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# A STUDY ON HEAVY METAL CONTENT IN SINGHARA FLOUR IN INDIA

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**ABSTRACT** Singhara atta is an excellent source of good carbohydrate and energy boosting nutrients like iron, calcium, zinc and phosphorous. There are no reports regarding the level of heavy metal content in Singhara flour. The objectives of this study was to determine the concentrations of lead (Pb) and copper (Cu) in Singhara flour collected from various part of India. Out of 24 samples of Singhara flour analysed, Lead (Pb) content ranged from 0.0638 ppm to 1.6929 ppm and Copper (Cu) from 0.0011 ppm to 6.1725 ppm. It was found that 16 samples contain Lead (Pb) and all the samples for copper are within the permissible limit as specified by FSSAI. It is found that concentration of Lead (Pb) and Copper (Cu) in all Singhara flour samples collected from various regions of India is within the safe limits as prescribed by FSSAI.

**KEYWORDS :** Singhara flour; heavy metal; Atomic absorption spectrometry; Lead (Pb), Copper (Cu)

## 1. INTRODUCTION:

Singhara is also known as water caltrop, water chestnut, ling nut, devil pod, bat nut and buffalo nut. They are abundantly found in the warm temperate areas of Africa and Eurasia. Singhara has been declared am invasive species in Virginia. It is found in abundance in India, China, Washington, North Carolina and Florida. It has been cultivated in the Indian subcontinent and China for nearly 3,000 years. In Japanese, this plant is called 'Hishi' which means a lozenge or a diamond shaped[1].*Singhara is harvested from aquatic plants that* exist in the form of three species *Trapanatans, T. bicornis and T. rossica* . The Singhara is edible and has been consumed by people in the Indian subcontinent and south-east Asia for thousands of years [2,3]. The Singhara seed can be eaten raw or, can be dried and ground to a flour that is known as Singoda flour (also known as Singhara ka atta). The flour can be used to make batter, breads, dosas, snacks such as pakoras and sweet desserts. This nutritionally rich flour has been widely used in religious rituals especially during fasting days. Singhara flour is gluten free with a glycaemic index of 60. Since the flour is a heavy appetizer, it also providing essential nutrients.

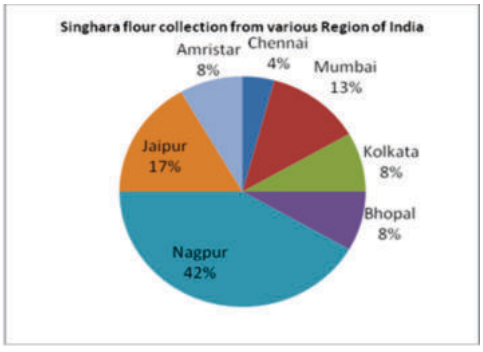
The main sources of heavy metals in plants are their growth media, nutrients, agro inputs, soil and others factor such as pesticides and fertilizers . Heavy metals along with other pollutants are discharged to the environment through industrial activity, automobile exhaust, heavy duty electric power 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 (ceruloplamin), 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 Singhara flour 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 [4,5,6].

There reports available in the literature about any study on the level of Heavy metals in the Singhara flour available in India is scarce. Therefore, it is important to study the heavy metal contamination in the Singhara flour. In the present study, the concentration of these two heavy metals including Lead (Pb) and Copper (Cu) was determined in Singhara flour collected from various regions of India.

## 1. MATERIALS AND METHODS:

### 1.1. Sample Collection

A total of 24 samples of Singhara flour were collected from various regions of India.




### 1.2. Apparatus And Reagents

Atomic Absorption Spectrophotometer AAS 7000SP with air-acetylene base for flame; Microwave Digestion System (Model 3000, Anton Paar), Volumetric Flask (100 ml), Pipettes, Funnels, Filter paper Whatmann No.4, Glass rods, Concentrated HCl (AR Grade), Concentrated $HNO_3$ (AR Grade), Distilled water, Lead standard (99.99%) and Copper Standard (99.99%).

### 1.3. Sample Preparation And Digestion:

0.1g of the homogenized sample was grinded in a mixer. From this, 0.1g of ground sample (dried) was weighed into digestion Teflon vessel. 6 ml concentrated $HNO_3$ and 1 ml concentrated HCl was added in the sample. Vessels were left aside for 5 minutes to initial vigorous reaction. Teflon vessels were closed in position in Microwave Digestion System, the samples were digested for 50 minutes and cooled to room temperature. 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 $HNO_3$: $H_2O$(1:1) solution. Then it was made up to 100 ml volumetric flask with distilled water.

#### 2.4.2 Intermediate standard (100 ppm)

10 ml 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 White pepper samples was carried out using Flame and air-acetylene AAS 7000.

## 3 RESULTS AND DISCUSSION:

A total of 24 samples of Singhara flour were analysed for the presence of Lead (Pb) and Copper (Cu) on AAS 7000 at Central Agmark Laboratory, Nagpur. The samples were received from various regions of India. Table 1 showed the Analytical conditions for analyzing heavy metal in Singhara flour samples for AAS.

**Table 1. Analytical Conditions of AAS 7000 SP for analyzing heavy metals in Singhara flour**

| 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 Singhara flour

It has been found that out of 24 Singhara flour samples, 66.7 % (16 samples) were found to be positive for Lead (Pb). The Lead (Pb) content has not been detected i.e '0.00' ppm in 08 samples of Singhara flour. Table 2 indicates the level of Lead Content in ppm in Singhara flour. The range of Lead (Pb) content Singhara flour is from 0.0638 ppm(Minimum) to 1.6929 ppm(Maximum). The lead contamination of Singhara flour were found to be 12.5 % (0.2363 to 0.6472 ppm) in Mumbai, 8.3% Not detected in Kolkata, 8.4% (0.622 to 1.6345 ppm) at Bhopal, 4.2 % (1.3326 ppm) from Chennai, 16.6 %(0.795 to 1.6929 ppm) at Jaipur, 8.4% (0.4138 to 0.4955ppm) from Amristar, 33.3 % Not deducted and 18.3%(0.2872 to 1.2444ppm) from Nagpur.

**Table 2. Level of Lead (Pb) and Copper (Cu) in ppm in Singhara flour samples obtained from various regions of India**

| S.No | Region | Lead (Pb) content (ppm) | Copper (Cu) Content (ppm) |
|---|---|---|---|
| 1 | Mumbai | 0.3141 | 0.9254 |
| 2 | Mumbai | 0.2363 | 1.7758 |
| 3 | Mumbai | 0.6472 | 5.3439 |
| 4 | Kolkata | ND | 3.6462 |
| 5 | Kolkata | ND | 3.4298 |
| 6 | Bhopal | 1.6681 | 0.6220 |
| 7 | Bhopal | 1.6015 | 1.6345 |
| 8 | Chennai | 1.3326 | 5.5113 |
| 9 | Jaipur | 0.795 | 3.9461 |
| 10 | Jaipur | 1.0673 | 1.8763 |
| 11 | Jaipur | 0.8767 | 6.1725 |
| 12 | Jaipur | 1.6929 | 0.9905 |
| 13 | Amristar | 0.4955 | 5.4788 |
| 14 | Amristar | 0.4138 | 5.6579 |
| 15 | Nagpur | 0.0638 | 0.3306 |
| 16 | Nagpur | ND | 0.4688 |
| 17 | Nagpur | 0.2872 | 0.5113 |
| 18 | Nagpur | 1.2444 | 0.0011 |
| 19 | Nagpur | ND | 0.5006 |
| 20 | Nagpur | ND | 0.7239 |
| 21 | Nagpur | ND | 0.8939 |
| 22 | Nagpur | ND | 0.0883 |
| 23 | Nagpur | ND | 0.4262 |
| 24 | Nagpur | ND | 0.4581 |

### 3.2 Copper (Cu) content in Singhara flour

It has been found that out of 24 Singhara flour samples analysed, All samples were found to be positive for copper (Cu). The Copper (Cu) content ranges from 0.0011ppm (Nagpur region) to 6.1725 ppm (Jaipur region) in Singhara flour samples. The copper contamination of Singhara flour were found to be 12.5 % ( 0.9254 to 5.3439 ppm) in Mumbai, 8.3% (3.4298 to 3.6462 ppm) in Kolkata, 8.4% (1.6015 to 1.6681 ppm) at Bhopal, 4.2 % (5.5113 ppm) from Chennai, 16.6 %(0.0995 to 6.1725 ppm) at Jaipur, 8.4% (5.4788 to 5.6579 ppm) from Amristar, 41.6% (0.0011 to 0.8939 ppm) from Nagpur.

## 4. CONCLUSION:

### 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 Singhara flour, the maximum Lead content (Pb) was 1.6929 ppm which was found to be the permissible limit.

The Lead (Pb) content of Singhara flour in the present study was within the permissible limits as defined by the Indian legislation.

### 4.2 Copper

The permissible level of Copper (Cu) as per FSSAI under category "foods not specified" is 30 ppm (maximum) in India. In Singhara flour, the maximum Copper content (Cu) was 6.1725 ppm which was found to be within the permissible limit. Hence all the samples of Singhara flour samples analysed were safe for human consumption with respect to Copper (Cu) content.

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

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