

A Study on Heavy Metal Content in White Pepper Available in Domestic Market in India

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ABSTRACT

The tropical berries called *Piper nigrum* is the source of White pepper. White pepper is the most preferred spices in export point of view in international market. White peppers are mainly used in vegetables, different types of sauces, casseroles etc. It contains sodium about 0.2 mg. It is used as a food preserver. It has the capacity to act as an alternative medicine to recover intestinal upsets, relieves nausea and may help to recover from fever. The monitoring of heavy metal contamination in spices is necessary for human health. The contamination of heavy metals such as Lead (Pb) and Copper (Cu) in White pepper (Whole and Ground) samples available in different parts of India were determined using Atomic Absorption Spectroscopy (AAS). The result showed that out of 36 samples of White pepper (Ground) analysed for Lead (Pb), 6 samples were observed to contain Lead ranged from 0.0018 to 0.14 ppm and 9 samples contained Copper (Cu) ranged from 0.005 to 0.302 ppm respectively. Out of 37 samples of white pepper (whole) analysed, only 5 samples have contaminated Lead (Pb) with low level ranging from 0.0037 ppm to 0.1739 ppm and 8 samples have Copper (Cu) content ranging from 0.018 ppm to 0.0916 ppm. As per FSSAI, the maximum permissible level for “foods not specified” category for Lead (Pb) is 2 ppm and for Copper (Cu) is 30 ppm. All the samples contained Lead and Copper within the acceptable limits and may not produce any health risk for human consumption.

KEY WORDS: Heavy metals, White pepper, Lead (Pb), Copper (Cu), Spices, India.

1. INTRODUCTION

Pepper (*Piper nigrum* L.) has great economical value and in many dishes, this spices used to enhance the flavor. *Piper nigrum* L. is usually grown in warm climate of 25 to 30°C and 60 to 93% humidity. White Pepper is originated from tropical berries called *Piper nigrum*. White pepper produces through a process called “retting”. This is the process by which the darker-coloured skin of the pepper fruit has been removed. There are many other processes like mechanical, chemical, or biological to remove the outer pepper from the seed. There are mainly two type of White pepper i.e. Whole and Ground. Ground white pepper has many uses in different preparation of foods like in Chinese and Thai cuisine, many types of sauces, and mashed potatoes. In comparison to black pepper, White pepper is more spicy. White pepper is mainly added after the dish has been cooked. On the other hand, the process of preparation and handling can make them source of contamination. The heavy metals mainly contaminated in plants through their growth media, nutrients, agro inputs, soil and others factor such as pesticides and fertilizers.

Heavy metals are contaminated to the environment through many sources like industrial sources, automobile exhaust, pesticides used in agriculture etc and the food chain is being contaminated. The accumulation of Heavy in the vital human organs over a long period of time is the main cause for cancer. 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 (ceruloplasmin), cytochrome-c-oxidase, superoxide dismutase etc. It also plays a role in iron metabolism melanin synthesis and central nervous system function. However, extensive exposure of copper affects severely in the liver and kidneys, which may cause vomiting, hematemesis (vomiting of blood), hypotension, melena (black “tarry” feces), coma, jaundice and gastrointestinal distress. Presence of Pb and Cu in Spices above the tolerable limit cause severe health hazards to the people consuming it. So, monitoring of their levels in contaminated food is very essential for the safety of human health. Studies regarding heavy metal contamination in the white pepper are scanty. Therefore, it is important to study the heavy metal contamination in the White pepper.

In the present paper, we have conducted a study of the two heavy metals i.e. Lead (Pb) and Copper (Cu) content in white pepper (Whole and Ground) collected from different parts of India.

2. MATERIALS AND METHODS

Sample Collection: A total of 37 samples of White pepper (Whole) were purchased/collected from market from different Geographical area such as Amritsar (4), Bhopal (2), Guntur (5), Kanpur (8), Kochi (1), Kolkata (3), Mumbai (9) and Nagpur (5).

A total of 36 samples of White pepper (Ground) were purchased/collected from market from different Geographical area such as Amritsar (5), Bhopal (2), Guntur (5), Kanpur (8), Kochi (1), Kolkata (3), Mumbai (7) and Nagpur (5).

Apparatus and Reagents: Atomic Absorption Spectrophotometer AAS 7000SP with air-acetylene base for flame; Microwave Digestion System (M.D. 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 Watman No.4 or equivalent and Glass rods Concentrated HCl (AR Grade), Concentrated HNO₃ (AR Grade), Distilled water, Lead standard (99.99%) and Copper Standard (99.99%).

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 HNO₃ 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 M.D. 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.

Preparation of Standards:

Stock standard solution (1000 ppm): 0.10 g Pb (99.99%) / Cu (99.99%) powder was dissolved into 2 ml HNO₃: H₂O (1:1) solution. Then it was made up to 100 ml volumetric flask with distilled water.

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.

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

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 SP work station as Per AOAC Official method 999.10.

3. RESULTS

A total of 37 samples of White pepper (Whole) and 36 samples of White pepper (Ground) were analysed for the presence of Lead (Pb) and Copper (Cu) on AAS 7000 SP 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 White Pepper samples for AAS.

Table 1. Analytical Conditions of AAS 7000 SP for analyzing heavy metals in White Pepper

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

Lead (Pb) content in White Pepper (Whole and Ground): It has been found that out of 37 White Pepper (Whole) samples, 5 samples were found to be positive for Lead (Pb). Out of 36 White Pepper (Ground) samples, 6 samples were found to be positive for Lead (Pb). Table.2, indicates the range of Lead Content in ppm in White Pepper (Whole and Ground) samples received from different geographical area of India, which gives positive results. The range of Lead (Pb) content in White pepper (Whole) is from 0.0037 ppm to maximum of 0.1739 ppm while the range of Lead (Pb) content in White Pepper (Ground) is from 0.0018 ppm to 0.14 ppm (Table.2). The lead (Pb) content has not been detected i.e. '0.00' ppm in rest of the White Pepper (Whole) (32) and White Pepper (Ground) (30) samples.

Table 2. Level of Lead (Pb) in ppm in White Pepper (Whole and Ground)

Samples obtained from different regions of India

White Pepper (Whole)			White Pepper (Ground)		
S.No.	Region	Lead (Pb) content (ppm)	S.No.	Region	Lead (Pb) content (ppm)
1	Guntur	0.0037	1	Nagpur	0.0018
2	Mumbai	0.0712	2	Mumbai	0.0854
3	Kochi	0.1315	3	Mumbai	0.0965
4	Bhopal	0.1464	4	Kochi	0.1105
5	Amritsar	0.1739	5	Nagpur	0.1379
			6	Amritsar	0.1400

Copper (Cu) content in White Pepper (Whole and Ground): It has been found that out of 37 White Pepper (Whole) samples analysed, 8 samples were found to be positive for copper (Cu). Out of 36 White Pepper (Ground) samples analysed, 9 samples were found to be positive for copper (Cu). Table.3, indicates the copper concentration

in ppm in White Pepper (Whole and Ground) samples received from different regions of India, which gives positive results. The Copper (Cu) content ranges from 0.018 ppm to 0.0916 ppm in White Pepper (Whole). While the copper concentration in White Pepper (Ground) samples ranged from 0.005 ppm to 0.302 ppm (Table.3). The Copper (Cu) content has not been detected i.e. '0.00' ppm in rest of the White Pepper (Whole) (29) and White Pepper (Ground) (27) samples.

**Table 3. Level of Copper (Cu) in ppm in White Pepper (Whole and Ground)
Samples obtained from different regions of India**

White Pepper (Whole)			White Pepper (Ground)		
S.No.	Region	Copper (Cu) content (ppm)	S.No.	Region	Copper (Cu) content (ppm)
1	Guntur	0.018	1	Nagpur	0.005
2	Guntur	0.018	2	Guntur	0.0072
3	Guntur	0.0317	3	Guntur	0.0122
4	Guntur	0.0367	4	Guntur	0.0187
5	Mumbai	0.0392	5	Guntur	0.0259
6	Guntur	0.0568	6	Guntur	0.0273
7	Mumbai	0.0681	7	Kanpur	0.1218
8	Kolkata	0.0916	8	Kanpur	0.1363
			9	Nagpur	0.302

DISCUSSION

Lead (Pb): 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 White Pepper (Whole), the maximum Lead content (Pb) was 0.1739 ppm which was found to be within the permissible limit. At the same time, the maximum Lead (Pb) content in White Pepper (Ground), was 0.14 ppm which was also within the permissible limit as specified by FSSAI in India. Hence all the samples of White Pepper (Whole and Ground) analysed were safe for human consumption with respect to Lead (Pb) content.

Jawad (2016), determined the heavy metal in spices and medical herbs available on the Iraq Markets. Lead (Pb) content in White pepper was found to be 3.21 ± 1.24 mg/kg. WHO limits for Lead (Pb) for spices is 100 mg/kg. It was reported that Lead (Pb) concentration was within the acceptable limits. Nkansah and Amoako (2010), reported the Lead content in white pepper as 98 mg/kg which was also found to be within the acceptable limits specified by WHO. The high contamination of Lead (Pb) may be due to air pollution, inclusion or absorption at the mill during grinding, and from some pesticides etc. during cultivation. In the present study, the Lead content in White Pepper (Whole and Ground) is very less and within the acceptable limits as specified by FSSAI as well as WHO. Hence, White Pepper (Whole and Ground) analysed from different parts of India may not produce health risk for human consumption, if other sources of toxic metals contaminated food are not taken.

Copper (Cu): The permissible level of Copper (Cu) as per FSSAI under category “foods not specified” is 30 ppm (maximum) in India. In White Pepper (Whole), the maximum Copper content (Cu) was 0.0916 ppm which was found to be within the permissible limit. At the same time, the maximum Copper (Cu) content in White Pepper (Ground) was 0.302 ppm which was also within the permissible limit as specified by FSSAI in India. Hence all the samples of White Pepper (Whole and Ground) analysed were safe for human consumption with respect to Copper (Cu) content. Jawad (2016), determined the heavy metal in spices and medical herbs available on the Iraq Markets. Copper (Cu) content in White pepper was found to be 5.31 ± 0.89 mg/kg. WHO limits for Copper (Cu) for spices is 50 mg/kg. It was reported that Copper (Cu) concentration was within the acceptable limits. Nkansah and Amoako (2010), reported the Copper (Cu) content in white pepper as 13 mg/kg which was also found to be within the acceptable limits specified by WHO. Ozkutlu (2006), reported a range of 3 to 11 mg/kg for Cu levels in some spices while in previous work they reported level of 6-17 mg/kg.

In the present study, the Copper (Cu) in White Pepper (Whole and Ground) is very less and within the acceptable limits as specified by FSSAI as well as WHO. Hence, White Pepper (Whole and Ground) analysed from different regions of India may not produce health risk for human consumption, if other sources of toxic metals contaminated food are not taken.

4. CONCLUSION

Screening of 37 samples of White Pepper (Whole) and 36 samples of White Pepper (Ground) collected from different regions of India revealed that all the White Pepper (Whole and Ground) samples were found to contain Lead (Pb) and Copper (Cu) within the permissible limit as specified by Indian legislation and WHO. In view of this, it has been concluded that consumption of White Pepper (Whole and Ground) may not produce any health risk for human consumption, if other sources of toxic metals contaminated food are not taken.

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