

STUDY OF HEAVY METALS IN ROOT VEGETABLE (ONIONS AND POTATOES) OF MASTUNG IN AREA OF BALOCHISTAN

Manzoor Iqbal Khattak^{*1}, Mahmood Iqbal Khattak² and Anwar Khan Panezai³

¹Chemistry Department, University of Balochistan, Quetta, Pakistan

¹PCSIR Laboratories, Peshawar.

²Institute of Bio-Chemistry, Balochistan University, Quetta.

E.mail; manzoor_iqbal@yahoo.com

ABSTRACT: The fundamental goal of this work is presented to call attention to the accumulation of poisonous heavy metals, for example, Cd, Co, Cu, Ni, Pb and Zn, in the sprouts of two homegrown onions and potatoes gathered from Mastung, Balochistan. Supplementary, the spectroscopic measurement of heavy metals in vegetation's followed the pattern ($Zn > Cu > Co > Ni > Pb > Cd$), so is the case for flora in like manner but beneficial for healing tenacities as well.

Keywords: Heavy Metals, spectroscopic techniques, vegetables and concentration determination.

1. INTRODUCTION

Baluchistan is innate to home-developed of some restorative floras. In Baluchistan, various uninhabited plants have been gathered and exchanged with local commercial centers to inhabitant openness. All parameters considered to lack of logical data is open to idle sweet-smelling plant, which can be refined and utilized for different tenacities. The helplessness of therapeutic herbs and flavors to over-abuse and eradication should be managed even-mindedly. The worries and issues relating to the preservation of these plants could be tended through an assortment of exercises including zenith government and non-legislative associations of the segment.

The ventures are required for the advancement of suitable preservation, development and reaping procedures. Facilitated endeavors in the nation should be guaranteed in the field of protection, conservation, documentation and utilization of neighborhood indigenous learning on the utilization of these assets. The preservation and practical utilization of the living spaces of these plants, in addition for guaranteeing proceeded with the accessibility of the essential fixings and could be tended to through taming of high esteem plants.

The Allium cepa "onion". 'Cepa' is a Latin word for onion, or else termed the onion knob or straightforward onion, is utilized as a vegetal and is the utmost usually established types of the genera "Allium". This variety furthermore comprises a few unlike animal groups inversely referred to as onions and settled for nourishment, e.g. the Japanese bundling onion "A. fistulosum", the Egyptian onion "A. proliferum", and the Canadian onion "A. canadense". The term "wild onion" is linked to numerous Allium types though Allium cepa is solely recognized after growth and its genealogically rough sole form isn't recognized, despite the statistic that getaways from growth have twisted out to be built up in some areas [1]. The onion is most often times a two-yearly or a lasting herbal, however, is normally regarded as a yearly and collected in its primary developing season.

Onion is developed on a territory of 44372.71ac per a creation of 332.976 metric tons. It is chiefly developed in "Chagi (10,378.4 ac)", "Turbat (4277.4 ac)", "Kalat (6610.1 ac)", "Khuzdar (2503.17 ac)", "Kharan (1976.85 ac)", "Qila Saifullah (1934.83 ac)", "Nasirabad (2471.05 ac)", "Mastung (8,720.35 ac)", and "Lasbela (617.77 ac)". For example, it can be realized, the aquatic necessity of onion is very high and changes from 43.40 to 1,03.7 cm. It isn't prescribed for development in Nokundi, Quetta and Turbot zones.. The plants of onions are given in Figure-1.



Figure-1. The plants of onions.

Bulb-Onions greeneries are a bit of anthropoid supper and comprise, take after metals in correct time sums. Take after metals become hooked on the onions greeneries over aquatic cast-off for the water framework, and mud by mineral addition by yields. The heights of those take after metals upsurge, as a consequence of typical ride out of rocks, exchange of misuses like auto batteries, used metal family machines, usage of composts, insecticides, herbicides' and manufacturing wastes [2-3]. Mumba *et al.*, [4] initiated that the centralization of Cadmium Cd is considered highest in cabbages which are immersed by store aquatic resources.

There is a little evidence of the stages of taking after metals on aquatic, mud, sediment, onion, pepper and tomatoes handles of Challava Waterway in the written work. In any case, no evidence is found on the stages of taking after metals in onion greeneries. Those are generally cast-off as flavors in the diet. Regardless of the way that flavors address besides a slight measure of entire diet utilization, amazing stages of overpowering metals might happen and those are created in sullied muds. In this way, it is required to do expansive transmission on the sustenance and vegetal harvests created in the district of the Challava-River for deadly overpowering metals (Cd, Pb and Zn), especially onions greeneries. Remember the true objective to take nearly information into the influence of tannery assignments on herba yields created on the set of the channel.

Potato (disambiguation).The potato is a tuberous yield after the lasting night-shade *S. tuberosum*. "Potato" might mention whichever to the herbal itself or the edible root [5]. "In the Andes", wherever the classes are homegrown, nearly additional linked established potato-tuber types.

Potato-tubers were offered exterior the Andes area roughly four hundred years ago,[6] and since have twisted into a necessary portion of an excessive fragment of the world's diet source. potato is the biosphere's 4th-biggest sustenance edible, next to "maize, wheat, and rice" [7].

Wild-potatoes is exported from the USA to southern Chile. [8]. The potato was at first recognized to have been arranged uninhibitedly in various sites, [9] anyway later inborn testing of the wide blend of cultivars and wild species demonstrated a solitary begin for potatoes in the zone of present-day southern Peru and strange northwestern Bolivia (from a species in the *Solanum brevicaulis* complex), where they were controlled around 7,000–10,000 years back [10-12]. Following a few times of specific raising, there are before long finished a thousand novel sorts of potatoes [11]. More than 99% of the clearly made potatoes general slid from groupings that began in the bogs of south-focal Chile, which have expelled once basic blends from the Andean awesome countries [13-14].

The created zone of potatoes in Balochistan is 8265.67 acre (area measurement unit) and products are 48.220 metric-tons. It is essentially created in "Qila-Saifullah (4,257.63 ac)", "Kalat (1,623.5 ac and Pishin". Potatoes are moreover a tall outlet trim. In district Quetta, "the CWR of potato is 38% advanced than in Kalat (Table 6)". Thusly, the potato isn't endorsed to be produced in Quetta area.

Potatoes are frequently created on daybeds. Regardless, those daybeds are not honestly arranged. The wrinkles take after trench happening cause tremendous water disaster.

Potato (disambiguation) plants are given in Figure

The potatoes are the world's 4th greatest sustenance trim and are essential in various eating regimens in the biosphere. Despite the presence of a wellspring of exceedingly consumable sugar and invigoratingly whole Proteios, the potatoes are moreover a splendid wellspring of other essential supplements. Starting late, growing thought has engrossed on overpowering metals groupings of potatoes wherever all through the biosphere. Significant metals take essential optimistic and harmful parts in humanoid lifecycle [15-20]. Metals, for instance, Pb, Hg, Cd, and Cu are total harmful substances, which reason common risks and represented to be especially hazardous [21]. Elements like Co, Cu, Zn and Mn are elementary metals for individuals, meanwhile, they expect a basic part in regular systems, yet the essential considerable metals can make harmful effects when their confirmation is excessively raised [22-23]. From now on, the take after generous metal substance in potato is a basic idea. Considerable metal meetings of floras are directly connected through their quantities in the earth, anyway, their stages basically shift per herbal types, and can even in like manner impacted by genotypes inside comparable species [24].

As demonstrated by compound properties, considerable metals are parts that show metallic properties and are portrayed in the perspective of thickness, atomic number Z, mixture possessions or harmful quality [25]. The goal of overpowering metals release in the earth, common lifestyle take mutually anthropogenically examples are industrial, transportation, fertilizers, insecticides and consistent (earth, salt-water, clean, well of magma gas and timberland fire) causes [26]. Overpowering metals are solidly associated through disintegrating earth and lifespan value and interminable prologue to the low-slung level of

considerable heavy-metals can incite outrageous prosperity impacts that in excess will realize serious poisoning [27]. Prosperity risks [28-29] and effects of overpowering heavy-metals (e.g. Cd, Co, Pb, Ni, Zn) take prominent and recorded subsequently historical ages [30-32]. Individuals could be exhibited to those elements over diverse routes, for instance, airborne, aquatic and sustenance [33-37]. prologue to the developed lifestyle has been extensively pointing by point all through the world [38-39]. There is a creating stress over prologue to overpowering metals the world over; thusly, estimation of those parts in the mass-media like airborne, aquatic, earth, support [40] and harvests [41-46] take expanded extra hugeness. Since of their uncommon nature, significant elements lean towards to amass [47] in the earth these go in the advanced lifestyle [48]. In like manner, take-up and bio-accumulation by floras and potatoes remain single of the essential parts of significant elements, that hinge on various components, for instance, types and nature of unlike root-vegetable in fascinating elements, et cetera [49-51].

-
2



Figure-2. The plants of Potato (disambiguation).

Most extraordinary reasonable neck and neck of considerable elements in the diet (palatable portions of dissimilar root-vegetable in mg/kg) for Cadmium, Copper, lead and Zinc are 0.05, 10, 0.2 and 20, correspondingly

[52] . What's more, European establishment oblige standards aimed at Cadmium and lead “(in mg/kg of new weight)” designed for nearly food-stuff are as in Table-1[53] .

Table-1. Some WHO standards of Heavy metals in vegetables.

Vegetable Range	Cd	pb
Onions	4.1	0.1
Potatoes	4.1	0.1
Tomatoes	0.5	0.1

In the ebb and flow ponder, the stages of Pb , Cd , Zn, Cu, Co and Ni were resolved in onions and potatoes from the region of Mastung in Balochistan and this work of research will be standard information in future for the researchers and scientists.

2. EXPERIMENTAL

Coherent (Analar) audit chemicals and refined aqua cast-off all through the examination. China and polymer holders cast-off were wash-away with fluid chemicals, flushed by aqua, consumed 10% nitric acid destructive for on day, prepared totally with refined aqua and desiccated in such an approach to confirm, to the point a little spoiling doesn't happen. Tests were newly accumulated for together the examination and rheostat regions in long extent of September 2015. They remained packed in filter-paper, named and took in a split second to the exploration office for getting ready. In the examination focus, every one of the overflowed onion greeneries tests remained wash-away with tap-water, starting with refined aqua. The illustrations remained, cut into about unvarying extents. These were completed to empower ventilation of the parts at a comparative rate. The cut fragments remained in spotless destructive washed-away in ceramic pot conferring to check and stove dehydrated at 1323K for a day in Mummert grill “(Scherzer DIN 40051-IP21)” up-until the point that these remained feeble and new. At this stage, no scaled-down scale living things can create and thoughts were removed to keep from any wellspring of debasement. All cauldrons were named by test number. The dehydrated “onion tests were granulated by means of destructive washed-mortar-pestle and sifted to get a fine powder. Lastly secured in bolted topped elastic compartments and checked reasonably for examination. In ask for to find the capability and resolute quality and precision of the AAS (atomic absorption spectrometry) and the consistency of handling procedure cast-off for the examination of Co, Cd, Cu, Pb, Ni and Zn in the watered onion greeneries tests, 3 sub-trial of onion leaves tests were pointed with (0.5mg per liter Cadmium and Chromium, and 3 mg per liter lead) multi-segment ordinary course of action.

Tests and spaces were prepared as depicted by [2]. Around 500mg of grounded onion, greeneries tests were assessed into a 150ml estimating utensil. 5.0-milliliter conc: HNO₃ destructive and 2.5 mL of HClO₄ destructive, along foaming chips were incorporated. The mix was warmed at 343.15K for 20 minutes till the point when the moment that a light shaded course of action was gotten (assimilation complete).The tests plan was not allowed to dry in the midst of a breakdown. The test was then sieved into a 100 ml standard glass and 2, 5ml fragment of refined aqua were

consumed to wash the estimating utensil, the substance isolated into the 100ml container. The remainder was permitted to calm to 25 °C beforehand debilitating was completed to the check and the substance assorted inside and out by quivering. The ingestion was finished in triplicate for the two cases and clear. The buildups were continued running on the AAS machine. Additionally, spikey and unspoked tests were prepared and analyzed as overhead.

Determination of heavy metals concentration

The plant species examination frameworks used as a piece of the present examination have been depicted in more detail elsewhere Westermann. Signify substance of Cd, Zn, Cu, Ni and Pb in topsoil and in the plant, tissues were directed by an inductively coupled plasma release spectrometry (ICP-AES (Perkin Elmer, 4300 DV) of a more expansive extent of 12-20 parts. The standard arrangements utilized for the ICP investigative adjustment have their Certificate of Analysis (Certipur_ Reference Material). The substantial metal assurance was finished by point by point technique that portrayed by Sawidis [43] . To evaluate the aggregate substantial metals in the plants, tests (roots and shoots) were dried at 105°C for 24 h in corrosive washed and reweighed volumetric 100 ml Pyrex tapered cups. The examples were corrosively processed in a microwave broiler (CEM, MARSX squeeze, USA), as indicated by the EPA strategy 3051 [44]. After the mineralization, the examples were separated (0.45 mm PTFE) and weakened. The plant tests gathered were corrosive treated after the EPA strategy 3052 [45] and examined by an ICP-OES. Normal estimations of five repeats were taken for every assurance. The exactness of explanatory systems was communicated as Relative Standard Deviation (RSD) which went from 5-10% and was computed from the standard deviation separated by the mean. Chemicals, stock arrangements, and reagents were gotten from Sigma/Fluka/Merck and were of diagnostic review. All dishes previously utilize were washed with refined water, absorbed nitric corrosive (30%) overnight, flushed in deionized water and air-dried.

The tuber tests remained dehydrated at 378K for a day, crushed to permit 1 mm, and set away until the point that examination for considerable metals (Co, Cu Cd, Ni, Pb, and Zn). “A Perkin– Elmer Analyst 700 AAS” with deuterium establishment corrector remained cast-off as a piece of this examination.

The working limits for segments remained established as suggested creator. lead, Nickle, Cadmium, Copper, Cobalt and Zinc in potatoes were directed by “HGA graphite” radiator by means of Ar as lethargic vapors. Substitute segments stayed directed by using air-Ethyne fire. “Bergh of Speed-wave microwave assimilation (MWS-3+)” scheme was utilized. All chemicals cast-off as a piece of the current action were of descriptive chemical survey except for the most part communicated. “Deionized water (Millipore-Q Gradient)” remained useful for all weakening. Plastic and dish sets were prepared by engrossing debilitate nitric acid (1+9) and were flushed with refined aqua going before utilizing. The typical game plans of analytes cast-off for modification remained conveyed by debilitating a standard course of action of 1g per liter of the agreed segment gave by “Sigma– Aldrich (St Louis, MO, USA)”. 0.3-0.5g of test remained handled with 8.0 ml of conc: Nitric acid 65% (Merck-Marker) and 2.0 ml of conc:

hydrogen peroxide 30% (Merck-Marker) in microwave absorption scheme and debilitated to 35 ml with two-fold de-ionized water “(Millipore-Q Gradient)”. The authentic examination was completed using “PROC ANOVA” [16] with mean parcel by “Fisher's secured LSD”.

3. RESULTS AND DISCUSSION

From Table-2 and Figure - 3 revealed the going with designs: Zn > Cu > Co > Ni > Pb > Cd independently. Similarly, the results showed that Zn has the most dumbfounding concentration. All things considered, tasteful retrievals remained gotten in-all tests, that favor the exploratory technique, the viability of the AAS. Ordinary metallic quantities and reaches (mg/kg dehydrated mass) initiated in onion after considering zone then rheostat regions are showed up on Table 2. Zn > Cu > Co > Ni > Pb > Cd obsession levels independently. The profile of the

metal substance of onion leaves in the examination area were seen to be in the demand Zn > Cu > Co > Ni > Pb > Cd. As Table.2 displays, the optimistic relationship was originated among all the metals in the cases after the examination region. it demonstrates the nearness of adjacent highest centralization of various elements, recommends that the elements may have begun after the similar anthropogenically sources. Usually, the stage of debasement of Zn , Cu , Co , Ni , Pb and Cd showed up on Table-2. were to some degree advanced at the examination domain than at the regulator one, that recommends the looked into an onion of learning regions were distinguishably polluted by the elements. Regardless, an example of the occasion of taking after metallic elements in onion trial of the examination zone exposed that the gathering of Zn is most surprising and an impetus in tests researched.

Table-2 Level of heavy metals in onions and potatoes of Mastung in Balochistan.

S.NO.	Name	Pb mg/kg	Cd mg/kg	Zn mg/kg	Cu mg/kg	Co mg/kg	Ni mg/kg
1	Onions	0.21	0.02	12.04	1.55	0.74	0.35
2	Potatoes	0.07	0.03	7.65	0.96	0.57	0.28

This exhibits the onions were created in sullied districts when appeared differently in relation to uncontaminated ones. The most lifted entire mean obsession gained in the examination is anyway advanced than biosphere ordinary of 0.060 mg per kg “(Forstner and Wittmann, 1984)”. Similarly, analogous to other contemplates the most raised nasty obsession was higher than 0.155 to 0.605 mg per kg, 0.011 to 0.031 mg per kg nitty gritty by Ellen et al. [21]. stages of Cadmium procured in the examination remained inferior to the extent of 2.50 to 4.01mg per kg and average regard 4.15 mg per kg declared by “Chandrappa and Lokeshwari” [46] . The aim behind the tall obsession can be that Cadmium is by and large effortlessly occupied by sustenance harvests and particularly verdant root-vegetable [46] conversely with typical limits, average centralization

of Cadmium in overhang exposed characteristics underneath the “WHO/EU, ICRCCL and EU (1986) limits”. Cobalt is the dynamic focal point of coenzymes called cobalamins, the most broadly perceived instance of which is vitamin B12. In that limit it is an essential take after dietary mineral for all animals. Cobalt fit as a fiddle is in like manner a dynamic supplement for minute living beings, green development and parasites. Joining of cobalt as showed up in Table-2 and Figure-3

Copper quantities: Cu is single of the basic micro-nutrients, and its sufficient source for developing floraie ought to be guaranteed over simulated or natural manures [47]. Cu happens in the mixes with no referred to capacities and also catalysts having fundamental capacity in plant digestion [24]. As can be seen in Table 2 and Figure-4.

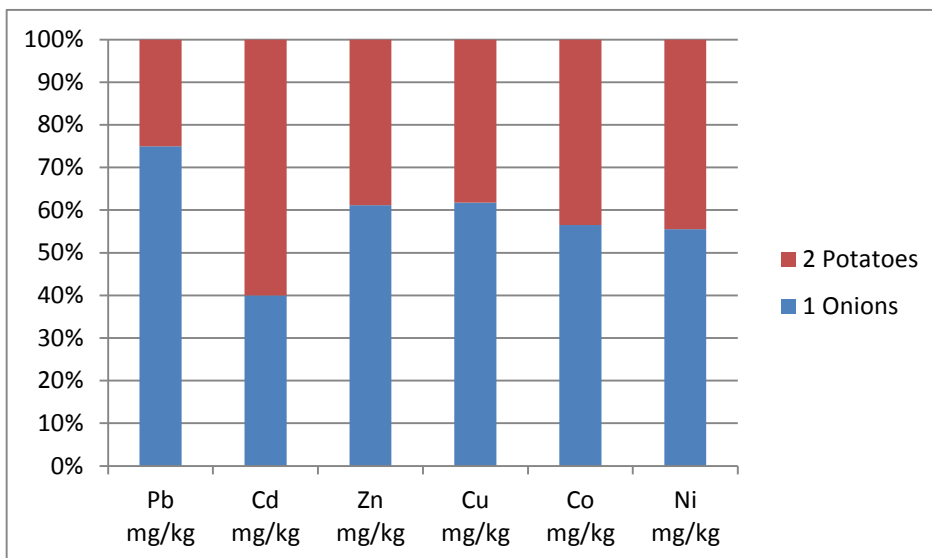


Figure-4. Level of heavy metals in onions and potatoes of Mastung in Balochistan.

Zn Concentration: Examination of change uncovered that the cultivars contemplated fundamentally varied regarding Zn focus. The most astounding Zn fixation (18.880

milligrams per kilograms) was chosen in the “cultivar Fianna”. Amongst the cultivators, Outer space needed the slightest Zinc center (12.4) as showed up in Table 2 and

Figure-4. Zinc is one of the fundamental metals for a run of the mill advancement and change in individuals. Deficiency of zinc can come to fruition in view of deficient dietary confirmation, debilitated osmosis, irrational release or procured blemishes in zinc absorption [23].

Pb Concentration: Huge contrasts were seen amongst the potatoes cultivators for the lead as in Tab-2 and Figure-3. Average lead fixations fluctuated amid 0.07mg per kg.

Ni Concentration: Nickel assumes a few parts in body capacities including protein capacities. In exceptionally following sums it might be helpful to initiate a few frameworks, however, its danger at more elevated amounts is more protein noticeable [48]. Critical contrasts were found among the mean fixations as indicated Table 2 and Figure-3.

The concentration of Cadmium: Cd is an irrelevant segment in sustenance and normal rainwaters, and it stores up mainly in the liver and kidneys. Cd in diets is generally gotten after numerous wellsprings of ecological sulling [15] and the centralization of Cd in onion and potatoes as showed up in Table 2 and Figure-4. Discovered the center estimation of ended the 16 potatoes genotypes, the metallic elements social occasion plan intended for the potatoes was in next solicitation; Zn > Cu > Co > Ni > Pb > Cd. Comparable buildup slant was moreover experiential by "Mendil et al. [22]".

3. CONCLUSION

The consequences consume exhibited that the usage of profluent aqua after organizations could extend the confirmation of generous metallic elements by herbs. Riches in the vegetable gave off an impression of being a direct result of considerable metals in soils, anyway moreover contemplates is relied upon to attest it. The advanced joining of lead and Chromium in the florae after the allowable regards can be a prosperity threat to customers and despite the way that the gathering of Cd is underneath the recommended rules. It is along these lines suggested that there ought to be constantly checking of these metals in the vegetables to maintain a strategic distance from harmful impacts in the purchasers. Additionally, investigate into the take-up of the overwhelming metals by various vegetables under similar conditions would likewise be fundamental. Likewise, the present examination uncovered that the potato cultivars contemplated indicated significant variety in substantial metal fixations. In this investigation, it is likewise critical to take note of that most favored cultivar by the neighborhood makers in this locale, typically contained even more overwhelming metal focuses. We trust that such data can be helpful for understanding the significance of cultivar choice in solid nourishment and enhancing customer mindfulness. Exorbitant treatment and water framework aquatic contamination might root significant metallic sulling in potatoes age zones. In these cases, a supportive tactic might be to practice the potatoes genotypes that gather fewer overpowering metallic elements.

4. RECOMMENDATIONS

- The onion and Potatoes plants ought to be developed from the region that are not sullied with overwhelming metals. In this way, these discoveries demonstrate that the restorative plant or plant parts utilized for various maladies

must be checked for substantial metals tainting so as to make it feasible for human utilization.

- Prolong utilization of polluted plants might be demoralized in light of the fact that it may be the incessant or unpretentious well-being risk.
- The Govt. of Pakistan should weight on the launching of training for the destruction, lack of education and dumbness of Balochistan in river regions with the end goal of the improvement of prosperous Pakistan.

REFERENCES

1. Germplasm Resources Information Network – (GRIN). "Allium cepa information from NPGS/GRIN". USDA, ARS, National Genetic Resources Program. Retrieved 22 April 2011.
2. Awofolu, O. R. (2005): A Survey of Trace Metals in Vegetation, Soil and Lower Animals along some selected Major Roads in Metropolitan City of Lagos, *Environmental Monitoring and Assessment*, **105**, 431 - 449.
3. Francis, O. A. (2005): Trace Heavy Metals Contamination of Soils and Vegetation in the Vicinity of Livestock in Nigeria. *EJEAF*, **4(2)**, 866-867.
4. Mumba, P. P.; Chibambo, B. Q. and Kadewa, W. (2008). A Comparison of The Levels of Heavy Metals in Cabbages Irrigated With Reservoir and Tap Water. *Int. J. Environ. Res.*, **2(1)**, 61-64.
5. 15. Adriano, D. C. (1984). Trace Metals in The Terrestrial Environment. Verlag Spiegler, New York.
6. Association) AAPH (2005). Standard methods for the examination of Water and Wastewater. Washington, DC: American Public Health Association.
7. Agency for Toxic Substances and Diseases Registry (ATSDR) (2007). *Toxicological Profile for Lead*. US Department for Health and Human Services. pp. 1-4.
8. Bell, G. F. (1998). *Environmental Geology: Principles and Practice*. Blackwell Science Ltd. Osney Mead, Oxford, UK, pp 487-489.
9. Hilson, G. (2001). 'A Contextual Review of the Ghanaian Small-scale Mining Industry', Mining, Minerals and Sustainable Development, no. 76.
10. Kortatsi, B. K. (2004). *Hydrochemistry of groundwater in the mining areas of Tarkwa- Prestea, Ghana*. PhD Thesis, University of Ghana, Legon-Accra.
11. Kuma, J. S. and Younger, P. L. (2004). 'Water quality trends in the Tarkwa gold-mining district, Ghana', *Bull. Eng. Geol. Env.*, vol. 63, pp. 119-132.
12. Kusimi, J. M. (2007). *Groundwater Hydrochemistry and Land cover Change in the Wassa West District of Ghana*. Royal Institute of Technology, Stockholm, Sweden. pp 5-8.
13. Ragnar, A. and Bjorn, E. (2005). *Contamination of water resources in Tarkwa mining area of Ghana*. Department of Engineering Geology, Lund University, Lund.
14. . Faboya OOP (1997). Industrial Pollution and Waste Management. In Dimensions of Environmental Problems in Nigeria (Edited by Akinjide OS). Published by Davison Press University of Ibadan, Nigeria.
15. FAO/WHO (1993). Food Additives and Contaminants. Joints FAO/WHO Food Standard Programme 2001 ALINORM 01/12A 1 – 289.

16. SAS Institute, (1998). SAS/STAT User's Guide, Version 6.4. SAS Institute, Cary.
17. Divrikli, U., S. Saracoglu, M. Soylak and L. Elci (2003). Determination of trace heavy metal contents of green vegetable samples from Kayseri-Turkey by flame atomic absorption spectrometry. *Fresenius Environmental Bulletin (FEB)*, 12, 1123–1125.
18. Dundar, M. S. and H. B. Saglam (2004). Determination of cadmium and vanadium in tea varieties and their infusions in comparison with 2 infusion processes. *Trace. Elem. Electrolytes*, 21, 60–63.
19. Colak, H., M. Soylak and O. Turkoglu, (2005). Determination of trace metal content of various herbal and fruit teas produced and marketed from Turkey. *Trace. Elem. Electrolytes*, 22, 192–195.
20. Oktem, F., H. Yavrucuoglu, A. Turedi and B. Tunc (2005). The effect of nutritional habits on hematological parameters and trace elements in children. *Suleyman Demirel Univ. Tip Fak. Der.*, 12, 6–10. (In Turkish).
21. Ellen, G., J.W. Loon and K. Tolsma (1990). Heavy metals in vegetables grown in the Netherlands and in domestic and imported fruits. *Z. Lebensm. Unters. Forsch.*, 190, 34–39.
22. Mendil, D., M. Tuzen, K. Yazici and M. Soylak (2005). Heavy metals in lichens from roadsides and an industrial zone in Trabzon, Turkey. *Bull. Environ. Contam. Toxicol.*, 74, 190–194.
23. . Narin, I., M. Tuzen, H. Sari and M. Soylak (2005). Heavy metal content of potato and corn chips from Turkey. *Bull. Environ. Contam. Toxicol.*, 74, 1072–1077.
24. Kabata-Pendias, A. and H. Pendias (2001). Trace Elements in Soils and Plants. 3rd ed. CRC Press Boca Raton FL, p.114.
25. Sanchez M (2008). Cuases and effects of heavy metal pollution: Nova Science Publishers, Inc.
26. He Z, Zhang M, Calvert D, Stoffella P, Yang X, Yu S. Transport of Heavy Metals in Surface Runoff from Vegetable and Citrus Fields. *Soil Sci Soc Am J*. 2004;68(5):1664–69.
27. Ho y, El-Khaiary M (2009). Metal Research Trends in the Environmental Field. In: Wang L, Chen J, Hung Y, Shammass N, editors. Heavy metals in the environment: CRC Press Taylor & Francic Group.
28. Singh A, Sharma R, Agrawal M, Marshal F. Health risk assessment of heavy metals via dietary intake of foodstuffs from the wastewater irrigated site of a dry tropical area of India. *Food Chem Toxicol*. 2010;48(2):611–19.
29. Khan K, Cao Q, Zheng M, Huang Y, Zhu Y. Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, China. *Environ Pollut*. 2008;152(3):686–92.
30. Hayes R. The carcinogenicity of metals in humans. *Cancer Causes Control*. 1997;8(3):371–75.
31. Volesky GMNaB (2009). Toxicity and Sources of Pb, Cd, Hg, Cr, As, and Radionuclides in the Environment. In: Wang L, Chen J, Huang Y, Shammass N, editors. Heavy Metals In The Environment: CRC Press Taylor & Francis Group.
32. Järup L. Hazards of heavy metal contamination. *Brit Med Bull*. 2003;68:167–82.
33. Qiao-qiao C, Guang-wei Z, Langdon A. Bioaccumulation of heavy metals in fishes from Taihu Lake, China. *J Environ Sci*. 2007;19(12):1500–04.
34. Mclaughlin M, Parker D, JM C. Metals and micronutrients. food safety issues Filed Crops Research. 1999;60:143–63.
35. Hu G, Huang S, Chen H, Wang F. Binding of four heavy metals to hemicelluloses from rice bran. *Food Res Inter*. 2010;43(1):203–06.
36. Kim K, Park Y, Lee M, Kim J, Huh J, Kim D. et al. Levels of heavy metals in candy packages and candies likely to be consumed by small children. *Food Res Int*. 2008;41(4):411–18.
37. Conti ME. The content of heavy metals in food packaging paper boards: an atomic absorption spectroscopy investigation. *Food Res Int*. 1997;30(5):343–48.
38. Muchuweti M, Birkett J, Chinyanga E, Zvauya R, Scrimshaw M, Lister J. Heavy metal content of vegetables irrigated with mixtures of wastewater and sewage sludge in Zimbabwe: implication for human health. *Agr Ecosyst Environ*. 2006;112(1):41–48.
39. Tu`rkdog`an M, Kilicel F, Kara K, Tuncer I, Uygan I. Heavy metals in soil, vegetables and fruits in the endemic uppergastrointestinal cancer region of Turkey. *Environ Toxicol Pharmacol*. 2002;13(3):175–79.
40. Altındag` A, Yig`it S. Assessment of heavy metal concentrations in the food web of lake Beysehir, Turkey. *Chemosphere*. 2005;60(4):552–56.
41. Isildak O, Turkekul I, Elmastas M, Tuzen M. Analysis of heavy metals in some wild-grown edible mushrooms from the middle black sea region, Turkey. *Food Chem*. 2004;86(4):547–52.
42. Alama M, Snowa E, A T. Arsenic and heavy metal contamination of vegetables grown in Samta village, Bangladesh. *Sci Total Environ*. 2003;308(1-3):83–96.
43. Yusufa A, Arowolob T, Bamgbose O. Cadmium, copper and nickel levels in vegetables from industrial and residential areas of Lagos City, Nigeria. *Food Chem Toxicol*. 2003;41(3):375–78.
44. Radwan M, Salama A. Market basket survey for some heavy metals in Egyptian fruits and vegetables. *Food Chem Toxicol*. 2006;44(8):1273–78.
45. Sharma R, Agrawal M, Marshall F. Heavy metals in vegetables collected from production and market sites of a tropical urban area of India. *Food Chem Toxicol*. 2009;47(3):583–91.
46. Nasreddine L, Parent-Massin DNasreddine L, Parent-Massin D. Food contamination by metals and pesticides in the European Union. *Toxicol Lett*. 2002;127:29–41.
47. Jamalialia M, Kazia T, Araina M, Afridi H, N J, Kandhroa G. et al. Heavy metal accumulation in different varieties of wheat (*Triticum aestivum* L) grown in soil amended with domestic sewage sludge. *J Hazard Mater*. 2009;164(2-3):1386–91.
48. Devkota B, Schmidt G. Accumulation of heavy metals in food plants and grasshoppers from the Taigetos Mountains, Greece. *Agr Ecosyst Environ*. 2000;78(1):85–91.
49. Lukšienė B, Račaitė M. Accumulation of Heavy Metals in Spring Wheat (*Triticum Aestivum* L.)

- Oveground and Underground Parts. Environm Res Eng Manag. 2008;4(46):36–41.
50. Rattan R, Datta S, Chhonkar P, Suribabu K, Singh A. Long-term impact of irrigation with sewage effluents on heavy metal contentin soils, crops and groundwater-a case study. Agr Ecosyst Environ. 2005;109(3-4):310–22.
51. Arora M, Kiran B, Rani S, Rani A, Kaur B, Mittal N. Heavy metal accumulation in vegetables irrigated with water from different sources. Food Chem. 2008;111(4):811–15.
52. Luo C, Liu C, Wang Y, Liu X, Li F, Zhang g. et al. Heavy metal contamination in soils and vegetables near an e-waste processing site, south China. J Hazard Mater. 2011;186(1):481–90.
53. Douay F, Roussel H, Fourrier H, Heyman C, G C. Investigation of Heavy Meta Concentrations on Urban Soils, Dust and Vegetables Nearby a Former Smelter Site in Mortagne du Nord, Northern France. J Soils Sediments. 2007;7(3):143–46.