Moroccan Journal of Chemistry
ISSN: 2351-812X
http://revues.imist.ma/?journal=morjchem&page=login
Seemab & al./ Mor. J. Chem. 5 N°3 (2017) 505-512

CHARACTERIZATION AND EVALUATION OF POLLUTANTS IN LATE SEASON VEGETABLES OF DISTRICT MANSEHRA

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Received 21 Jan 2017, Revised 18 July 2017, Accepted 28 July 2017

Abstract

The experiment was conducted during 2015-16 at Mansehra to find out the pollutants and heavy metals in off season vegetable crops i.e. Spinach, Coriander, Turnip, Radish, Potato, Chilies, Pea and Kale with the title captioned "Characterization and evaluation of pollutants in off season vegetables of district Mansehra". Metals pollutants are naturally occurring elements that have a high atomic weight and a density at least 5 times more than that of water. Levels of cobalt, copper, iron, nickel, lead and zinc were dead set in water, vegetable and soils in Mansehra. Most metals Zn, Ni, Co, Cu were within the safe limit according to standard values. Average amount of Zn in soil was 151.06 mg kg^{-1}. Likewise, in vegetables Fe and Pb were high above the safe limit according to W.H.O/FAO standard and other metals Zn, Ni, Cu their average amount was 2.0 mg kg^{-1}, 2mg kg^{-1}, 16.9 mg kg^{-1} but the level of Pb 59.9 mg kg^{-1} and Fe 229.9 mg kg^{-1} in some vegetables in excess amount and above the safe limit. Therefore, it is recommended that the follow metals are inside cutoff points situated down for safe human utilization.

Keywords: *Characterization – Evaluation; Pollutants; Vegetables.*

1. Introduction

A pollutant (toxin) is a matter, transported into the atmosphere that might have unwanted results, or unfavorably affects the efficiency of resources. A contaminant might have possibility to cause extended or temporary harm by altering the production procedures of animals or plants and by meddling with individual facilities, healthiness, ease, or assets standards. According to Tietenberg [8], stock pollutants are those that the surroundings have slight or no absorptive ability. Stock pollutants consist of heavy metals, non-biodegradable plastics and persistent artificial chemicals. Fund pollutants are not wiped out but to a certain extent transformed into fewer damaging substances or diluted to harmless concentration. In addition, pollutants could be explained by dividing in horizontal and vertical zones [8]. Notable pollutants are heavy metals, EPPP (Environmental Persistent Pharmaceutical Pollutants), Volatile organic compounds, PAH (Polycyclic aromatic hydrocarbons), POP (Persistent Organic Pollutants), Xenobiotics. The vicinity that is damaged by a pollutant is known as horizontal zone. The damage either atmospheric or ground-level is referred to vertical zone. The existence of xenobiotics (artificial) chemicals or other variations in the normal soil are the reasons for soil pollution. Metal pollutants can tie with critical cellular components, for instance enzymes, structural proteins and nucleic acids and hinder their performance [9]. The aim of study was to monitor the toxic heavy metals Co, Pb, Ni and Fe,Zn,Cu in vegetables through atomic absorption. Determination of specific climate conditions in the area of research and their effects in the amount of pollution / contamination. To study the heavy metal quantities in total and mobile forms in soil and interpretation of values in connection with the phenomenon of soil pollution /contamination by comparing with reference values. Determination of heavy metal quantities in plant samples and interpretation of the results from the level of contamination and food safety hazard points of view by comparing values with the maximum permitted levels.

2. Materials and methods

In present study samples of vegetables, soil and water were collected from different locations of District Mansehra to measure the toxic metals (Fe, Zn, Co, Cu, Ni and Pb) concentration.

2.1. Samples Collection

Table 1. Area, Location and source of vegetables

S.No	Area	Location	Source
1	Gulibagh	Road side	Potato
2	Gulibagh	Road side	Green chilli
3	Gulibagh	Road side	Peas
4	Gulibagh	Road side	Cabbage
5	Gulibagh	Road side	Turnip
6	Baffadoraha	Road side	Raddish
7	Baffadoraha	Road side	Turnip
8	Ghandian	Road side	Potato
9	Baffamera	Road away	Spinach leaves
10	Baffamera	Road away	Raddish
11	Baffamera	Raod away	Brassica leaves
12	Baffamera	Road away	Methi leaves
13	Baffamera	Road away	Coriander leaves
14	Khawajgan	Road side	Raddish
15	Khawajgan	Road side	Turnip

Different vegetable samples like Brassica, Spinach, Cabbage, Methi, Raddish, Turnip, Potato, Peas, Cauliflower, Green chilli, Coriander leaves were collected from different locations. There were 15 samples of vegetables collected from different fields according to location and five samples of soil
from different location.

2.2. Method of Soil and Vegetable Digestion

A well-mixed of 10 gm and 2 gm dried and powdered soil and vegetable respectively was taken in to a glass beaker for each sample. In these samples 20 ml of acidic solution (10 ml nitric+ 10 ml per chloric) was added and were kept for some hours and then heated on a hot furnace until no brown fumes were given off. The samples were cooled and added 10 ml HNO3. The mixture was evaporated near to dryness and diluted the mixture by adding 100 ml of distilled water and filtered in flasks.

2.3. Water Sampling

Stream water was collected like from Baffa doraha and Khawajgan, whereas tube well water collected from gulibagh and Baffa mera. 4 samples of water were collected from each location.

2.4. Analysis of Heavy metal pollutants in Soil, Water and Vegetables

For examination of heavy metals in vegetables, soil and water samples by measuring through Atomic Absorption Spectrophotometer. Hollow cathode lamp of Pb, Fe, Co, Zn, Ni, and Cu were utilized to measure the metals concentrations in following samples. Standard arrangements of 1000 ppm of individual components (Cu, Pb, Ni, Zn, Fe, Co) were made to set up the working standard of 100 ppm. At that point further dilutions of 1, 2, 3, 4, 5, 6 ppm were carried out as working expectations standard of test components.

3. Results and Discussion

3.1. Iron Content in Soil, Vegetables and Water.

In vegetables, the iron content ranges from 4.8 to 692.6 mg kg^{-1}, the average content is 229.9 mg kg^{-1} which is higher than the permissible limit [6]. Range of Fe content in soil is 780.9 to 787 mg kg^{-1}. There is no guideline value sets for Fe in drinking water by WHO, NSDWQ-Pak, or EU standards [4-5].

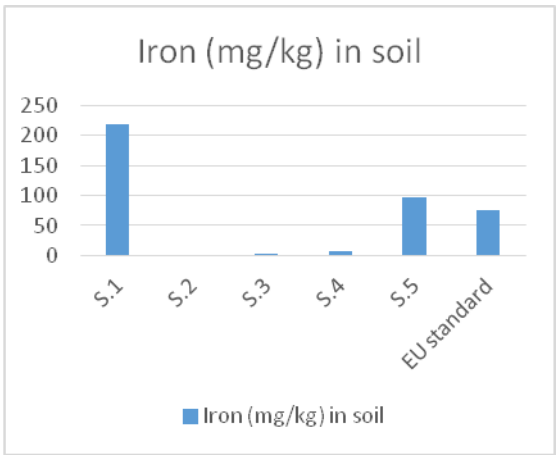

Fig 1. Iron in soil mg kg^{-1}

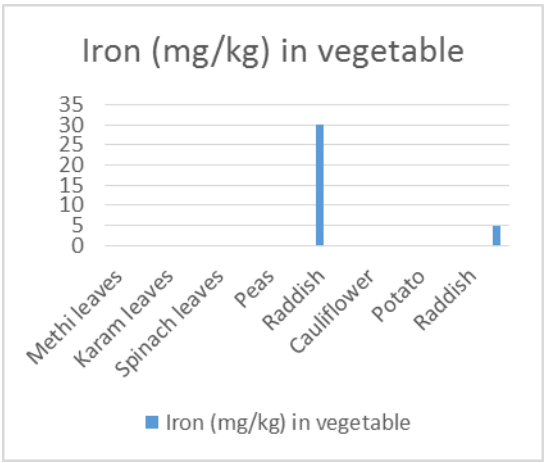

Fig 2. Iron in vegetables mg kg^{-1}

3.2. Zinc Content in Soil, Vegetables and Water

Average zinc (Zn) content in the soils is estimated to be 151 mg kg^{-1}. The standard limit of Zn in soil (for sewage sludge applications) set by EU is 150–300 mg kg^{-1} [4]. Both in ground and in surface waters in Pakistan, the Zn level was found well below the standards set by NSDWQ-Pak [5]; however, on the other hand, this data shows the water deficiency in Zn, which hinders this source to meet the RDA.

The average content of zinc in vegetables is 2.0 mg kg^{-1} which is below the permissible limit set by WHO/FAO, [6]. Soluble forms of Zn are readily available to plants, and the uptake of Zn has been reported to be linear with metal concentration in the nutrient solution and in soils, and Zn contents of plants vary considerably, reflecting the different factors of various ecosystems and of the genotypes [1].

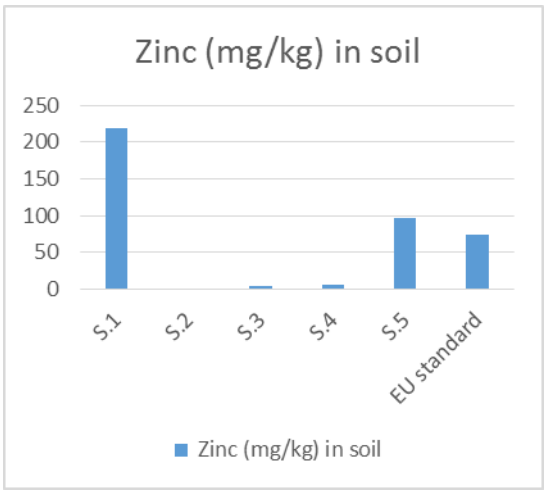

Fig 3. Zinc in soil mg kg^{-1}

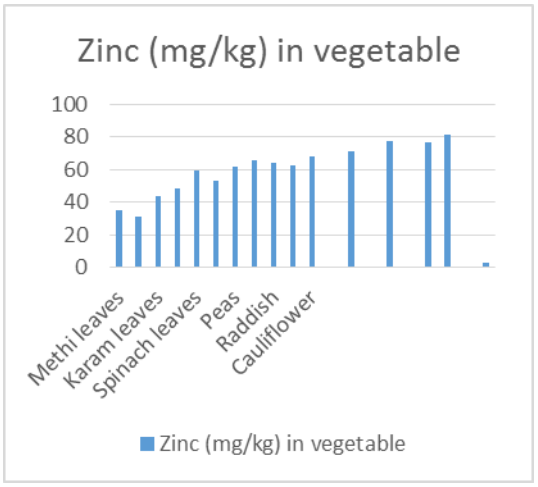

Fig 4. Zinc in vegetable mg kg^{-1}

3.3. Copper Content in Soil, Vegetables and Water

Cu concentration in soil and dust ranges from 22 to 146 mg kg^{-1}. The average concentration is 54.38 mg kg-1 which is below the permissible limit [3]. In vegetables the Cu range from 2.9 to 115.9 mg kg^{-1}, the average content is 16.9 mg kg^{-1} which is below the permissible limit [6]. In water Cu content is not found. According to European Standards, the allowable concentration of Cu in soil (on which sewage sludge is applied) is 50–140 mg kg^{-1}[4].

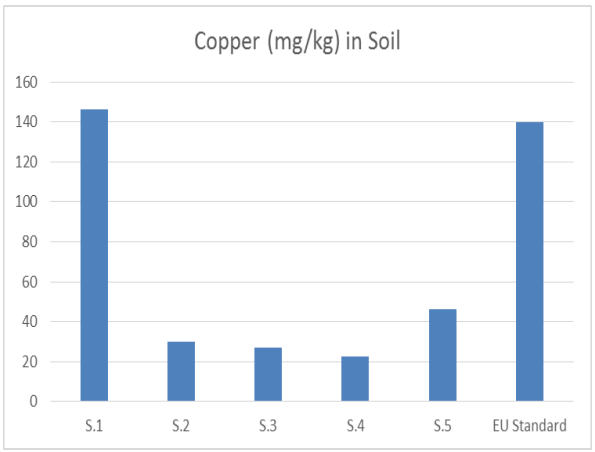

Fig 5. Copper in vegetable mg kg^{-1}

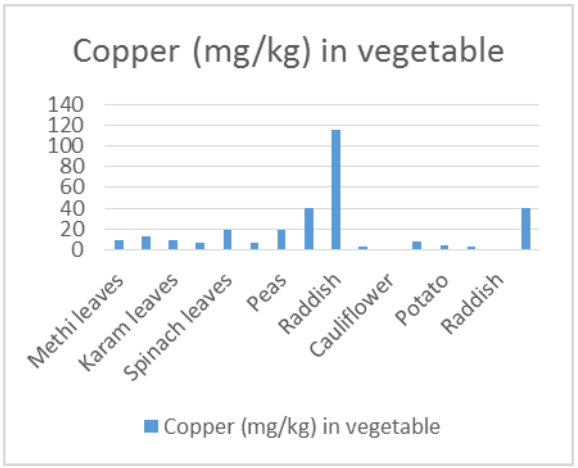

Fig 6. Copper in vegetable mg kg^{-1}

3.4. Lead Content in Soil, Vegetables and Water

In soil the Pb concentration is well below the acceptable level of Pb (50–300 mg kg^{-1}) in normal soil on which sewage sludge is applied by European Union [4]. In water average amount of Pb is 0.9 mg/l which is above the safe limit according to WHO standard. Moreover, the contamination of heavy metals especially Pb in roadside soil is related to the traffic density on the roads [2]. According to European Union the permissible level of lead in vegetables are 0.1 to 2.7 mg kg^{-1} which is much higher in vegetables, average content of Pb in vegetables is 59.9 mg kg^{-1} which is above the safe limit. The variations in the Pb concentration at some points may be due to traffic burden, brick kilns, and usage of leaded gasoline [7].Average concentration of Pb in soil is 68.56 mg kg^{-1} which is below the permissible limit according to [3].

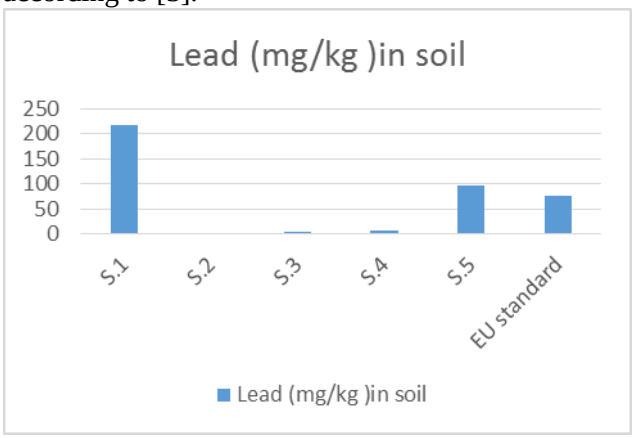

Fig 7. Lead in soil mg kg^{-1}

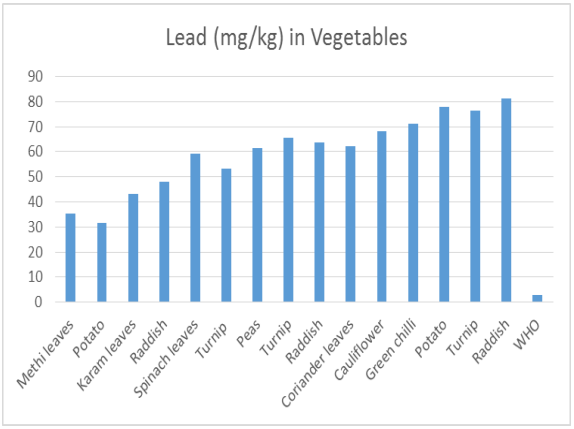

Fig 8. Lead in Vegetables mg kg^{-1}

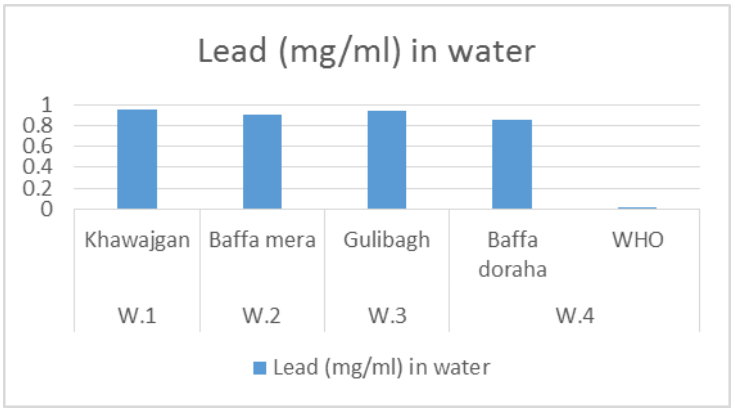

Fig 9. Lead in water mg mL^{-1}

3.5. Nickel Content in Soil, Vegetables and Water

Nickel (Ni) is widely distributed in nature and is found in animals, plants, and soil; the concentration of Ni in soil is approximately in the range of 3.9 to 218.5 mg kg^{-1} The average amount is 65.1 mg kg^{-1} which is below the permissible limit according to EU standard. In vegetables the average amount of Ni is 2 mg kg^{-1} which is safe within the limit [4]. The concentration of Ni was not found in water. The maximum permissible concentration for Ni set by WHO in drinking water is 0.07 mg mL^{-1} [4], whereas National Standards for Drinking Water Quality, Pakistan (NSDWQ-Pak), suggest the guideline value of 0.02 mg mL^{-1} [5].

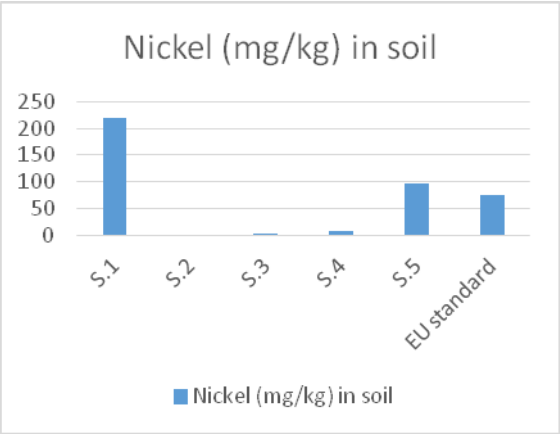

Fig 10. Nickel in soil mg kg^{-1}

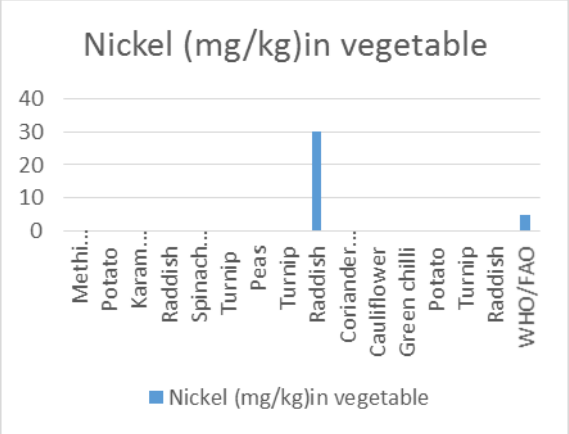

Fig 11. Nickel in vegetable mg kg^{-1}

3.6. Cobalt Content in Soil, Vegetables and Water

The centralization of cobalt was not found in examples of vegetables and in water. The convergence of cobalt changes from 0.7 to 94.9 mg kg^{-1} in soil. The normal substance of metal in soil is 32.5 mg kg^{-1}, there is no restriction standard situated for cobalt.

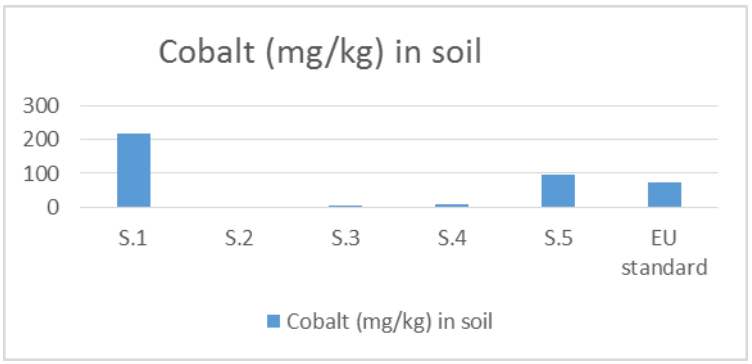

Fig 12. Cobalt in soil mg kg^{-1}

Table 2. Level of toxic metals in soil (mg kg^{-1})

Sample Code	Area	Zn (mg kg^{-1})	Pb (mg kg^{-1})	Cu (mg kg^{-1})	Co (mg kg^{-1})	Fe (mg kg^{-1})	Ni (mg kg^{-1})
S.1	Baffa Doraha	259.3	89.1	146.5	94.9	787	218.5
S.2	Khawajgan	106.6	52.5	29.8	0.00	780.9	0.00
S.3	Gulibagh	125.3	63.6	27.1	0.7	785.2	3.9
S.4	Gulibagh	174.3	64.9	22.4	8.4	785	7
S.5	Baffa Doraha	89.8	72.7	46.1	58.9	786	96.5
Minimum value		**89.8**	**52.5**	**22.4**	**0.7**	**780.9**	**3.9**
Maximum value		**259.3**	**89.1**	**146.5**	**94.9**	**787**	**218.5**
Average amount		**151.06**	**68.56**	**54.38**	**32.5**	**784.82**	**65.1**

Table 3. Concentration of toxic metals in vegetables (mg kg^{-1})

S.no	Location	Vegetables	Zn	Pb	Cu	Co	Fe	Ni
v.1	Baffa mera	Methi leaves	0.00	35.3	9.51	0.00	357.8	0.00
V.2	Ghandian	Potato	0.00	31.4	12.8	0.00	195.2	0.00
V.3	Baffa Mera	Karam leaves	17	43.3	9	0.00	415.8	0.00
V.4	Baffa Mera	Raddish	0.00	48.1	6.2	0.00	110.2	0.00
V.5	Baffa Mera	Spinach leaves	13	59.3	18.5	0.00	390.8	0.00
V.6	Baffa Doraha	Turnip	0.00	53.2	6.7	0.00	141.8	0.00
V.7	Gulibagh	Peas	0.00	61.6	18.5	0.00	76.5	0.00
V.8	Khawajgan	Turnip	0.00	65.7	39.9	0.00	447.6	0.00
V.9	Khawajgan	Raddish	0.00	63.8	115.9	0.00	692.6	30
V.10	Baffa Mera	Coriander leaves	0.00	62.3	2.9	0.00	289.2	0.00
V.11	Gulibagh	Cauliflower	0.00	68	0.00	0.00	0.00	0.00
V.12	Gulibagh	Green chilli	0.00	71.3	7.6	0.00	110.5	0.00
V.13	Gulibagh	Potato	0.00	77.7	3.8	0.00	69.9	0.00
V.14	Gulibagh	Turnip	0.00	76.5	2.9	0.00	4.8	0.00
V.15	Baffa Doraha	Raddish	0.00	81.4	0.00	0.00	146	0.00
	Minimum values		**13.5**	**31.4**	**2.9**	**0.00**	**4.8**	**0.00**
	Maximum values		**17**	**81.4**	**115.9**	**0.00**	**692.6**	**30**
	Average amount		**2.0**	**59.9**	**16.9**	**0**	**229.9**	**2**

Table 4. Concentration of toxic metal in water

S.no	**Location**	**PH**	**zinc**	**Lead**	**Copper**	**Cobalt**	**Iron**	**Nickel**
W1	Khawajgan	6.97	0.00	0.949	0.00	0.00	0.00	0.00
W2	Baffa mera	8.30	0.00	0.910	0.00	0.00	0.00	0.00
W3	Gulibagh	8.23	0.00	0.936	0.00	0.00	0.00	0.00
W4	Baffa doraha	6.96	0.00	0.858	0.00	0.00	0.00	0.00

4. Conclusion

Heavy metals are important in many respects to man especially in the manufacturing of certain important products of human use, Forethought ought to be taken amid the vehicle and offer of vegetables. As the vegetables and fruits are great wellspring of crucial follow components, they may give the obliged sum follow metals to our body. Although heavy metal poisoning could be clinically diagnosed and medically treated, the best option is to prevent heavy metal pollution and the subsequent human poisoning. Along these lines, it was closed from the aftereffects of the study that the levels of follow metals are inside cutoff points situated down for safe human utilization.

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