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Comparative Analysis of Heavy Metals in Some Vegetables within Maiduguri Metropolis

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Abstract Pollution is the undesirable changes in the physical, chemical or biological characteristics of air, water or land that can harmfully affect the health, survival or activities of human or other living organism. Soil is a dynamic habitat for an enormous variety of life-forms. It gives mechanical support to plants from which they extract nutrients. It shelters many animal types, from invertebrates to mammals. It also provides habitats colonized by a staggering variety of microorganisms. Heavy metals may come from many different sources in urbanized areas, including vehicle emissions, industrial discharges and other activities. Heavy metals can accumulate in topsoil from atmospheric deposition by sedimentation, impaction and interception. Humans and other living organisms are exposed to a variety of heavy metals that are released into the environment. Human exposure to metals and their compounds in the environment is through food, drinks and water. Other forms of uptake are via skin contact. The results obtained from this analysis revealed that Pb and Cd shows the highest concentrations, while as shows the lowest levels in the whole vegetable organs studied. Conclusions: The concentrations of the above parameters were higher than the FAO, WHO/EU and FAO/WHO allowed limit. Thus, the high values of these trace metals in the vegetable samples could put the consumers of these vegetables at health risk. Further works should be carried out in the soil samples where the vegetables are grown.

Keywords Analysis, Heavy Metals, Vegetables, Maiduguri Metropolis

Introduction

Pollution is the undesirable changes in the physical, chemical or biological characteristics of air, water or land that can harmfully affect the health, survival or activities of human or other living organism [1]. It is the existence of substances in the environment that prevents the functioning of natural processes producing undesirable environmental and health effects due to their chemical composition or quality [2]. The substances that cause pollution are referred to as pollutants, therefore pollutants can be defined as substance not normally present or that are present in large concentration than normal with harmful effects especially on living organism. In other words, pollution is the undesirable modification of air, water or food by substance that are toxic or with diverse effects on health, offensive though not necessarily harmful to health with the risk of damaging human health, the artificial and the natural environment [1]. It is an act of discharging accidentally or deliberately that in any way damages or threatens the environment [3].

Soil is a naturally occurring, unconsolidated mineral and organic material at the earth's surface that provides an environment for living organisms. Soil has been referred to as the earth's "critical zone" and as deserving special status, because of its role in controlling the earth's environment and thus affecting the sustainability of life on the planet [4]. Soil is a dynamic habitat for an enormous variety of life-forms. It gives mechanical support to plants

from which they extract nutrients. It shelters many animal types, from invertebrates to mammals. It also provides habitats colonized by a staggering variety of microorganisms [5].

All these forms of life interact with one another and with the soil to create continually changing conditions and helps to control soil quality, depth, structure and properties. The interactions between these multiple factors are responsible for the variation of soil types. This allows an on-going evolution of soil habitats [4]. Consequently, the same fundamental soil structure in different locations may be found to support very different biological communities. These complex communities contribute significantly to the continuous cycling of nutrients. The chemicals have varying effects on living organisms in the soil and once the waste materials enter the soil they become part of the biological cycle that affects all forms of life. Most of the soil contamination can be attributed to industrial, municipal and military waste management practices that advocate disposal rather than treatment [4].

Heavy metals are natural constituents in nature, usually occurring in low concentration under normal conditions. Anthropogenic activities can cause elevated levels of these metals in various parts of the ecosystem. Environmental pollution by heavy metals may occur via various diffuse and point sources. Heavy metal scattering by traffic is an example of diffuse spread, while the emission of heavy metals by industrial establishments like metal smelters and iron works represents point sources [6]. Traffic activities on roads can contribute to elevated levels of heavy metals in these environments through fossil fuel combustion, wear and tear of many parts of the automobile, in addition to natural sources, as they might exist in the rocks of the surrounding areas. Heavy metals have been widely used in other research projects and therefore comparative data are readily available. Many studies have examined the contribution of individual components of the urban hydrological cycle to the transport and storage of heavy metals.

Heavy metals may come from many different sources in urbanized areas, including vehicle emissions, industrial discharges and other activities. Atmospheric pollution is one of the major sources of heavy metal contamination. Heavy metals can accumulate in topsoil from atmospheric deposition by sedimentation, impaction and interception [7]. Humans and other living organisms are exposed to a variety of heavy metals that are released into the environment. The uptake of these metals occurs through three main routes: dermal absorption, inhalation and ingestion of contaminated dusts and soils, It has been noted that children of age 1-8 are of specific concern for this pathway via their hands or mouths [7].

Most trace elements especially the heavy metals remain in the soil nearly indefinitely. These metals remain bound to organic matter unless they are remobilized mechanically as windblown dust [8]. Human exposure to metals and their compounds in the environment is through food, drinks and water. Other forms of uptake are via skin contact. However, over a period of time, adverse toxic effects may occur as a result of long-term low-level exposure. Motivations for controlling heavy metal concentrations in gas streams are diverse. Some of them are dangerous to health or to the environment (e.g. Hg, Cd, As, Pb, Cr), some may cause corrosion (e.g. Zn, Pb), some are harmful in other ways (e.g. Arsenic may pollute catalysts). Within the European community the 10 elements of highest concern are As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sn, and Tl, the emissions of which are regulated in waste incinerators. Some of these elements are actually necessary for humans in minute amounts (Co, Cu, Cr, Mn, Ni) while others are carcinogenic or toxic, affecting, among others, the central nervous system (Mn, Hg, Pb, As), the kidneys or liver (Hg, Pb, Cd, Cu) or skin, bones, or teeth (Ni, Cd, Cu, Cr) [9]. Heavy metal pollution can arise from many sources but most commonly arises from the purification of metals, e.g., the smelting of copper and the preparation of nuclear fuels. Electroplating is the primary source of chromium and cadmium through precipitation of their compounds or by ion exchange into soils and muds, can be localize and lay dormant. Unlike organic pollutants, heavy metals do not decay and thus pose a different kind of challenge for remediation [10].

Many heavy metals act as biological poisons even at parts of per billion (ppb) levels. The toxic elements accumulated in organic matter in soils are taken up by growing plants [2]. The metals are not toxic as the condensed free elements but are dangerous in the forms of cations and when bonded to short chains of carbon. Many metals with important commercial uses are toxic and hence undesirable for indiscriminate release into the environment [11]. The uncontrolled input of heavy metals in soils is undesirable because once accumulated into the soil, the

metals are generally very difficult to remove. Subsequent problems may be toxicity to the plant growing on the contaminated soils and uptake by the plants resulting in high metal levels in plant tissues.

Generally, at the biochemical levels, the toxic effect caused by excess concentrations of heavy metals include competition for sites with essential metabolites, replacement of essential ions, reactions with SH groups, damage to cell membranes and reactions with the phosphate groups [2].

Materials and Methods

The fresh samples were uprooted directly from the farm located at the dumpsite in staffQuartersUniversity of Maiduguri and the University of Maiduguri Teaching Hospital in Maiduguri. The samples were dried in oven, ashed in an electric furnance and digested. The concentrate was filtered using a filter paper and transferred to a 110 ml flask and diluted to mark with distilled water. Minerals and heavy metals (Fe, Mg, Ni, Zn, Ni, Co, Cd and Pb) were determined using Atomic Absorption Spectrometer (AAS).

Results and Discussion

Sampling point	Heavy metals concentration in ppm					
	Zn	Cu	Cd	Pb	Fe	Cr
UMTH	14.0	14.0	10.5	9.0	15.5	18.0
UNIMAID	10.5	13.0	9.5	6.5	20.0	20.5

The concentration of some of the heavy metals in spinach were significantly high above the value recommended by FAO/WHO (2001) except for Cu and Zn which were below the maximum recommended limit of 73.3 and 99.4 mg/kg respectively.

In general, the extent of Pband Cd contamination in the vegetable crops are of great concern as this may pose health risk to man. From the survey of literature, the main source of Pb is the akyl derivatives inpetroleum. It also comes from other sources like metal manufacturing sewages, paints, fertilzer, pesticides and ashes. This could probably be the mechanism of anthropogenic Pbcontributor into the soil and consequently into the vegetable crops. The elevated levels of Pb (9 and 6.50mg/kg) far exceeded the recommended limit (of 0.3 mg/kg) in vegetable crops which indicateother source such as vehicular emission than contaminants from dump site. Pb is most ubiquitous toxicant in the environment. Pb may impair renal function, red blood cell production, nervous system, causes blindness.

The concentrations of Cd of all the samples under investigation were above the maximumpermissible concentration (of 0.2mg/kg) of Cd (FAO/WHO 2001). This high level of Cd might be due to the use of cadmiumcontaining fertilizers. Cadmium has a long biological life of 20 – 30 years in the kidney [11]. Chronic exposure may eventually accumulate to Toxic levels as a result of high levels obtained in this study. This may lead to anaemia, damage proximal tubules, severe bone pain and mineral loss.

Cr though an essential trace nutrient and a vital component for the glucose tolerance factor, Cr toxicity damages the livers, lungs and causes organ haemorrhages. The high value of Cr might be attributed to the fugitive emissions from road dust.

Conclusion

The concentrations of the above parameters were higher than the FAO, WHO/EU and FAO/WHO allowed limit.. Thus, the high values of these trace metals in the vegetable samples could put the consumers of these vegetables at health risk. Further works should be carried out in the soil samples were the vegetables are grown.

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