weakened in immune system and nervous system disorders [5] Therefore, it must be taken into account that elements such as iron, copper and zinc play an important role as vital elements needed for the proper functioning of the human body, while elements such as lead, mercury, arsenic and cadmium are considered harmful to the human body [5].

Air pollution with lead and cadmium resulting from various industrial activities and thus contaminating soil, water, food, and plants with such toxic elements and their incorporation into the food chain, which causes a great danger to human and animal health [5]. This study aims to verify the quantity of some essential and non-essential heavy metals in various types of date palm consumed in the markets in Tripoli, Libya, and to compare the obtained results with Libyan and international standards.

Methods

Chemicals

All chemicals used in this study were analytical grade (Sigma Aldrich), and Deionized water was used for the preparation of all solutions.

Sample collection

20 different types of date palm samples were randomly selected from different Supermarkets in Tripoli. Table 1 shows the types and identification of date palm samples. All samples were kept in a plastic bag, and then Transferred to the laboratory for investigation.

Table 1. Types and identification of date palm samples.

No	Product name	No	Product name	No	Product name	No	Product name
1	Saudi agua	6	bekrari	11	eibel	16	degla gahfeer
2	saheedy no 2	7	tabony	12	khadraya	17	degal jalow
3	halima	8	sokary	13	degla wedan	18	degal 1
4	brmil	9	broncy	14	degala ojlla	19	degla 2
5	majhool	10	biothy	15	saheedy asfar	20	homraya

Samples treatment

The date fruits from designated varieties were collected during summer 2022 from different locations of Tripoli, Libya, at the mature ripened stage, washed in portable water to remove dirt. After washing, the dates were air dried and placed in polyethylene zip lock bags and kept under refrigerated conditions, and brought to the Environmental Safety Laboratory. Nearly 0.5 kg of deseeded date fruit of each variety was mashed separately to get a homogeneous and representative sample. After that, a 1 g sample was weighed accurately

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and digested using 10 mL of concentrated nitric acid, and perchloric acid in the ratio 2:1 was added. The samples were heated for 45 min at 90C^0; later, the temperature was increased to 150 C^0 at which the samples were boiled for at least 2–3 h until a clear solution was obtained.
Concentrated nitric acid and perchloric acid were added with hydrogen peroxide to the Sample (5 mL was added at least three times) and digestion continued until the volume was reduced to about 1 mL. The interior walls of the tube were washed down with a little DDW, and the tubes were swirled throughout the digestion to keep the wall clean and prevent the loss of the samples.
After cooling, 5 mL of 1% HNO3 was added to the sample; the solution was filtered using Whatman No. 42 filter paper. The filtrate was then transferred to a 25 mL volumetric flask, and the volume was made up using distilled water. The content of heavy metals (Cd, Fe, Cr, Mn, Zn, and Pb) was determined by Inductively Coupled Plasma-Optical Emission Spectrometry (5110 ICP-OES).

Results and discussion

This study was carried out to evaluate the trace metal contents of Date palm fruit from markets in Tripoli, Libya. Metal contents (Mn, Fe, Zn, Cd, Pb, and Cr) of the samples determined by ICP-OES are reported in Table 2.

Heavy metal contents.

Lead content

All date palm samples had measurable Pb contents. The Average of Pb concentration was 8.2 ppm in the samples (Table 2). It was almost similar to the value reported previously [6]. But it was slightly greater than the value of the present study (9.343 ppm), nevertheless, another study reported a lower value, which was 3.81 ppm [7].

Cadmium content

Average Cd content was 1.22 ppm (Table 2). The concentration detected by Taha et al. [7] ranged from 0.09 –28 ppm, which was higher than our results.

Iron content

The average Fe concentration was 24.526 ppm in the samples (Table 2). The concentration detected by a previous study was similar to this study [8], which ranged from 38.8–115 ppm, but Badarusham et al. [9] reported a lower value, ranging from 8.08 –13.5 ppm.

Zinc content

Mean Zn concentration was < 0.001 ppm in the samples (Table 2), the concentration detected by [10] ranged between 0.000214 – 0.00243 ppm

Chromium content

Average Cr content was 0.685 ppm in the samples (Table 2), which was higher than the average value reported by [11]. It was 0.122 ppm.

Manganese content

The average Mn content was 2.863 ppm in the samples (Table 2), which was almost similar to the value obtained by Badarusham et al. [9]. It ranged from 1.62–3.36 ppm, but Taha et al. [7] reported a higher value, which was 53.36 ppm on average.

Table 2. Concentration of heavy metals in different Date palm samples (ppm).

Sample name	Sample code	Mn (ppm)	Fe (ppm)	Zn(ppm)	Cd (ppm)	Pb (ppm)	Cr (ppm)
Saudi Agua	SDG	3.75	12.5	<0.002	3.75	<0.002	2.5
Saheedy No 2	SD2	2.50	<0.002	<0.002	1.25	<0.002	<0.002
Halima	HLM	5.00	18.00	<0.002	1.00	10.00	1.00
Brmil	BRM	7.00	20.00	<0.002	5.00	40.00	1.00
Majhool	MJL	2.00	21.00	<0.002	<0.002	<0.002	<0.002
Becrari	BCR	3.00	110	<0.002	1.00	10.00	1.10
Tabony	TAB	4.00	40.00	<0.002	1.00	<0.002	1.10
Sokary	SOK	4.00	24.00	<0.002	1.00	13.00	1.00
Broncy	BRN	2.00	47.00	<0.002	1.00	11.00	4.00
Biothy	BIO	3.00	40.00	<0.002	1.40	50	<0.002
Eibel	EBL	4.00	20.00	<0.002	1.00	<0.002	<0.002
Khadraya	KDR	2.00	5.00	<0.002	1.00	9.00	<0.002
Degla Wedan	DWD	3.00	51.00	<0.002	1.00	<0.002	1.00
Degala Ojlla	DOJ	2.00	13.00	<0.002	2.00	20.00	<0.002

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Saheedy Asfar	SDF	3.00	62.00	<0.002	1.00	<0.002	<0.002
Degla Jahfeer	DJF	2.00	<0.002	<0.002	<0.002	<0.002	<0.002
Degal Jalow	DJL	1.00	<0.002	<0.002	<0.002	<0.002	<0.002
Degal 1	DG1	1.00	2.00	<0.002	1.00	<0.002	<0.002
Degla 2	DG2	1.00	00.00	<0.002	<0.002	<0.002	<0.002
Homraya	HOM	2.00	7.00	<0.002	1.00	1.00	1.00

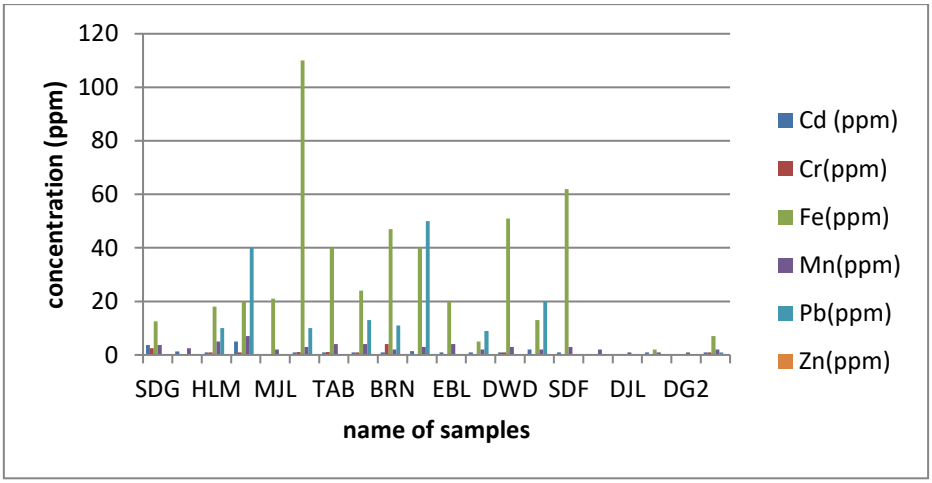

Figure 1. Concentration of heavy metals in different Date palm samples.

Conclusion

As seen from the results and the table 2 the study results revealed that (Cd, Fe, Cr, Mn, Zn and Pb) in 20 kind of date palm fruit from deffrent market in Tripoli the method was fast, easy and accurate to moniter heavy metals in date palm where we used Inductively Coupled Plasma-Optical Emission Spectrometry ICP-AES.

Conflict of interest. Nil

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المستخلص

في هذه الورقة، نعرض نتائج قياس بعض المعادن الثقيلة في 20 عينة من ثمار نخيل التمر خلال صـــيف عام 2024. يُعدّ نخيل التمر مصـــدرًا هامًا للعناصر الغذائية في ليبيا. تهدف هذه الدراسة إلى تحديد تركيز كل من المنغنيز، والحديد، والزنك، والكادميوم، والرصاص، والكروم. في ثمار نخيل التمر، وباسـتخدام مطيافية الانبعاث الضـوئي البلازمي المقترن حثيًا، كانت نطاقات التركيز في عينات نخيل التمر: 2-7، <0.002-110، <0.002، <0.002-5، <0.002-40، <0.002-2.5 جزء في المليون للمنغنيز، والحديد، والزنك، والكادميوم، والرصاص، والكروم، على التوالي.

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