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Assessment of Heavy Metals in Peppers Sold in Major Vegetable Markets of Kano State

[1]Isah, B.I. and *[2]Ado, G.
[1]Department of Biological Sciences, Nigerian Police Academy Wudil, Kano
[2]Department of Science Education, Federal University Gashua, Yobe State, Nigeria.
***Correesponding Author**: garbado05@gmail.com; +2348036350343

Abstract

Heavy metal concentrations in four pepper samples sold in major vegetable markets in Kano Sate, North western Nigeria was investigated in this research work. The heavy metals analyzed for include, Nickel, Lead (Pb) and Copper (Cu) using Atomic Absorption Spectrophometry method. The results of the analysis revealed that Nickel ranged from (0.011±0.001ppm to 0.022±0.001ppm), Lead (0.053±0.001 to 0.100±0.001 ppm), and Cupper (0.003±0.0001 to 0.007±0.001 ppm), for all the analyzed pepper samples. The heavy metals concentrations in the pepper's samples were significantly different at $p < 0.05$ level of significance among the selected markets. From the results, the levels of contamination by these heavy metals on the pepper samples were very low compared to the permissible limits stipulated by FAO/WHO (2012).

Keywords: Copper, Heavy metals, Lead, Nickel and Pepper

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Introduction

Pepper (*Capsicum* spp) is an important fruit vegetable in the tropics and the world second most important vegetable after tomatoes (Olaniyi and Ojetayo, 2010). Nigeria is the largest producer of pepper in Africa, producing about 50 % of the total African production on approximately 200,000 hectares of farmland annually. Pepper production in Nigeria stood at 695,000 metric tons obtained from an area of 77,000 ha, which gives an average yield of 9,026 metric tons per hectare (FAO, 2008). Pepper is often grown solely or in mixtures with either cereals crops or other vegetables. It is often consumed fresh, dried or processed and along with other fruit vegetables like tomato, onion, among others. It is an important spice crop highly cherished for its pungent flavour. Over the years, pepper has increased in popularity, value and importance, thus standing as an indispensable part of the daily diet of Nigerians (in their millions). However, significant quantities of heavy metals have been detected in natural food spices such as pepper (Gaya and Ikechukwu, 2016). While some heavy metals such as; chromium, iron, manganese, cobalt, zinc and copper are considered essential at low levels, other metals such as cadmium and lead in their low levels can have toxic effects in human biochemical reactions (Järup, 2003; Cao *et al*., 2010). Recently, lead and cadmium were listed by the Agency for Toxic Substances and Disease Registry (ATSDR) as second and seventh priority toxic substances (ASTDR, 2015).The accumulation of these important hazardous metals can breed middle-term or long-term health effects manifesting as depression, chronic asthma, liver damage, insomnia, kidney damage and neurological disorders (Baraka, 2002) Heavy metals are referred to as metals having specific density greater than 5 g/cm^3, and are found at different concentrations in the earth's crust. Their deposition in soil occurs at a faster rate, at higher pH and as well as in the presence of a high proportion of carbonates (Abdalla, 2014). Their accumulation can be found in the surface layer of the soil. The increase in their concentrations in soil increases their absorbance by plants, which in turn may cause havoc to human's life. Over the years human activities via industrial, agricultural, traffic, domestic, mining and other anthropogenic activities have contributed immensely to the high and toxic levels of these metals in the environment (Osakwe and Okolie, 2015). Heavy metals are enormously insistent in the environment; thus biodegradable and non-biodegradable and thus readily accumulate to toxic levels (Ahmed and Bouhadjera, 2010). Toxicity of heavy metals can damage or reduce mental and central nervous function, worsen energy level and damage to blood composition, lungs, kidney, liver and other essential organs. Long term exposure to heavy metals may lead to slowly progressing physical, muscular and neurological degenerative process in form of Alzheimer disease, Parkinson's disease, muscular dystrophy and multiple sclerosis. Allergies are not uncommon and repeated long term contract with some of their compounds may cause cancer (Michael, 2010). The presence of heavy metals in food substance constitutes serious health hazards, developing in their relative level (Luke, 1997).

Materials and Methods

Pepper samples were bought from 3 markets in Kano, namely Yankaba, Janguza and Rimi. Yankaba is along Hadejia Road, Janguza is on Gwarzo Road while Rimi is located in the Kano Municipal Local Government with the aim of analyzing heavy metals concentrations present in the peppers sold in these markets. The study area lies within the GPS coordinate of 12^{o} 0' 0.0000" N and 8^{o} 31' 0. 0012" E. The study area comprises of 3 local government areas (LGAs) namely: Nassarawa LGA, Tofa LGA and Municipal LGA. The six markets were selected such that three markets were selected from each LGA. Markets were selected based on the number of people purchasing the vegetables and distributing them almost all over the state. The areas fall within the Sudan savannah. The secondary vegetation is farming practices and other developmental projects like road constructions (Tijani and Onodera, 2009). The climate is tropical savannah. The city has on average about 980mm (38.6 in) of precipitation per annum. Kano is very hot for most of the year, peaking in April. (Tijjani and Onodera, 2009).

Sample Collection and Preparation

A total of thirty-six (36) samples of peppers were used in this study twelve for each species. The peppers samples which include; (Bell pepper), (Red pepper) and (Chilli pepper) were purchased from the six (3) markets. The peppers were purchased from three sales points per market. The samples were collected in nylon bags and labeled properly. In order to ensure that heavy metals determine are exclusively those taken up by the plants from the soil each sample was properly washed with tap water and then with deionized water. The samples were then dried in air, followed by oven drying at 80 ^{o}C until constant weight was achieved. The dry samples were ground to fine particle using laboratory mortar and pestle, stored in airtight nylons and properly labeled. The pepper samples were then transferred to the Central laboratory of the Bayero University, Kano Nigeria for analysis of heavy metals (Ni, Pb and Cu).

Sample Digestion

The determination of heavy metal concentrations was carried out using wet digestion method as described by Jone and Case (1990) as adopted by Makanjuola and Osinfade (2016). 0.5g of each pepper sample was placed in 100ml beaker and 3.5 ml of 30% H_2O_2, 3ml H2SO4, 0.5ml HNO3 and 1ml HCLO3 were added. The content in each beaker was first heated to 100°C, gradually increased to 250°C, and was then left at this temperature for 30 minutes. Each beaker and its content were then allowed to cool and an additional 1ml of 30% H_2O_2 was added to the digestion mixture and reheated. The digestion process was repeated until a clear solution was obtained in each case. The clear solution was transferred to 50ml volumetric flask, made up to mark with distilled water. Blank solution was also prepared. Standard solution for each element under investigation was prepared and used for calibration. Measurement for each heavy metal was carried out using Atomic Absorption Spectrophotometer with double beam and deuterium background correction (Buck Atomic Absorption Spectrophotometry Model 210/211)

Heavy Metals Determination

Filtrate resulting from wet digestion was subsequently analyzed for Ni, Pb and Cu using Buck flame Atomic Absorption Spectrophotometer (AAS). The AAS was fueled by acetylene. Standards were analyzed accordingly but without the pepper. The actual concentrations were extrapolated from calibration curves. Analytical concentrations of the analyzed pepper were measured in parts per million (ppm). Each analysis was repeated twice and standard deviations from the mean values were calculated (Gaya and Ikechukwu, 2016). The results obtained from the laboratory analysis were generally expressed as mean ± standard deviation with minimum and maximum for each heavy metal.

Results

There must be explanation about the result in the table

Table 1: Mean concentrations (ppm) of heavy Metals in Pepper

Markets	Pepper Sp.	Nickel (Ni)	Lead (Pb)	Cupper (Cu)
	Bell Pepper	0.015 ± 0.000	0.055 ± 0.001	0.005 ± 0.000
	Red Pepper	0.013 ± 0.000	0.053 ± 0.001	0.005 ± 0.000
YanKaba	Chilli Pepper	0.019 ± 0.001	0.069 ± 0.001	0.007 ± 0.000
	Min.	0.013 ± 0.000	0.053 ± 0.001	0.005 ± 0.000
	Max.	0.019 ± 0.001	0.069 ± 0.001	0.007 ± 0.000
	Bell Pepper	0.020 ± 0.001	0.088 ± 0.001	0.003 ± 0.000
	Red Pepper	0.022 ± 0.001	0.071 ± 0.001	0.004 ± 0.000
Janguza	Chilli Pepper	0.016 ± 0.001	0.055 ± 0.001	0.006 ± 0.000
	Min.	0.016 ± 0.001	0.055 ± 0.001	0.003 ± 0.000
	Max.	0.022 ± 0.001	0.088 ± 0.001	0.006 ± 0.000
	Bell Pepper	0.019 ± 0.000	0.079 ± 0.001	0.007 ± 0.000
	Red Pepper	0.016 ± 0.000	0.081 ± 0.001	0.004 ± 0.000
Rimi	Chilli Pepper	0.011 ± 0.001	0.100 ± 0.001	0.005 ± 0.000
	Min.	0.011 ± 0.001	0.079 ± 0.001	0.004 ± 0.000
	Max.	0.019 ± 0.000	0.100 ± 0.001	0.007 ± 0.000

Discussion

The mean concentrations of some heavy metals (ppm) in the sold peppers in selected markets in Kano State, Northwestern part of Nigeria, were shown in Table 1. The 3 species of peppers considered in this study analyzed for 3 heavy metals are Nickel, Lead and Cupper.

As shown in Table 1, lead has the highest mean concentrations (0.100±0.001 ppm) recorded for Chilli pepper obtained from Rimi market this finding agreed with result of Aslam, *et al.* (2014). Nickel has the concentrations of (0.020±0.001 as obtained in Bell pepper of Janguza market. The least values were obtained from Cupper (0.003±0.000) for Bell in Janguza market. The least concentration in Nickel was obtained at Rimi in Chiilli Pepper as (0. 011±0.001) this result corresponded with finding of Rahman, *et al.* (2019), Jan *et al.* (2015) Red pepper obtained its highest value in lead at Rimi Market as (0.081±0.001) this is also agreed with the result Fiala (1999). Average abundance of heavy metals in the pepper samples investigated was of the order Pb>Ni > Cu. In the result, Cu had the lowest concentration, while Pb had the highest concentration for the peppers analyzed in this study.

Conclusion

Levels of Ni, Pb, and Cu in the groups of pepper sold in major markets in Kano have been successfully determined using AAS. For all the peppers investigated, the values of all heavy metals investigated when compared with the maximum permissible limit set by FAO/WHO (2012) for leafy vegetables and fruiting vegetables are below the FAO/WHO limits. This study has shown that samples of pepper sold in selected markets in Kano are not contaminated with the investigated heavy metals (Ni, Pb and Cu), though the influx of environmental pollution basically from vehicle exhaust and other gaseous air pollutant could cause an increase in their values. It is therefore recommended that the levels of heavy metals in the peppers and then irrigation water should be continuously monitored to check on their levels.

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