



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

<sup>1</sup>Dr.Ashish Mukherjee,<sup>2</sup>Dr.Manvi Sharma,<sup>3</sup>Sh.Anup Kumar Senapathi

<sup>1</sup>Director of Laboratories,<sup>2</sup>Assistant Director,<sup>3</sup>Junior Chemist

<sup>1</sup>Central Agmark Laboratory, Nagpur,

<sup>1</sup>Central Agmark Laboratory, Nagpur, Maharashtra, India

**Abstract:** Barley (*Hordeum vulgare*), a member of the grass family, is a major cereal grain grown in temperate climates globally. It is believed to be originated from western Asia or Ethiopia. Barley is the fourth largest grain crop globally, after wheat, rice, and maize corn. Barley is generally used in breads, soups, stews, and health products and sometimes as animal fodder also. Exposure of heavy metals to human beings has risen dramatically in the last 50 years.

The study involved analysis of 27 barley flour samples for lead and copper contamination from various regions of India. Out of 27 samples of Barley flour analysed, 15 samples were positive for Lead (Pb) and 26 samples were detected with copper ranged from 0.1211 ppm to 9.4842 ppm

The Barley flour samples collected and analysed are safe for human consumption as they are within the safe limits as prescribed by FSSAI.

**Key words:** Barley flour; heavy metal; Atomic absorption spectrometry; Lead (Pb), Copper (Cu).

## 1. INTRODUCTION:

Barley was called as *bere*, in old English which traces back to Proto-Indo-European and “flour” word originated from the Latin word *farina*. The word *barn*, which originally meant “barley-house”, is also rooted in these words [1]. Less than 5% of total barley production is used for human food in most developed countries, but in some countries in the Far East, Middle East, and North Africa, barley products form an important part of the diet. The most common products are blocked, pot and pearl barley, barley flakes, and barley flour [2].

Barley flour is used in the manufacture of flat bread, for infant foods and for food specialities. It is also a component of composite flours used for making yeast-raised bread [3]. Barley contains large amount of carbohydrates. Besides that it contains protein, calcium, and phosphorus in moderate amount and Vitamin B in small amount. It has nutlike flavour. Barley is not generally used to produce bread as it contains little gluten, which imparts its elastic property. The presence of aminoacids viz. Lysine, Threonine and valine is high in barley flour compared to wheat flour [4].

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 (ceruloplasmin), 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. Presence of these pollutants (Pb and Cu) in Barley 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 [5,6,7].

Therefore, it is important to study the heavy metal contamination in the Barley flour. In the present study, the concentration of these two heavy metals including Lead (Pb) and Copper (Cu) was determined in Barley flour collected from various regions of India.

## 2. MATERIALS AND METHODS:

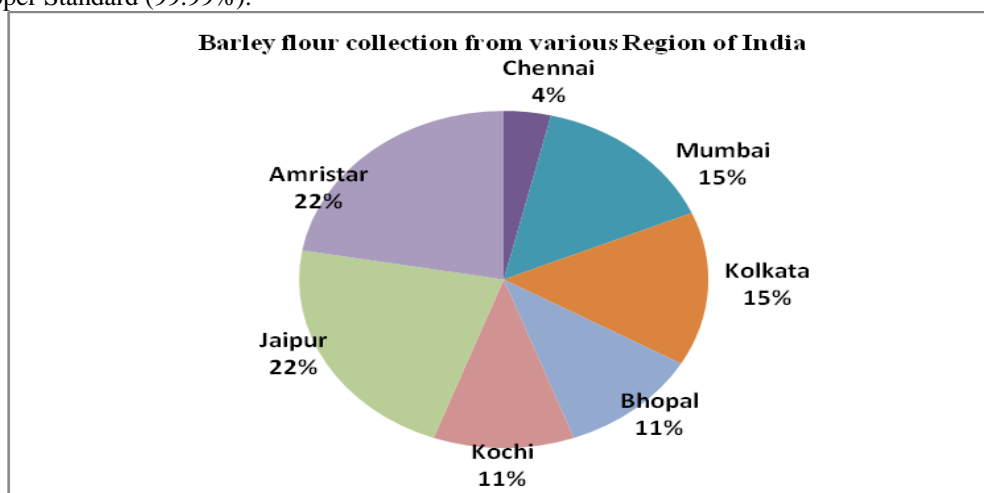
### 2.1. Sample Collection

A total of 27 samples of Barley flour were collected from various regions of India.

### 2.2. APPARATUS AND REAGENTS

Atomic Absorption Spectrophotometer AAS 7000SP with air-acetylene base for flame; Microwave Digestion System (Model 3000, Anton Paar) are used for digestion of the collected samples, Volumetric Flask (100 ml), Pipettes, Funnels, Filter paper

Whatmann No.4 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:

0.1g of homogenised samples in batches were weighed into digestion Teflon vessel. 6 ml concentrated HNO<sub>3</sub> and 1 ml concentrated HCl was added and digested in Microwave Digestion System (Model 3000, Anton Paar) for a period of 50 minutes and cooled to room temperature. The digested samples were washed thoroughly; filtered and made up to the volume 100 ml volumetric flask with distilled water. A reagent blank, sample blank, spike samples were prepared in the same manner.

### 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 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 SP workstation as Per AOAC Official method 999.10.

### 3 RESULTS:

A total of 27 samples of Barley 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 Barley flour samples for AAS.

**Table 1. Analytical Conditions of AAS 7000 SP for analyzing heavy metals in Barley 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. Results and Discussion

Table 2 represents the level of Lead and Copper Content in ppm in Barley flour

#### 3.1 Lead (Pb) content in Barley flour

The results of Lead and copper are summarized in Table-2.

It has been found that out of 27 Barley flour samples, 55.6 per cent i.e. 15 samples were found positive for Lead (Pb). The Lead (Pb) content has not been detected i.e. '0.00' ppm in 12 samples of Barley flour. The range of Lead (Pb) content in Barley flour is from 0.0219 ppm (Minimum) to 2.0497 ppm (Maximum). The lead contamination found in Mumbai region were 14.8 % (0.2386 to 1.9383 ppm), similarly 3.7 % (0.9104 ppm) at Chennai, 14.8 % "Not detected" from Kolkata, 11.1 % (1.3326 to 2.0497 ppm)

from Bhopal, 11.1 % ND from Kochi, 18.5% ND and 3.8 % (0.0219 ppm) from Jaipur, 22.2 % (0.3866 to 1.5209ppm) from Amristar .

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

It has been found that out of 27 Barley flour samples analysed, 99 per cent samples were found positive for copper (Cu). The Copper (Cu) content ranged from 0.1211ppm at Jaipur region to 9.4842 ppm at Amristar region in Barley flour samples. The copper contamination in Mumbai region were 14.8 % (0.984 to 2.4808 ppm), similarly 3.7 % (1.8921 ppm ) at Chennai, 14.8 % (6.3296 to 7.0592 ppm) from Kolkata, 11.1 % (1.042 to 3.699 ppm) from Bhopal, 11.1 % (1.0719 to 5.3357 ppm) at Kochi, 18.5% (0.1211 to 0.5571ppm) and 3.8 % Not detected from Jaipur, 22.2 % (1.2162 to 9.4842ppm) from Amristar .

### 4. Conclusion:

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 Barley flour, the maximum Lead content (Pb) found 2.0497 ppm.

The permissible level of Copper (Cu) as per FSSAI under category “foods not specified” is 30 ppm (maximum) in India. In Barley flour, the maximum Copper content (Cu) is 9.4842 ppm which was found within the permissible limit. Hence all the samples of Barley flour samples analysed were safe for human consumption with respect to Copper (Cu) content.

The study assessed indicated that the Lead (Pb) and Copper (Cu) content of Barley flour in the various region were within the permissible limits and safe for consumption

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

S.No	Region	Lead (Pb) content (ppm)	Copper content (ppm)
1	Mumbai	0.2386	2.1583
2	Mumbai	0.4164	2.4808
3	Mumbai	1.9383	1.042
4	Mumbai	1.92	0.984
5	Chennai	0.9104	1.8921
6	Kolkata	ND	7.0592
7	Kolkata	ND	5.8418
8	Kolkata	ND	6.3296
9	Kolkata	ND	6.4338
10	Bhopal	2.0497	2.5013
11	Bhopal	1.394	3.699
12	Bhopal	1.3326	1.042
13	Kochi	ND	5.3357
14	Kochi	ND	1.0719
15	Kochi	ND	5.2992
16	Jaipur	ND	0.1211
17	Jaipur	ND	0.4723
18	Jaipur	ND	0.5571
19	Jaipur	ND	0.2907
20	Jaipur	0.0219	0.218
21	Jaipur	ND	ND
22	Amristar	0.3866	2.1783
23	Amristar	0.8767	2.1895
24	Amristar	1.2578	9.4842
25	Amristar	1.2306	3.6664
26	Amristar	1.1489	2.5811
27	Amristar	1.5029	1.2162

ND- Not detected and may be taken as “0”.

### 4 ACKNOWLEDGMENTS

We would like to express our sincere gratitude to to Shri Faiz Ahmed Kidwai, Additional Secretary- cum- Agricultural Marketing Adviser to the Govt. of India and all the Staffs of Central Agmark Laboratory and Regional Agmark Laboratories who have been source of constant inspiration to us. We would like to express our gratitude to Regional Office, Kolkata, Chennai, Bhopal, Jaipur, , Amristar, Guntur, Mumbai and Kochi to collect and provide the samples of Barley flour for analysis. The views expressed in the manuscript are that of authors and not binding on the Government of India.

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