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Estimation of micronutrients contamination in mango leaves sample surrounding different industrial area of Gujarat, Western India

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Abstract

The anthropogenic pollution caused by heavy industries enters plants then goes through food chain and ultimately endangers human health. A preliminary survey work was taken up during the year 2014-2015. The aim of study were to estimation of micronutrients (Fe, Mn, Zn and Cu) contamination in mango leaves sample surrounding different industrial area of Gujarat like, Ankleshwar, Sachin and Vapi. The concentrations of micronutrient level were determined using Perkin-Elmer Induction Coupled Plasma Mass Spectroscopy, (ICP-MS). the result revealed that the concentrations of analyzed micronutrient range from Fe content 491 to 990 mg/kg with mean value of 798 mg/kg, Mn content 31.5 to 97.9 mg/kg with mean value of 70.1, Zn content 12.6 to 46.5 with mean value of 31.2 mg/kg and Cu content 3.9 to 14.7 mg/kg with mean value of 8.5 mg/kg in fields situated within the 2 km area of Ankleshwar, Sachin and Vapi GIDC. While, Fe content in fields situated in outside Fe content 503 to 985 mg/kg with mean value of 752 mg/kg. Mn content 32.2 to 99.7 mg/kg with mean value of 62.7 mg/kg, respectively. Zn content 20.0 to 43.0 mg/kg with mean value of 29.9 and Cu content 4.3 to 10.7 mg/kg mean value of 7.8 mg/kg. Thus the mango leaves samples value situated within 2 km and out-side 2 km area of Ankleshwar, Sachin and Vapi GIDC industrial area of Gujarat, indicated that among the micronutrient content Fe content in mango leaves nearby different industrial area were found above maximum permissible limit. While the values of other micronutrients (Mn, Zn and Cu) were found below maximum permissible limit in different industrial areas of Gujarat.

Keywords: Micronutrient, Contamination, ICP-MS, Mango leaves, Industrial area, Gujarat

Introduction

Mango is important fruit crop of south Gujarat are predominately known for their high nutritional content mostly consumed for health and nutritional benefit. Generally industrial, mining and agricultural waste contains various micronutrients and heavy metal viz. Fe, Mn, Zn and Cu (Devkota*et al.*, 2000; Sharma *et al.*, 2006). When the micronutrient and heavy metal polluted water from industries are uses as the source of irrigation for vegetable crops then it is absorb by crops through root transportation system. The absorbed micronutrient and heavy metal have a tendency to accumulate along the food chains, and cause health and toxicity problems not only for environment, but also human beings. The pollution includes point sources such as emission, effluents and solid discharge from industries, vehicle exhaustion and metals from smelting and mining, and nonpoint sources, such as soluble salts (natural and artificial), use of insecticides/pesticides, disposal of industrial and municipal wastes in agriculture, and excessive use of fertilizers (McGrath *et al.*, 2001). Each source of contamination has its own damaging effects to plants, animals and ultimately to human health. Ankleshwar, Sachin and Vapiis industrial belt of Gujarat, India. These estates consist of an estimated 3000, 100 and nearly 2000 industrial units respectively. These industrial belts contain many villages surrounding nearby industries and most of village farmers are engaged with cultivation of vegetable, mango and sapota. Although micronutrient such as Iron, Manganese, Zinc and Copper etc. are essential but their higher concentration may cause health problem animals, plant growth and soil contamination.

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Materials and Methods

Mango leaves samples were collected around agricultural field of each industrial area was divided two part (i) polluted site (2 km industrial peripheral

area) and (ii) non polluted site (out-side 2 km industrial peripheral area). Total (50) mango leaves samples were collected in order to estimation of micronutrient contamination different industrial areas of Gujarat like, Ankleshwar, Sachin and Vapi. Based on the preliminary survey, randomly five plant samples were mango leaves collected from the field and after mixing the five samples one representative plant sample of mango leave sample was made and was collected in clean bag separately, labeled properly and brought to the laboratory.The plant samples after bringing in the laboratory were washed with tap water and distilled water on the samples was socked with clean cloth. Then samples were air dried at room temperature and then oven dried (at 60 ^{o}C). The dried samples were grounded to make powder form by a grinder-cum-mixture and all the samples were kept aside for analysis of Fe, Mn, Zn, and Cu using standard methods Induction Coupled Plasma Mass Spectroscopy (ICP-MS).

Results and Discussion

Content of Fe, Mn, Zn and Cu in mango leaves samples nearby surrounding area of industrial area, Ankleshwar, Sachin and Vapi.

Results on total Fe from mango leaves samples are presented in Table-1. The results revealed that Fe content in fields situated within the 2 km area of Ankleshwar, Sachin and Vapi GIDC was widely 491 to 990 mg/kg with mean value of 798 mg/kg. While, Fe content in fields situated in outside 2 km area of Ankleshwar, Sachin and Vapi GIDC range from 503 to 985 mg/kg with mean value of 752 mg/kg. Overall range of total Mn content in mango leaves samples collected from inside and outside 2 km of three industrial areas was 31.5 to 97.9 mg/kg with mean value of 70.1 and 32.2 to 99.7 mg/kg with mean value of 62.7 mg/kg, respectively. All the 50 leaves samples of mango tree containing Fe were well above the maximum permissible limit (5.0 mg/kg). There is no specific permissible limit for Mn is available. However, higher content of Fe and Mn content in mango leaves samples and its translocation to the edible part making them toxic for human consumption. The results corroborated with the findings of Kumar *et al.* (2007). Buszewski*et al.* (2009) monitored during March to May and October to November Fe heavy metal uptake by plants in Torun, Poland. They found differences between minimum and maximum value of Fe (499 mg/kg).

Total Zn content in mango leaves samples situated in 2 km range of Ankleshwar, Sachin and Vapi GIDC industrial area was varied range from 12.6 to 46.5 with mean value of 31.2 mg/kg. The content of Zn in field situated outside the 2 km range was varied from 20.0 to 43.0 mg/kg with mean value of 29.9 mg/kg (Table-1). All the samples collected from nearby different industrial area were found below permissible limit of Zn <50.0 mg/kg. More or less, similar results were obtained by Sharma *et al.* (2009) value 0.6–2.3 of Zn mg/kg in vegetables collected from market sites of tropical area of India and Amune*et al.* (2012) found 0.25±0.13 mg/kg of Zn in crop plants during both dry and rainy season around Itakpe Iron mine, Okene, Nigeria. Buszewski*et al.* (2009) from Poland reported 75 mg/kg of Zn in plant dry mass, Rahman*et al.* (2010) obtained Zn 62.7-102.5 mg/kg in rice plant under effluent treatment in Dhaka, and Malik *et al.* (2010) recorded 61.9-172.6 mg/kg Zn in wild plant species from Islamabad, Pakistan.Result on Cu content from fifty (50) mango leaves samples presented in table-1 revealed that Cu content in fields located in 2 km periphery of three industrial areas was in range of 3.9 to 14.7 mg/kg with mean value of 8.5 mg/kg. The content of Cu in field situated outside the 2 km of three industrial areas was in the range of and 4.3 to 10.7 mg/kg mean value of 7.8 mg/kg Further, All the samples collected from nearby different industrial area below the maximum permissible threshold value of Cu <30.0 mg/kg. more or less similar result also noted by Buszewski*et al.* (2009) in Torun, Poland obtained Cu 35 mg/kg of plant dry mass, Micleane*t al.* (2000), in a mining area from North-Western Romania recorded 66.3–238.1 mg/kg of Cu in plants, Sharma *et al.* (2009) from production and market sites of a tropical area of India obtained 83–133 mg/kg of Cu in vegetables, Malik *et al.* (2010) found that wild plant species from Islamabad, Pakistan contained 8.9–357.4 mg/kg Cu and Bhattacharya *et al.* (2011) analyzing Cu concentration in street and leaf deposited dust in Anand city, India, reported 52 –130 mg/kg Cu in leaf sample.

Table 1: DTPA-extractable Fe, Mn, Zn and Cu content in leaves of mango grown in Ankleshwar, Sachin and Vapi

Sr. No.	Fe		Mn		Zn		Cu	
	In-side 2 km	Out-side 2 km	In-side 2 km	Out-side 2 km	In-side 2 km	Out-side 2 km	In-side 2 km	Out-side 2 km
Ankleshwar								
1	785	503	31.5	47.3	28.8	31.1	6.6	8.8
2	770	608	45.5	45.2	29.7	20.0	7.2	4.3
3	524	648	78.7	50.2	29.8	31.5	7.6	9.5
4	491	816	79.2	44.8	19.9	33.0	7.6	6.9
5	628	640	72.1	67.0	31.8	23.6	10.9	7.9
6	642	756	63.0	50.6	31.8	31.6	10.0	6.9
7	707	581	74.2	87.8	31.3	28.2	3.9	6.6
8	857	553	62.1	65.1	28.7	31.3	9.0	7.1
9	773	854	94.2	83.1	26.3	30.1	7.0	9.4
10	740	873	89.2	55.3	33.9	27.0	7.6	8.7
Min	491	503	31.5	44.8	19.9	20.0	3.9	4.3
Max	857	873	94.2	87.8	33.9	33.0	10.9	9.5
Mean	692	683	69.0	59.7	29.2	28.8	7.7	7.6
Sachin								
11	867	840	97.5	55.4	27.1	28.7	10.4	9.1
12	824	844	93.0	59.9	26.1	24.7	9.1	6.8
13	990	861	47.9	94.0	30.9	29.0	10.1	9.7
14	975	625	34.0	59.6	26.0	28.3	9.5	6.3
15	973	503	68.7	59.4	26.0	20.2	7.6	7.5
Min	824	503	34.0	55.4	26.0	20.2	7.6	6.3
Max	990	861	97.5	94.0	30.9	29.0	10.4	9.7
Mean	926	735	68.2	65.7	27.2	26.2	9.3	7.9
Vapi								
16	661	886	35.1	74.1	34.5	43.0	11.2	10.7
17	764	591	47.6	32.2	35.3	30.5	6.9	7.2
18	825	886	50.6	63.4	46.0	38.9	5.7	8.3
19	947	843	86.1	83.5	33.2	35.5	5.6	6.2
20	883	852	88.9	46.7	42.5	29.3	11.1	7.9
21	793	632	72.8	49.7	46.5	32.7	14.7	9.4
22	917	764	70.8	82.3	12.6	28.0	8.7	6.9
23	862	985	92.4	99.7	45.2	38.8	7.6	8.1
24	944	893	97.9	38.9	31.3	36.3	7.4	7.5
25	803	955	90.5	56.3	45.6	34.8	10.0	8.2
Min	661	591	35.1	32.2	12.6	28.0	5.6	6.2
Max	947	985	97.9	99.7	46.5	43.0	14.7	10.7
Mean	840	829	73.3	62.7	37.3	34.8	8.9	8.0
Overall								
Min	491	503	31.5	32.2	12.6	20.0	3.9	4.3
Max	990	985	97.9	99.7	46.5	43.0	14.7	10.7
Mean	798	752	70.5	62.1	32.0	30.6	8.5	7.8
MPL	5	5	-	-	50	50	30	30

Source:- Anita *et al.* (2010) Fe limit:- WHO/FAO (2011) Mn limit:- There is no Maximum Permissible Limit

Conclusion

Assessment of micronutrient in the mango leaves efficient way to fine the qualitative and quantitative difference in metal concentration at distinct industrial locations. It can be fulfilled that the soil samples collected from nearby surrounding area of industrial belt like, Ankleshwar, Sachin and Vapi does not showed any contamination of Mn, Zn and Cu toxicity except Fe in mango leaves surrounding different industrial area of Gujarat. The concentration of micronutrient Mn, Zn and Cu were below maximum permissible limit. while Fe found above maximum permissible limit.

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