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Measurment Heavy Metals of Three Cultivars of Date (*Phoenixdactylifera L.*) from Sudan

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Abstract

The date palm (*Phoenix dactylifera* L.) is one of mankind's oldest cultivated plants. A date palm fruit is an important component of the diet in most of the hot arid and semi-arid regions of the world. The Present study aimed at investigating two heavy metals (lead, Pb) and (cadmium, Cd) as mg/kg in three date palm cultivars cultivated in Sudan (Gondalia, Barakawi and Kulma). The results showed insignificant ($p \geq 0.05$) concentration of the two heavy metals (cadmium and lead) between the various cultivars in the four local market (sites) (Libya, Bahri, Soug Sitta and workshop). Cadmium concentration was ranged from (0.006-0.043mg/kg) and lead (0.02-0.029mg/kg) for all cultivars at the four locations. Although most of the cultivars had comparable concentration of cadmium, workshop showed the highest (0.043mg/kg) cadmium. Soug Sitta showed the highest levels of lead (0.029mg/kg) among the other four locations. Results revealed that that cadmium concentrations of the study at low concentrations if compared with limit of Codex Alimentarius Commission (2011) inverse to lead concentration. Finally, new ways of exhibition and packaging of date should introduce for safety and protection from any contaminant and heavy metals, which was set as a recommendation.

Introduction

The date palm, (*Phoenix dactylifera L.*) is a tree of considerable agricultural, cultural, economic and scientific importance in many Arab countries especially those with dry weather in arid regions and semi-arid regions [1,2]. Date palm is one of the major fruit crops in the Sudan because of the prevailing favorable climate for date cultivation, availability of abundant irrigation water and long-term experience acquired by the population in date cultivation together with related activities [3]. The major production areas of dates are the Northern and Nile States that are famous of a large number of cultivars such as Mishrigy, Wad Lagai, Wad Khatib, Barakawi, Gondalia, Gau and others that are differ mainly in moisture contents but the major production date in Sudan is based on dry dates for which Sudan is very famous Khairi MMA, et al. [4].

Sudanese dry dates is consumed as fresh varieties and are available throughout 8 months of the year, which is, full of most important nutrients such as carbohydrates, sugars and [5-7]. Harvesting, transporting, handling and storing of dry dates in Sudan is usually facilitate in simple containers like sacks and bags [4] due to low moisture and high sugar content without addition of preservatives. Marketing of these dates is usually without packaging at local markets for consumers and sometimes small retailers exhibit some dates in travelling cares near at crossroads where crowding and traffic jams. This method of marketing might affect the nutritive value of dates and might exposure the dates for air pollution and toxicity due to anthropogenic activities and fossil fuel combustion caused by rapid increasing of population in urban areas [8]. Emissions from road traffic that uses fossil fuel, industry, agriculture, sewage sludge, and

waste incineration are the chief sources of air pollution [9]. The term of heavy metals and semi-metals refer to metals with more than 4g/cm3 density per cubic centimeter and atomic weight of 5, 63 to 3,200, These elements are toxic for the organisms in concentrations above the critical threshold [10,11]. Heavy metals considered as one of the most important pollutants to the environment because of their toxicity, non-biodegradability [12]. Of all the heavy metals, cadmium (Cd) and lead (Pb) are the major hazardous air pollutants and toxic. In addition to they have more significant side effects on human health, since they are easily accessible through food chain transmission [10] and it is very difficult to wash off all the dust particles from the plant material before ingestion [9,13].

Study the heavy metals contamination in the fruit of date palm is important to that could presumably use as a biological indicator of heavy metal pollutions as to decide if it is safe or not for human consumption. The general objective of this study is evaluating two heavy metals in four different marketing sites (polluted) in Khartoum province.

Studies regarding the contamination of heavy metals in the fruit of date palm are scanty in Sudan. Results of the study would help to understand the underlying causes of several diseases because of consumption of the contaminated substances from the environment like toxic heavy metals in common foods, which have important effects on public health.

Materials and Methods

Materials

One kilogram of rape fruits of date palm (*Phoenix dactylifera L.*) of three different popular cultivars in Sudan (Barakawi, Gondaila and Kulma) was collected and purchased randomly from local markets (at crowding and traffic jam junction sites) of Bahri, Libya, Soug Sitta and heavy machine work shop near local market during October 2019 from small retailers. The collected samples were chosen of the same sizes approximately, and free of defects. The samples were kept in labeled polyethylene pages and transported to the laboratories of Bahri University for further preparation and analysis.

Preparation of the Samples

The three cultivars that were collected from the four sites were homogenized manually. About (500 g) of each cultivar was weighed and kept in polyethylene bag labelled G for (Gondalia)–B for (Barakawi) and K for (Kulma) to resemble the three cultivars. Numbers (1,2, and 3,4) were used for the labeling of four local market sites (Bahri local market, Libya local market, Soug Sitta local market and heavy machine workshop), respectively. The four samples of each cultivar were prepared by removing manually of seeds and only the edible parts were used for analysis. Samples were kept in freezer at -18°C until further analysis.

Chemical Methods

Lead and Cadmium Determination

Concentration of heavy metals was carried out by using Atomic Absorption Spectrophotometer, (Thermo Scientific Pvt. Ltd. India Model No. AA 350) Double Beam and deuterium background hollow cathode lamps of Pb and Cd were used at specific wavelengths. All samples were run in triplicates. Wet ashing method according to AOAC (2005) [14] was applied. Two grams of each cultivar from one site was placed in a 250 mL digestion tube and 10 mL of concentrated nitric acid and perchloric acid in the ratio2:1 was added. The sample was heated for 45 min at 90°C; later, the temperature was increased to150°C at which the sample was boiled for at least (2-3) h until a clear solution was obtained. Concentrated nitric acid and per chloric acid were added with hydrogen peroxide to the sample (5mL was added at least three times). Digestion process was continued until the volume reduced to about 1mL.The interior walls of the tube were washed down with a little deionized distilled water (DDW) and the tubes were swirled throughout the digestion to keep the wall clean and prevent the loss of the samples. After cooling, 5mL of 1% HNO3 was added to the sample. Thereafter, the solution was filtered using Whattman No.42 filter paper. The filtrate then was transferred to a 25mLvolumetric flask and volume was made up using distilled water.

Statistical Analysis

The data carried in triplicate and assessed by analysis of variance (ANOVA) procedure. Means were separated using Least Significant Difference (LSD) test with probability $p<0.05$.

Results and Discussion

Determination of Heavy Metals

Study the heavy metals contamination in the fruit of date palm is important to that could presumably be used as a biological indicator of heavy metal pollution to decide if it is safe or not for human consumption [9].

(Tables 1&2) illustrates the cadmium and lead concentrations as mg/kg on fresh weight basis in the four contamination sites.

	Barakawi	Gondaila	Kulma	LSD
				0.05
Site(Bahri)	0.008±0.001	0.008±0.001	0.01±0.001	0.006
Site(Libya)	0.008±0.001	0.01±0.001	0.006±0.001	0.045
Site(Soug Sitta)	0.014±0.001	0.015±0.001	0.022±0.001	0.009
Site(workshop)	0.03±0.001	0.043±0.001	0.024±0.001	0.006
Sig	Ns	Ns	Ns	

Table1: Cadmium concentration of three cultivars of date as (mg/kg) on fresh weight basis at four sites.
Ns=no significant difference.

	Barakawi	Gondaila	Kulma	LSD
				0.05
Site(Bahri)	0.021±0.001	0.022±0.001	0.025±0.001	0.021
Site(Libya)	0.02±0.001	0.023±0.001	0.022±0.001	0.014
Site(Soug sitta)	0.024±0.001	0.025±0.001	0.029±0.001	0.014
Site(workshop)	0.022±0.001	0.021±0.001	0.020±0.001	0.02
Sig	Ns	Ns	Ns	

Table 2: Lead concentration of three cultivars of date as (mg/kg) on fresh weight basis in four sites.
Ns=no significant difference

Cadmium Concentration of Three Date Cultivars

Table 1 displays the concentration of cadmium as mg/kg of the three date cultivars (Barakawi, Gondalia and Kulma) on fresh weight basis at four locations. Results of the four locations showed in significant ($p \geq 0.05$) concentration of cadmium in the three cultivars of date. Although there is insignificant ($p \geq 0.05$) differences between the three cultivars, Gondalia cultivar showed the highest concentration of cadmium with (0.043mg/kg) at workshop followed by Barakawi and Kulma cultivars (0.03 and 0.024mg/kg), respectively also at the workshop location. The lowest cadmium was recorded in Kulma at Libya local market with (0.006 ±0.001mg/kg) compared to the other two cultivars at the four sites. This result is lower than Taha kk, et al. [13] who reported a range of (0.00-99.6mg.kg-1) for ten unwashed dry date samples from Saudi Arabia with an average of 28.9mg. kg-.1 and Priyanka S, et al. [11] who reported 0.51-5.1mg/kg for four fruits from India. These differences in cadmium concentration might refer to differences in cultivars, locations, geographical areas and method used for detection.

Regardless to sites, cadmium concentration for the three cultivars was comparable at the three local markets. High concentration of cadmium at workshop may be due to fact that toxic metals dispersed in the environment through industrial effluents, organic wastes, refuse burning, and transport and power generation. They carried to places many miles away from the sources by wind, depending upon whether they are in gaseous form or as particulates. Thus, air is also a route for the pollution of environment [15].

Among locations, workshop showed the highest cadmium concentration in the three cultivars (0.024-0.043mg/kg). This may indicate an external source of the elements that may be the dust or pollution due to the industry of heavy traffic [15]. Among local markets, Soug Sitta showed the high concentration of cadmium after workshop for the three cultivars, which might attributed to the highest population lived there, and it considered as the vast local market among Bahri and Libya local markets. The release of high concentrations of cadmium form the number of several sources including employment in primary metal industries, eating contaminated food, with smoking being a major contributor Tchounwou PB, et al. [16].

Cadmium is toxic with severe impact upon kidney function and bone metabolism to the extent of being carcinogenic Shafiq M, et al. [17].

The different level of cadmium in the three cultivars might attribute to the differences concentration of cadmium in air where the date was sold. Cadmium released to the atmosphere through metal production activities, fossil fuel combustion, and waste incineration but the main cadmium compounds found in air are cadmium oxide, chloride, and

sulfate, and these compounds expected to undergo minimal transformation in the atmosphere that lead to the fate of cadmium in air through transport and deposition. Cadmium can travel long distances in the atmosphere and then deposit (wet or dry) onto surface soils and water, which can result in elevated cadmium [18].

The maximum levels of contaminants and toxics in food (part1) according (CODEX ALIMENTARIUS COMMISSION, 2011) [1] for cadmium list as (0.05mg/kg) which is higher than the level of cadmium of the study that was ranged from (0.006-0.043mg/kg) for the three cultivars in the four locations. Thus make the date is safe from lead contaminations. Instead, Packaging of fruit of dates palm for protection from any contaminant and heavy metals is preferable because of the high degree of toxicity of cadmium.

Lead Concentration of Three Date Cultivars

Table 2 illustrates the lead concentration of the three cultivars (Barakawi, Gondalia and Kulma) at the four locations. Results of the four locations showed also insignificant ($p \geq 0.05$) concentration of lead. Although there is insignificant ($p \geq 0.05$) differences between the three cultivars, Kulma contained the highest lead with (0.029mg/kg) in Soug Sitta, followed by Gondalia and Barakawi (0.025, 0.024mg/kg), respectively. Among local markets, Soug Sitta was highly of lead for the three cultivars compared with three other local markets. Results indicated that Soug Sitta could consider as the most contaminate locations compared to the other three locations, this might related to the natural occurrence of lead in the environment, anthropogenic activities such as fossil fuels burning, mining, and manufacturing contribute to the release of high concentrations [19].

Soug Sitta considered of vast local market of high population (compared to the two local market of the study), there, it is observed in such locations fruits and date was usually exhibit to the consumers by small retailers at evening where low light is available and they usually used lamb that contained lead which might indicate another source of lead in such markets. Therefore, it is advisable to exhibit dates in glass containers with cover in such locations to protect from pollution by heavy metals and to reduce the health effect of lead, which include delayed development in children, both mental and physical, anemia, vomiting, kidney damage, blood pressure [17].

Lead concentration of the three cultivar at the four locations was ranged from 0.02-0.029mg/kg. This result is lower than Taha kk, et al. [13] who measured concentration of lead (Pb) for unwashed date from Saudi Arabia that range (0.78-5.83mg.kg-1) with an average of 3.81 (mg•kg-1) which was measured by AAS.

Among location workshop showed the lowest level of lead in the three cultivars, inverse to the previous results of cadmium. The concentration of Pb in the dust and fruit tissue increased with increasing anthropogenic sources according to the study of Aldjain IM, et al. [9]; Salama KF, et al. [20]. Therefore, fruits of date palm might be used as a pollution indicator. The maximum levels of contaminants and toxics in food (part1) According (CODEX ALIMENTARIUS COMMISSION, 2011) [1] for lead listed as (0.1-0.2mg/kg). Result of the study of lead that was ranged from (0.02-0.029 mg/kg) for the three cultivars in the four locations is higher than the limits. This means that the date is not safe from lead contaminations.

Because of their high degree of toxicity cadmium and lead rank among the priority metals that are of public health significance. These metallic elements considered systemic toxicants that are known to induce multiple organ damage, even at lower levels of exposure [21]. It might be recommend that fruits of date palm could be safe for human consumption after washing.

Conclusion

The present study aimed at investigating two heavy metals (lead and cadmium) as mg/kg in date palm cultivars from Sudan (Gondalia, Barakawi and Kulma). The results showed insignificant ($p \geq 0.05$) concentration of heavy metals between the various cultivars in the four contamination sites (Libya, Soug Sitta, Bahri and workshop), the concentration of cadmium in the three cultivars in the four locations ranged(0.006-0.043mg/kg).The concentration of Lead in the three cultivars in the four Locations range (0.02-0.029mg/kg).

Although the insignificant results of lead and cadmium, cadmium Showed high concentration in workshop for the three cultivars while, lead showed high concentration in Soug Sitta for the three cultivars because of the crowding. Results revealed that Cadmium at low and safe concentrations in the examined locations inverse to lead concentration. It was recommended to wash of the fruit of dates after purchasing from local market before eaten in addition to packaging of dates for protection from any contaminant and heavy metals.

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