



Assessment of Heavy Metals in Tomatoes, Green Beans and some Vegetables on Road Side Farms in Farin-Lamba, Jos South Local Government Area Plateau State, Nigeria

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ABSTRACT: Heavy metals retention by vegetables and crops planted along road-side is of awesome concern due to dangers associated with human health risks. This paper therefore evaluates the levels of heavy metals in onion bulbs, onion leaves, tomato fruit, cabbage, carrot roots, green beans and green pepper on Road-side Farms in Farin-Lamba, Jos South Local Government Area, Plateau State, Nigeria using AAS model AA240FS. The results of analysis show that the mean concentration of the heavy metals obtained by sum of all the plants analyzed were Cd: 0.633 ± 0.02 ; Cu: 0.209 ± 0.07 ; Pb: 0.756 ± 0.5 ; Cr: 0.566 ± 0.07 ; Mn: 0.457 ± 0.3 ; Zn: 0.663 ± 0.1 and Ni: 0.057 ± 0.02 , respectively. The result shows that the vegetable samples have high content of lead and low content of nickel. The average values of the heavy metal content obtained were compared to Food and Agricultural Organization (FAO) and world Health Organization (WHO) Standard limits, cadmium 0.2 mg/kg, copper 0.1 mg/kg, lead 0.3 mg/kg, chromium 2.3 mg/kg, manganese 0.4 mg/kg, zinc 3.3 mg/kg and nickel 5.0 mg/kg. The results from the study show that the mean concentration of chromium, zinc and nickel were within the permissible limits set by FAO/WHO with exception of cadmium, copper, lead and manganese which were higher than the permissible limits. Therefore, consumption of these vegetables by members of the communities where these vegetables were planted or other communities expose the population to adverse effects of these heavy metals. This may pose a serious health challenge on long term consumption of the vegetables.

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Vegetables contained crucial portion of the human nourishment since they incorporate all classes of food required for human wellbeing. They moreover serve as neutralizing operators for acidic substances formed amid assimilation. As human exercise such as mining, water system crops utilizing sullied water, wearing and tearing of automobile increases, contamination and defilement of the human nourishment chain has ended up avoidable (Singh *et al.*, 2010). Heavy metals are metallic components that have generally high density and are poisonous or harmful indeed at low concentrations (Lennetech, 2004; Clemens and Ma, 2016). Heavy metals are non-specific term which apply to metals and metalloids with nuclear thickness more prominent than 4g/cm^3 , or 5 times or more noteworthy than the thickness of water (Hawkes, 2000). Assimilation of metals by crops and continuous

amassing along the nourishment chain may be a potential danger by and large to living being particularly creatures and human (Sprtnskyy *et al.*, 2007). One of the major routes of entrance of heavy metals within the nourishment chain is retention through the roots of crops (Jordan *et al.*, 2006).

There are numerous factors responsible for retention and collection of overwhelming metals in vegetables, such component incorporate temperature, dampness, natural matter, pH and supplement accessibility. Heavy metals aggregation in vegetable plants depends upon the species of plant and the capacity of diverse plants in retaining metals is assessed by either plant uptake or soil to plant exchange variables of the metals (Jamali *et al.*, 2007). The major nourishment chain course for human introduction is the utilization of

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vegetable plants sullied with overwhelming metals. The food plants whose framework of observing is based on thorough and persistent development, have an awesome capacity of retaining components from the soil. The developing of such plants in sullied soil is an indication of a potential hazard, the vegetable tissue can gather overwhelming metals (Jordan *et al.*, 2006). Vegetable crops are crucial portion of human nourishment since they are sources of nutrients (Argun *et al.*, 2007). Overwhelming metals retention by plants is of awesome concern since there are dangers associated with human health risks. Through nourishment chain, heavy metal pollutants enter human body. Vegetables planted in overwhelming metals sullied soils gather high sums of metals compare to those grown in uncontaminated soils (Duruibe *et al.*, 2007).

Increase in human activities such as mining, industrialization and urbanization with deficiently environmental management results in releasing of the mechanical and sewage squander into waterways and lakes which lead to progressive contamination of our water body. Numerous times such squander water is depleted to the agrarian cultivate arrive which serves as water system of crops incorporates vegetables. Hence, contaminated water is found to be rich in both natural matter as well as heavy metals like lead, chromium, cadmium, nickel, cobalt and other that at long last get to the soil of agrarian cultivate lands. This leads to nourishment chain defilement as crops and vegetables assimilate them from the soil. Food safety issues and potential wellbeing chance make this as one of the foremost genuine natural concern (Cui *et al.*, 2004). The nutrient present in vegetables cannot be over emphasized, these nourishment stuffs are vital component of our diet, and heavy metal contamination (posed great danger to human beings) is a potential risk to human health. Vegetables amass metals in their clear out leaves, stems and roots (Rai *et al.*, 2019). A few of these heavy metals such as As, Cd, Hg, Pb and Se are not fundamental for plant development, since they do not perform any known physiological work in plants (Shuaib *et al.*, 2021). The choice of the study area is as a result of the closeness of the farm sites to where tin ore are mined locally, the water drained out during mining are emptied into the nearby water body which are used as water for irrigation on the farm sites especially during dry season. Also, the proximity of the farm site to the road is another factor considered because of the tearing and wearing of automobiles tyres that can ultimately lead to the release of some heavy metals. Hence, the objective of this paper is to assess the levels of heavy metals in onion bulbs, onion leaves, tomatoes fruit, cabbage, carrot roots, green beans and green pepper on Road-side Farms in Farin-

Lamba, Jos South Local Government Area, Plateau State, Nigeria.

MATERIALS AND METHODS

Sample Collection: Fresh vegetable samples (onion bulbs, onion leaves, tomato fruit, cabbage, carrot roots, green beans, green pepper) were collected at different spots 30 meters away from each other and 50 meters away from the roadside in Farin Lamba, Jos South Local Government Area of Plateau State. All collected vegetable samples were labeled as follow: OB (onion bulbs), OL (onion leaves), TF (tomatoes fruit), CB (cabbage), CR (carrot roots), GB (green beans) and GP (green pepper). All the collected samples were stored kept in clean polythene bags according to their types and brought taken to the laboratory for analysis.

Preparation of Vegetable Samples: The collected samples were washed under a running tap, rinsed with de-ionized water to remove sand and dust particles that stuck on the surfaces. The samples were cut into smaller pieces and open air dried on for 24 hours to reduce moisture. Each samples were dried in an oven at 80 °C for 3 hours until constant weight was obtained. The samples were ground in a mortar, sieved through 2.0 mm size sieve mesh to obtain a uniform particle size. They were labelled accordingly and stored in air tight containers until required for analysis.

Digestion Procedure: 1.0 g of each dried vegetable sample was weighed on analytical weighing balance and was transferred into a pyrex beakers. 20 ml of (3:1) of concentrated nitric acid (HNO₃) and perchloric acid (HClO₄) respectively were transferred into different beakers containing the dried vegetable samples. The beakers were placed on a hot plate to digest at 150 °C. After half an hour of digestion, 2 ml concentrated HCl was added to the reacting mixture and was allowed to digest for another 30 minutes. Digestion was completed for different vegetable samples with evolution of white fumes. The digested samples were allowed to cool at room temperature (25°C), filtered and transferred into a 50 ml volumetric flask and made up to mark with deionized water. The filtered solution was stored in sample containers and kept in a refrigerator at 4 °C prior to metal analysis.

Determination of metal by Atomic Absorption Spectrophotometer (AAS): The cadmium (Cd), copper (Cu), lead (Pb), chromium (Cr), manganese (Mn), zinc (Zn) nickel (Ni) contents of the samples were analyzed using Atomic Absorption Spectrophotometer (model: AA240FS).

RESULTS AND DISCUSSION

The variations of the heavy metal contents observed in these vegetables depend on the physical and chemical nature of the soil and absorption capacity of each metal by the plant, which is altered by several environmental and human factors thus having variable heavy metal contents in table 1. Results of the analysis indicates the concentration of cadmium to range from 0.594 to 0.659 mg/kg, it was highest in cabbage (CB) and lowest in onions leaves (OL) as shown in Table 1. The cruel concentration of Cadmium is 0.633 mg/kg and that of FAO/WHO standard limit is 0.2 mg/kg. The concentration of Cadmium is above the standard limit, this may pose serious problems to the wellbeing of the inhabitants thereby causing problems such as cardiac failure, cancer, cataract formation in the eye etc to the consumers (Rehman *et al.*, 2018). The concentration of copper (Cu) in vegetable samples was found to be highest in green pepper with value 0.260 mg/kg and

lowest in cabbage and carrots with value 0.110 mg/kg as seen in table 1. The cruel concentration of copper in all the vegetable samples analyzed was 0.209 mg/kg which is more than the maximum permissible concentration of 0.1 mg/kg set by the FAO/WHO. The high level of copper in the area may lead to extreme mucosal irritation followed by depression, gastrointestinal irritation and possible necrotic changes in the liver and kidney can also occur (Singh and Kalamdhad, 2011). The concentration of lead (Pb) was found to be highest in tomato fruits (1.563 mg/kg) and lowest in green beans 0.172 mg/kg, while the mean concentration of lead was 0.756 mg/kg. This value is greater than permissible concentration limit of 0.3 mg/kg by FAO/WHO. This is often due to contaminated sewage for irrigation and the utilization of herbicides on farm lands. The excess of lead (Pb) in the diet can pose a serious challenge such as hematological effects, neurological effects and behavioral effects (Pandey and Madhuri, 2014).

Table 1: Heavy Metals Concentration in Vegetables and in comparison with FAO/WHO Standard limits

Heavy metals (mg/Kg)	Vegetable Samples						Mean ± SD	FAO/WHO Standard limits (mg/Kg)	
	OL	OB	GB	GP	CB	CR			
Cd	0.594	0.637	0.623	0.651	0.659	0.623	0.643	0.633 ± 0.02	0.2
Cu	0.220	0.210	0.250	0.300	0.110	0.110	0.260	0.209 ± 0.07	0.1
Pb	0.423	0.227	0.172	1.352	1.161	0.329	1.563	0.756 ± 0.50	0.3
Cr	0.550	0.510	0.560	0.600	0.500	0.720	0.520	0.566 ± 0.07	2.3
Mn	0.704	0.245	0.609	0.277	0.367	0.521	0.476	0.457 ± 0.30	0.4
Zn	0.740	0.681	0.924	0.681	0.479	0.543	0.590	0.663 ± 0.10	3.3
Ni	0.020	0.041	0.086	0.065	0.041	0.056	0.090	0.057 ± 0.02	5.0

OB (Onion bulbs), OL (Onion leaves), TF (Tomato fruit), CB (Cabbage), CR (Carrot roots), GB (Green beans) and GP (Green pepper); SD: Standard deviation

From Table 1, the mean concentration of manganese was somewhat higher (0.457 mg/kg) than the standard limits by FAO/WHO (0.4 mg/kg). The presence of manganese in vegetable may be attributed to the natural occurrence of overwhelming metals in the soil, which the vegetables in turn take up by retention from the soil through the vegetable roots. Automobile emission also contributed to the presence of manganese in vegetable samples. Excess of manganese within the diet may cause hallucinations, forgetfulness and nerve damage (Ferrante, 2013). The cruel concentration of chromium in the vegetable samples was 0.566 mg/kg which falls within the permissible limit by (FAO/WHO) of 2.3 mg/kg. This can be due to fact that different vegetables have different absorption rate for different heavy metals, this account for different concentration in different vegetable. The cruel concentration of zinc in vegetable samples was 0.663 mg/kg. When compared to FAO/WHO of 3.3 mg/kg, it implies that the mean concentration falls within the permissible limits by FAO/WHO. This means there is no health challenge

related with zinc in the utilization of these vegetables in the study area. The mean concentration of nickel in all the analyzed vegetable samples was 0.057 mg/kg while that of FAO/WHO is 5.0 mg/kg, this is an indication that the cruel concentration falls below the acceptable limits by FAO/WHO, it shows that there will be no serious health hazard associated with nickel in the utilization of the vegetables. In general, the concentration of cadmium in all the seven samples ranges from 0.594 to 0.659 mg/kg, copper ranges from 0.227 to 1.563 mg/kg, lead ranges from (0.172 to 1.56 mg/kg) and manganese ranges from 0.067 to 0.704 mg/kg. The results of four of the heavy metals appeared to be higher in concentration than the standard limits; this may pose a serious health risk to the consumers of these vegetables. However, the concentration of chromium, zinc and nickel are within the maximum permissible limits by FAO/WHO. Since the concentration ranges are below the standard limits, there will be no health risk associated with chromium, zinc and nickel on the consumers.

Conclusion: The results from the study shows that the cruel concentration of chromium, zinc and nickel are within the permissible limits set by the FAO/WHO exception of cadmium, copper, lead and manganese which are higher than the allowable limits by the (FAO/WHO, 2018). Therefore, consumption of these vegetables in this community means exposing the human population to adverse effect of some of these heavy metals of higher concentration as a result of emission from automobile, the use of contaminated sewage sludge, fertilizer, pesticides as well as the use of contaminated water for irrigation.

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