

Analysis Of Heavy Metal Contents In Soil And Vegetables Grown Near Gautam Budh Nagar, U.P., India

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Abstract: This paper analyses the heavy metal contents of soil and leafy vegetables grown near Gautam budh Nagar district of Uttar Pradesh, India. The heavy metals Pb, Cd, Mn, Zn and Cu were analysed using Atomic Absorption Spectrophotometer. The soil and vegetable samples were collected from five different sites near GB Nagar district (UP). The leafy vegetables taken for study are cabbage and spinach which are commonly grown in this area. The vegetable samples were collected from the varying distances from the roadside. The results of the study showed that the Pb content in most of the vegetable samples were higher than the permissible limits as defined by the Prevention of Food Adulteration Act 1954. The concentration of other heavy metals were within the safe limits in both the vegetables. Among the heavy metals studied, Pb concentration was highest at three sites and at other two sites Cu concentration was the highest. The results also indicated that heavy metal concentration tend to slightly decrease as the distance from the roadside increases.

Index Terms: Atomic Absorption Spectrophotometer, cabbage, Gautam Budh Nagar, Heavy metals, leafy vegetables, Soil, Spinach.

1 INTRODUCTION

Gautam Budh Nagar is a suburban district of Uttar Pradesh state in northern India. It is part of the National Capital Region (India). Two main rivers of India Ganga and Yamuna flow nearby to this district. The Yamuna River separates Gautam Budh Nagar from Delhi and Faridabad District. Gautam Budh Nagar is bounded by Delhi and Ghaziabad to the north and south. The Sandy and Loam Soil, are the major types of soil found in this area. Wheat, rice and sugar cane are the major crops of this district. Millet is also planted in some areas. Vegetables are also grown in the surrounding areas throughout the year. Being in the purview of NCR, the development of the district is moving with a fast pace. Noida & Greater Noida of the district are world class industrial hubs. Many large scale industries have already been established by the multinational companies and industrialisation is taking place in other areas of the district also. The industrial and economic development causes negative impact on the environment (Dhami J.K., 2013). As a result of urbanization and anthropogenic activities growing environmental pollution and increasing heavy metal concentration in soil and vegetables is the main concern today. Heavy metals are non biodegradable and their concentration keep on increasing in the soil with time. The plants growing on the contaminated soil absorb these heavy metals and accumulate them causing serious health risks (Jacob J.O., 2012). The aim of this study was to

assess the concentration of heavy metals Pb, Cd, Zn, Mn, and Cu in the soil and leafy vegetables Spinach and Cabbage so as to evaluate the bioaccumulation of these metals.

2 MATERIALS AND METHODS

2.1 Sample Collection

To study the average accumulation of heavy metals in vegetables and soil, five different sites were identified and selected where vegetables are mainly grown near Gautam Budh Nagar. The sites selected for study are Hapur Road, Dadri, Surajpur village, Bsrakh and Badarpur area. The vegetable (Cabbage and Spinach) samples were collected from the five identified sites. The leafy vegetables cabbage and spinach were chosen for the study as they are grown throughout the year in this area.

2.2 Sample Preparation

The soil and vegetable samples were collected from varying distances from the road side at each identified site. For metal determination in soil samples, 0.5-1 inch deep surface soil samples were collected from selected locations. Soil samples were dried at 110^o C, powdered and sieved through a mesh to homogenize. 1.0 gm of soil sample was digested with 10 ml Conc. HNO₃ in a 100 ml beaker. Then 5 ml each of Conc. HNO₃ and HClO₄ were added and heated to produce fumes and was evaporated to dryness. It was then diluted with distilled water and volume was raised to 100 ml. The vegetable samples were washed thoroughly with water to remove soil and adhering dust particles. Then samples were dried at 105^o C for 24 hrs and 1.0 gm of this oven dried sample was digested for 5-6 hrs in 20 ml Conc. HNO₃ and HClO₄ in the ratio 4:1. The final volume was made to 50 ml with distilled water following filtration. The assessment of heavy metals Pb, Cd, Mn, Zn and Cu was done by Atomic Absorption Spectrophotometer (make ECIL Hyderabad).

3 RESULTS AND DISCUSSION

The study shows that the heavy metal concentration in the soil is in the order Pb>Cu>Zn>Mn>Cd except in the case of

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- The plants growing on the contaminated soil absorb these heavy metals and accumulate them causing serious health risks (Jacob J.O., 2012).

Dadri and Badarpur where highest concentration reported is of Cu. Comparing with the PFA(Prevention of Food and Adulteration Act 1954), the level of Pb was found to be higher than the permissible limits of 2.5 mg/Kg in all the samples of both vegetables. The Cd level is below the permissible limits of 1.5 mg/Kg in all the samples. But when compared with European Standards, where permissible limits for Cd is 0.1 mg/Kg respectively, the levels for Cd were also reported to be slightly higher. Mn and Zn are present in very small amounts in all the vegetable samples. Cu level in both cabbage and spinach were found within the safe limits where permissible PFA limit is 30 mg/Kg.

Site	Pb	Cd	Mn	Zn	Cu
Hapur Road (NH24)	53.05 ±0.032	22.07 ±0.027	28.93 ±0.200	19.23 ±0.341	32.73 ±0.109
Dadri	54.08 ±0.035	21.66 ±1.034	46.54 ±0.003	76.83 ±9.002	83.41 ±7.254
Surajpur	47.32 ±0.029	19.86 ±1.803	25.41 ±1.225	28.43 ±0.221	38.91 ±3.005
Bisrakh	59.77 ±7.849	21.23 ±4.332	25.05 ±3.442	31.27 ±6.839	57.42 ±7.268
Badarpur	43.27 ±8.341	19.72 ±9.665	23.79 ±4.221	20.61 ±7.443	78.35 ±14.839

Sitewise Comparison of Heavy Metal Concentration (mg/Kg) in Soil (Average of 7 readings, ± standard deviation)

Site	Pb	Cd	Mn	Zn	Cu
Hapur Road (NH24)	10.03 ±4.32 1	0.51 ±0.440	5.42 ±0.542	1.42 ±2.32 1	4.02 ±4.382
Dadri	12.11 ±3.54 2	0.21 ±0.021	9.01 ±0.006	22.32 ±4.10 2	26.91 ±8.214
Surajpur	9.33 ±1.22 6	0.11 ±0.033	4.33 ±2.034	3.77 ±3.40 3	6.52 ±3.586
Bisrakh	14.13 ±5.67 2	0.13 ±1.002	4.01 ±6.521	4.01 ±5.53 2	11.31 ±2.743
Badarpur	8.54 ±1.03 5	0.11 ±1.320	3.34 ±4.232	2.8 ±7.16 7	21.32 ±8.205

Sitewise Comparison of Heavy Metal Concentration (mg/Kg) in Cabbage (Average of 7 readings, ± standard deviation)

Site	Pb	Cd	Mn	Zn	Cu
Hapur Road (NH24)	11.03 ±7.820	0.54 ±3.567	5.38 ±7.463	1.52 ±4.763	4.15 ±6.402
Dadri	10.81 ±1.572	0.27 ±6.873	14.11 ±8.655	11.36 ±5.724	10.44 ±5.076
Surajpur	5.31 ±3.823	0.17 ±7.054	7.21 ±3.481	2.98 ±3.592	3.71 ±5.441
Bisrakh	11.58 ±5.884	0.22 ±5.138	3.17 ±4.862	3.09 ±4.915	9.82 ±3.728
Badarpur	5.42 ±7.271	0.17 ±5.226	2.31 ±6.441	1.21 ±6.073	6.7 ±7.052

Site	0m	200m	500m
Hapur Road (NH 24)	10.03	9.86	9.75
Dadri	12.11	12.01	11.83
Surajpur	9.33	9.31	9.27
Bisrakh	14.13	13.96	13.04
Badarpur	8.54	8.21	8.03

Sitewise Comparison of Heavy Metal Concentration (mg/Kg) in Spinach (Average of 7 readings, ± standard deviation)

The results also show that the level of Pb is slightly higher in the samples of vegetables grown near the road side and the level further decreases successively in vegetables grown far from the roadside

Site	0m	200m	500m
Hapur Road (NH24)	11.03	10.86	10.84
Dadri	10.81	10.61	10.04
Surajpur	5.31	5.21	5.16
Bisrakh	11.58	11.32	11.08
Badarpur	5.42	5.02	4.86

Variation in Pb in Cabbage at different distance from the road (mg/Kg) (Average of 7 readings)

Site	0m	200m	500m
Hapur Road (NH24)	11.03	10.86	10.84
Dadri	10.81	10.61	10.04
Surajpur	5.31	5.21	5.16
Bisrakh	11.58	11.32	11.08
Badarpur	5.42	5.02	4.86

Variation in Pb in Spinach at different distance from the road (mg/Kg) (Average of 7 readings)

4 CONCLUSION

The study of heavy metal concentration shows the increased levels of Pb in soil as well as the vegetables. The levels of other heavy metals were reported to be in the safe limits. It is also seen that the concentration of heavy metals tend to decrease as the distance from the road is increased. Hence it is recommended that the vegetables should be grown away from the roadside or leaving a considerable distance from the road.

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