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## A STUDY ON HEAVY METAL CONTENT IN DATES AVAILABLE IN DOMESTIC MARKET IN INDIA

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### ABSTRACT

*Phoenix dactylifera*, commonly known as date or date palm, is a flowering plant species in the palm family, *Arecaceae*, cultivated for its edible sweet fruit. Dates are very rich in nutritive components, viz., carbohydrates, fats, minerals, protein, vitamins and dietary fibres. Dates are of two types Unpitted and pitted. Pitted dates are fruits that had their stones removed. Pitted dates without the pit are loaded with natural sweetness and can be used for noshing or baking. Pitted dates are firm, easy to chop up and can be used in variety of recipes. They can be stuffed with various fillings such as nuts (walnuts and almonds). The dates are directly consumed without any processing. Exposure of heavy metals to human beings has risen dramatically in the last 50 years. In today's urban and industrial society, there is no escaping from exposure to toxic chemicals and heavy metals. Humans are more likely to be exposed to heavy metal contamination from the dust that adheres to edible plants than from bioaccumulation. The objectives of this study was to determine the concentrations of lead (Pb) and copper (Cu) in Unpitted and Pitted dates received from different parts of India and also to assess whether the fruits were safe for human consumption.

Out of 50 samples of unpitted dates, only 12 samples were showing low level of Lead (Pb) ranges from 0.0093 ppm to 1.9516 ppm. As per FSSAI, the maximum permissible limit in "food not specified category" is 2 ppm (max.). Out of 51 samples of pitted dates analyzed, 9 samples were showing low level of Lead ranges between 0.0018 ppm to 0.2461 ppm. It clearly indicates that all the samples were found to contain Lead (Pb) within the permissible limit as specified by FSSAI.

Out of 50 samples of Unpitted dates analyzed, 8 samples were containing low level of Copper (Cu) content ranges from 0.0043 ppm to 1.9038 ppm. In case of pitted dates, 10 samples were found to contain Copper (Cu) content ranges from 0.0089 ppm to 0.128 ppm. As per FSSAI, the maximum permissible limit in "foods not specified category" for Copper (Cu) is 30 ppm. It clearly indicates that all the samples were found to contain Copper (Cu) within the permissible limit as specified by FSSAI.

The fruits of date palm are safe for human consumption. The concentration of Lead (Pb) and Copper (Cu) in all the dates samples (both unpitted and pitted) collected from different regions of India is within the safe limits as prescribed by FSSAI.

**Keywords** – Dates, Heavy metal, Atomic absorption spectrometry, Lead (Pb), Copper (Cu).

### INTRODUCTION

The date palm (*Phoenix dactylifera* L., family-Arecaceae) is one of the oldest cultivated trees in arid and semi-arid regions. The tree is valued mainly for its fruits (date) as well as for its ornamental value almost in every garden. Dates are very rich in nutritive components viz., carbohydrates, fats, minerals, protein, vitamin, and dietary fibers<sup>1,2</sup>. Dates make a sweet and nutritional snack. The date fruit consists of 70 % carbohydrates (mostly sugars), making it one of the most nourishing natural foods available to man. In most varieties, the sugar content of a date fruit is almost entirely of the inverted form (namely glucose and fructose), important for persons who cannot tolerate sucrose. The invert sugar in dates is immediately absorbed by the human body without being subjected to the digestion that ordinary sugar undergoes. The flesh of dates contains 60 to 65 % sugar, about 2.5 % fiber, 2 % protein and less than 2 % each of fat, minerals, and pectin substances. Date fruits are also a good source of iron, potassium, and

calcium, with a very low sodium and fat content. In addition, moderate quantities of chlorine, phosphorous, copper, magnesium, silicon and sulphur are also found in the date fruit. To grow as they should, date palms require the right balance of environmental factors including a sufficient direct sunlight and just the right amount of water as allowing the soil to dry out can be disastrous and stop the date palm from growing completely. They also require fertilizer and just the right temperature (above 20°C). Because of these requirements, the areas in which they can be grown are restricted. Typically, they are grown tropical or sub-tropical countries which can offer the right climate. In India, it is cultivated in Kachchh district of Gujarat with a production of 85351 tonnes per annum of fruits. Dates are of two types Unpitted and Pitted. Pitted dates are fruits that had their stones removed. Pitted dates are without the pit are loaded with natural sweetness and can be used for noshing or baking. Pitted dates are firm, easy to chop up and can be used in variety of recipes. They can be stuffed with various fillings such as nuts (walnuts and almonds). In fact, dates are so versatile that different countries have found their own novel uses for date fruit. They actually make an effective natural binding agent in baked treats. Date pectin, dietary fiber and syrup are some of the date substances which can find a plethora of applications as a thickener or gelling agent in processed foods, i.e., confectionery products, jams, table jellies, soft cheeses, yoghurts, etc.

The main sources of heavy metals in plants are their growth media, nutrients, agro inputs, soil and others factor such as pesticides and fertilizers. Heavy metals along with other pollutants are discharged to the environment through industrial activity, automobile exhaust, heavy duty electric power generators and pesticides used in agriculture etc. and enter into the food chain. Heavy metals have great significance due to their tendency to accumulate in the vital human organs over prolonged period of time. Heavy metals especially Lead (Pb) is a physiological and neurological toxin that can affect several organs in the human body. Lead can also damage kidneys and reproductive systems. Heavy metal such as Copper is essential for human body as it is an integral part of numerous enzymes including ferro-oxidase (ceruloplatin), cytochrome-c-oxidase, superoxide dismutase etc. It also plays a role in iron metabolism melanin synthesis and central nervous system function. However, chronic (long term) effects of copper exposure can damage the liver and kidneys. Acute symptoms of copper poisoning by ingestion include vomiting, hematemesis (vomiting of blood), hypotension (low blood pressure), melena (black "tarry" feces), coma, jaundice (yellowish pigmentation of skin) and gastrointestinal distress. Presence of these pollutants (Pb and Cu) in date fruits above the permissible limit may lead to severe health hazards to the people consuming it So, estimation of their levels in contaminated food is very important for the safety of human health<sup>3-5</sup>.

Studies regarding heavy metal contamination in the fruit of date palm are scanty. Therefore, it is important to study the heavy metal contamination in the fruit of date palm. In the present study, the concentration of these two heavy metals including Lead (Pb) and Copper (Cu) was determined in dates (Unpitted and Pitted) collected from different geographical regions of India.

## **2. MATERIALS AND METHODS**

### **2.1 Sample Collection**

A total of 50 samples of unpitted dates and 51 samples of Pitted dates were purchased from market from different Geographical area such as Mumbai, Kanpur, Jaipur, Kochi, Kolkata, Amritsar, Bhopal, Guntur and Nagpur.

### **2.2 Apparatus and Reagents**

Atomic Absorption Spectrophotometer AAS 7000SP with air-acetylene base for flame; Microwave Digestion System (Model 3000, Anton Paar), Contaminated free digestion vessels are used for digestion, Mixer – For grinding the sample, Volumetric Flask (100 ml), Pipettes, Funnels (Glass or plastic), Filter paper Whatman No.4 or equivalent and Glass rods Concentrated HCl (AR Grade), Concentrated HNO<sub>3</sub> (AR Grade), Distilled water, Lead standard (99.99%) and Copper Standard (99.99%).

### 2.3 Sample preparation and digestion

One portion of a well homogenized sample was grinded in a mixer. From this, 0.1g of ground sample (dried) was weighed into digestion Teflon vessel. 6 ml concentrated HNO<sub>3</sub> and 1 ml concentrated HCl was added in the sample in fume hood. Vessels were left aside for 5 minutes to initial vigorous reaction. Teflon vessels were closed in position in Microwave Digestion System (Model 3000, Anton Paar). Door was closed properly. After 50 minutes, digestion was over. System was cooled to room temperature. The digestion vessels were unscrewed. Cap and sides of Teflon vessel were rinsed with distilled water. Solution was filtered into 100 ml volumetric flask. Filter paper and funnel was washed properly then solution was made up to mark with distilled water. A reagent blank, sample blank, spike samples were prepared in the same manner with the same quantity of acid as for samples.

### 2.4 Preparation of Standards

#### 2.4.1 Stock standard solution (1000 ppm)

0.10 g Pb (99.99%) / Cu (99.99%) powder was dissolved into 2 ml HNO<sub>3</sub>: H<sub>2</sub>O (1:1) solution. Then it was made up to 100 ml volumetric flask with distilled water.

#### 2.4.2 Intermediate standard (100 ppm)

10 l of 1000 ppm solution was pipetted out into 100 ml volumetric flask and made up to mark with distilled water.

#### 2.4.3 Working Standards

The range of working/calibration standards were prepared such as blank (0), 0.5ppm, 1 ppm, 2 ppm, 4 ppm and 6 ppm in 100 ml volumetric flask.

### 2.5 Analysis of Lead (pb) and Copper (Cu) by AAS

Analysis of Lead and Copper in dates samples was carried out using Flame and air-acetylene AAS 7000 SP workstation as Per AOAC Official method 999.10.

## 3. RESULTS

A total of 50 samples of unpitted dates and 51 samples of pitted dates were analyzed for the presence of Lead (Pb) and Copper (Cu) on AAS 7000 at Central Agmark Laboratory, Nagpur. The samples were received from various geographical regions all over India. Table 1 showed the Analytical conditions for analyzing heavy metal in dates samples for AAS.

**Table 1: Analytical Conditions of AAS for analyzing heavy metals in Dates Samples**

Parameter	Lead	Copper
Wavelength (nm)	217	324.7
Slit width (nm)	0.4	0.2
Lamp current (mA)	4.0	2.0
Types of Flame	Air-Acetylene	Air-Acetylene
Fuel Gas pressure (M Pa)	0.0	0.10
Burner Height (mm)	8.0	8.0
Fuel Gas Flow rate (L/mm)	1.70	1.70
Combustion-supporting gas	Air	Air
Sampling speed	10	50
Integral time (s)	1.0	2.0
Smooth curve factor	1	10
Units	ppm	ppm

**3.1 Lead (Pb) content in unpitted and pitted dates**

It has been found that out of 50 unpitted dates samples, 12 samples were found to be positive for Lead (Pb). Out of 51 pitted dates samples, 9 samples were found to be positive for Lead (Pb). Table 2 indicates the range of Lead Content in ppm in unpitted and pitted samples received from different geographical area of India, which gives positive results. The range of Lead (Pb) content in unpitted dates is from 0.0093 ppm to maximum of 1.9516 ppm while the range of Lead (Pb) content in pitted dates is from 0.0018 ppm to 0.2461 ppm (Table 2). The lead (Pb) content has not been detected i.e. '0.00' ppm in rest of the unpitted dates (38) and pitted dates (42) samples.

**Table 2: Level of Lead (Pb) in ppm in Unpitted and Pitted Dates samples obtained from different regions of India**

Unpitted Dates			Pitted Dates		
S. No	Region	Lead (Pb) content (ppm)	S. No	Region	Lead (Pb) content (ppm)
1	Kanpur	0.0093	1	Guntur	0.0018
2	Nagpur	0.0166	2	Jaipur	0.0748
3	Rajkot	0.0295	3	Kochi	0.1082
4	Jaipur	0.065	4	Rajkot	0.123
5	Mumbai	0.0807	5	Rajkot	0.1252
6	Amritsar	0.0912	6	Rajkot	0.1336
7	Mumbai	0.1044	7	Bhopal	0.1358
8	Rajkot	0.1082	8	Rajkot	0.1867
9	Kochi	0.1358	9	Rajkot	0.2461
10	Rajkot	0.1443			
11	Bhopal	0.28			
12	Nagpur	1.9516			

**3.2 Copper (Cu) content in unpitted and pitted dates**

It has been found that out of 50 unpitted dates samples analysed, 8 samples were found to be positive for copper (Cu). Out of 51 pitted dates samples analysed, 10 samples were found to be positive for copper (Cu). Table 3 indicates the copper concentration in ppm in unpitted dates and pitted dates samples received from different regions of India, which gives positive results. The Copper (Cu) content ranges from 0.0043 ppm to 1.9038 ppm in unpitted dates. While the copper concentration in pitted dates samples ranged from 0.0089 ppm to 0.128 ppm (Table 3). The Copper (Cu) content has not been detected i.e '0.00' ppm in rest of the unpitted dates (42) and pitted dates (41) samples.

**Table 3: Level of Copper (Cu) in ppm in Unpitted and Pitted Dates samples obtained from different regions of India**

Unpitted Dates			Pitted Dates		
S. No	Region	Copper (Cu) content (ppm)	S. No	Region	Copper (Cu) content (ppm)
1	Nagpur	0.0043	1	Bhopal	0.0089
2	Guntur	0.0719	2	Guntur	0.0252
3	Guntur	0.0727	3	Guntur	0.0288
4	Guntur	0.0748	4	Guntur	0.0324
5	Guntur	0.0763	5	Mumbai	0.048
6	Guntur	0.0799	6	Guntur	0.0691
7	Guntur	0.0943	7	Guntur	0.0727
8	Nagpur	1.9038	8	Guntur	0.0791
			9	Mumbai	0.0808
			10	Kanpur	0.128

#### **4. DISCUSSION**

##### **4.1 Lead**

The permissible level for Lead (Pb) as per FSSAI (Food Safety and Standards Authority of India) under category "foods not specified" in India is 2 ppm (max). In unpitted dates, the maximum Lead content (Pb) was 1.9516 ppm which was found to be within the permissible limit. At the same time, the maximum Lead (Pb) content in pitted dates was 0.2461 ppm which was also within the permissible limit as specified by FSSAI in India. Hence all the samples of dates (unpitted and pitted) analysed were safe for human consumption with respect to Lead (Pb) content.

Aldjain et al., 2011<sup>6</sup> reported the level of Lead content in fruit tissues of date palm at different locations of Riyadh in the range 1.07 ppm to maximum of 2.29 µg/g and in the washing, it ranged from Not detected to maximum of 2.27 µg/g. The level of Pb was found to be highest in fruit tissues as compared to washing residues collected from date palm trees growing in different sites. The results obtained in the present study are also comparable. The main source of Lead (Pb) in dates samples was due to aerial deposition on the available surface including soil and plant parts. The metal accumulation could occur either through retention of heavy metals on foliage or through deposition of heavy metals on foliage and uptake from soil<sup>7</sup>.

##### **4.2 Copper**

The permissible level of Copper (Cu) as per FSSAI under category "foods not specified" is 30 ppm (maximum) in India. In unpitted dates, the maximum Copper content (Cu) was 1.9038 ppm which was found to be within the permissible limit. At the same time, the maximum Copper (Cu) content in pitted dates was 0.128 ppm which was also within the permissible limit as specified by FSSAI in India. Hence all the samples of dates (unpitted and pitted) analyzed were safe for human consumption with respect to Copper (Cu) content. Hamid, 2011<sup>8</sup> determined the Copper uptake index between sole plant and plants intercropped with date palm. Date palm had lower Copper uptake index with a record of 0.132 ppm and did not significantly differ with sole alfa alfa (plant) with an amount of copper recorded at 0.145 ppm. Therefore, intercropping developed conditions for phytoextraction by date palm in heavy metal contaminated soil.

The copper (Cu) content in the present study was within the permissible limits as defined by the Indian legislation. Hence, it does not pose a serious health risk. Dates samples (unpitted and pitted) analyzed from different regions of India may not produce health risk for human consumption, if other sources of toxic metals contaminated food are not taken.

#### **5. CONCLUSION**

Screening of 50 samples of unpitted dates and 51 samples of pitted dates received from different regions of India revealed that all the dates samples were found to contain Lead (Pb) and Copper (Cu) within the permissible limit as specified by Indian legislation. In view of this, it has been concluded that consumption of dates fruit may not produce any health risk for human consumption, if other sources of toxic metals contaminated food are not taken.

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