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RESEARCH ARTICLE

Study of lead metal contamination in Spinach (*Spinacia oleracea*) vegetable through vehicular emission in Nagpur city

Kharwade Shital[1], Bhabra Smita[2] and Ganatra Sunil H[1]

[1]Institute of Science, Department of Environmental Science, Nagpur, India.
[2]Global Scientific Inc. Nagpur, India

Address for correspondence: Dr. Sunil H. Ganatra, Head, Department of Environmental Science, Institute of Science, R. T. Road, Civil Lines, Nagpur, 440001 (M.S.) India.
email : sunilganatra@gmail.com

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ABSTRACT

Spinach (*Spinaciaoleracea*, local name: Palak) is an edible flowering plant in the family of *Amaranthaceae*. It is native to central and south-western Asia. This plant is widely used as a food vegetable in Asia, particularly in India. The Lead contamination of Spinach was studied in Nagpur region (Maharashtra, India). Samples of Spinach from within the vegetable markets of Nagpur city and roadside vendors collected and investigated for the Lead concentrations using atomic absorption spectrophotometer. It is reported that roadside samples showed high contamination of lead in in washed and unwashed samples respectively. It is confirmed that there is a relationship between the Lead metal contamination in air and road-side vegetable samples. The reported values are higher than the permissible limit as per UN-Act.

Keywords: Lead (Pb), *Spinacia oleracea,* Vehicle, Nagpur, India.

INTRODUCTION

Trace quantities of certain heavy metals are essential micronutrients for higher animals and plant growth; they are of considerable environmental concern due to their toxicity and cumulative behaviour (Igwegbe *et al*., 1992). As a result of urbanization and increasing anthropogenic activities, the heavy metal pollution of soil, water, and atmosphere, represents a growing environmental problem affecting food quality and human health in cities (John *et al*., 2012). Heavy metal such as Lead metal is a cumulative poison. Lead metal is one of the wide ranges of important type of contaminant that can be exhausted through vehicles on the roads and can also get deposited on the road side vegetables, which are sold in cities (Yogesh *et al*., 2009).

Vegetable Spinach is hygroscopic in nature absorbs metal deposits on surface when exposed to air from various sources. The main cause of lead dispersion in atmosphere is vehicular emission in which the leaded gasoline is included and the vulnerability of at-risk urban populations (Yogesh *et al*., 2009). Bhupal *et al*. (2001) an agricultural economist at the University of Delhi found that contamination starts immediately as soon as the vegetables are ready to market during the transportation of vegetables from production centers to markets.

Air pollution is associated with the full life-cycle of light motor and heavy utility vehicles in urban areas. At present 11,40,000 vehicles are running in Nagpur city. Total population is 24,20,000 as per 2011 census, hence it is concluded that every two person has one vehicle. Motor vehicles cause both primary and secondary pollution. Primary pollution is emitted directly into the atmosphere; secondary pollution results from chemical reactions between pollutants in the atmosphere (Brett *et al*., 1996).

Vehicles contribute significantly to the total air pollution load in many urban areas (Brett *et al*., 1996). Recent research has found that consumers in Nagpur are purchasing vegetables with high levels of heavy metals (HMs). In Nagpur, people consume spinach as a most nutritive vegetable hence selected as a subject for the study. Prolonged consumption of unsafe condition of heavy metals in foodstuffs may lead to the disruption of numerous biological and biochemical processes in the human body. Lead metal exposure can produce a wide range of adverse health effects. Lead being a carcinogen poses threat to human life through bioaccumulation and bio magnification (Atayese *et al*., 2009).

MATERIALS AND METHODS

Area of Study

The study was carried out in different areas of Nagpur city, Maharashtra state, India. Nagpur is situated at practically the geographical centre of India located at latitude of 21^0 07' & longitude of 79^0 07'. All major highways and railways passes via Nagpur. Nagpur city is at the junction of two National Highways, NH-6 and NH-7. This has resulted in the city being a major trade and transportation centre.

Sample collection

The vegetable Spinach was studied for presence of Lead metal as a case study. Samples were collected from the major markets of Nagpur city such as Gokulpeth, Sakkardhara, Sitabuldi, Cotton market, Khamla etc. The samples were collected from all the sites in same day from 8.00 a.m. to 12.00 p..m. The collected samples were packed in a pre-heated moisture free container. From each site, nearly 1 kilogram of sample collected. 50% of the sample leaves was washed with double distilled water and 50% of leaves kept as it is. The samples cut into small pieces manually. All samples are marked properly and packed in air-tight container

After that, both washed and unwashed spinach samples were kept in muffle furnace at 250^0C for half an hour. After heating the samples were cooled in desiccator for over nigh. The 5 gram of dry spinach ash powder was taken in round bottom flask along with 5 ml. of nitric acid and makeup to 50 ml. The mixture kept for open digestion about 1 hour. Then the digested sample (extract solution) was injected in atomic absorption spectrophotometer for detecting the concentration of Lead metal.

RESULTS AND DISCUSSIONS

The study is focused on the contamination of Lead metal concentration through vehicular emission in vegetables particularly Spinach. It is reported that lead contamination in Spinach is in all areas and even persist after washing. Khamla and Cotton market areas having high concentration of Lead, whereas Gokulpeth area shows less contamination.

Table 1 shows the vehicular traffic at various locations. Cotton market shows high vehicular traffic and also shows high SPM compare to Khamla and Gokulpeth.

To understand the air quality of these regions air quality monitoring were also performed and SPM, PM-10 and PM-2.5 were analysed for each areas except Sitabuldi area. Figure 1 shows the concentration of SPM, PM-10 and PM-2.5 at various locations graphically. To understand the relationship between the Lead contamination and vehicular traffic, study also extended and vehicular traffic also monitored at these places.

Table 1: Lead concentration in mg/kg in spinach and in air due to vehicular emission in various location in Nagpur city

Sr. No.	Area	Inside		Roadside		Number of Vehicles per day*	Air
		Washed	Unwashed	Washed	Unwashed		
1	Gokulpeth	0.157	0.234	0.193	0.36	4890	196.33
2	Khamla	0.250	0.340	0.378	0.448	5038	190.28
3	Sitabuldi	0.178	0187	0245	0.425	5404	260.10
4	Cotton Market	0.188	0.320	0.178	0.278	6330	214.23

** The data supplied by Nagpur Municipal Corporation. Statutory body for the maintenance of Nagpur city*

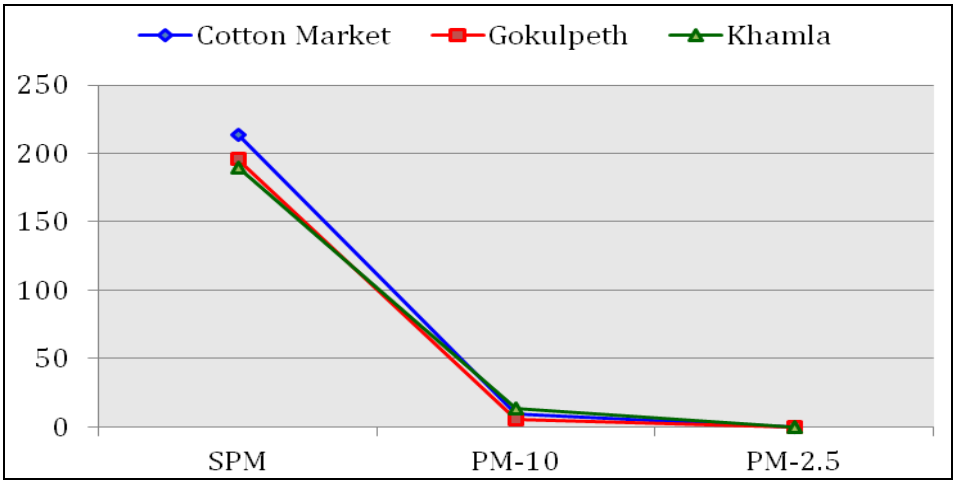

Figure 1: Values of SPM, PM-10 and PM-2.5 at various locations in Nagpur city.

CONCLUSION

Standard procedures were adopted to analyze the lead content in Spinach. The levels noticed in the samples were quite high .Significant difference was registered in samples from inside the market and in outside the market. In cotton market area is the prime vegetable areas in Nagpur city. All vegetables initially dump in this market and then retailer purchase from here and then sell it to various locations in Nagpur. In cotton market area contamination in air and in spinach are very high. The contamination persists even after washing indicates the presence of Lead at deeper region of leaves and holds into it. The contamination in Gokulpeth areas is less but not safe.

The results clearly indicates that the vegetable sold on roadside in Nagpur city are Lead metal contaminated and even after washing the contamination persist. So, it is advisable to wash the Spinach with warm water number of time before use.

Washing the Spinach once reduces lead concentration by 23 per cent. Washing it twice and thrice decreases the concentration by 53 per cent and 55 per cent respectively. This means 50 per cent of lead contamination can be controlled or avoided.

It is also recommended that pregnant women and children should not consume the Spinach which are purchase from roadside and must not use if it is not washed number of times.

The government authority should not allow the vendors to sit on roadside instead specific space should be allocated them which must be away from roadside and air pollution. Also the vendors should use protective covering on vegetation which should protect the contamination.

From this study it is very clear that the citizens of Nagpur are consuming the contaminated vegetables and their health is at stack. Proper vegetable selling process must be adopted by Government authority for the safety of people of this region. Also require exhaustive research on the contamination of other metals in vegetables in this region.

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