

ASSESSMENT OF SOME HEAVY METALS IN TOMATO FRUITS, ONION BULBS, SOIL AND WATER SAMPLES COLLECTED FROM MUBI NORTH, MUBI SOUTH AND MAIHA LGA IRRIGATION SITES.



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ABSTRACT

The amount of absorptions in heavy metals such as Cadmium, Copper, Lead, Chromium and Iron were all studied using Atomic Absorption Spectrophotometer on vegetable samples for Onion Bulbs were 0.85mg/kg, 7.87mg/kg, 0.82mg/kg, 2.6mg/kg, 10.4mg/kg for Cd, Cu, Pd, Cr and Fe respectively, and for Tomato Fruits 0.12mg/kg, 8.25mg/kg, 0.97mg/kg, 2.11mg/kg, 10.11mg/kg for Cd, Cu, Pd, Cr and Fe respectively which showed that the vegetables have high concentration of Pb which was above the permissible limit set by FAO/WHO which pose a serious health risk to the consumers, meanwhile the concentration of those metals in Soil Samples, the concentration of Fe was below the permissible limit with a concentration of 14.9mg/kg also the concentration of Cd, Cu, Pd, Cr and Fe in the Irrigation water in Mubi North LGA were all within the permissible limit, meanwhile the concentrations of vegetables samples Onion Bulb and Tomato Fruits in Mubi South LGA were found to be 0.16mg/kg, 3.79mg/kg, 0.34mg/kg, 2.01 and 12.1mg/kg for Cd, Cu, Pd, Cr and Fe respectively for Onion Bulb which also indicated that the concentration of Pb was slightly above the permissible limit set by the FAO/WHO however Fe was found to be below the permissible limit, thus when consumed Fe play a vital role in providing nutrient for living creatures, it also mediated reactions and support most of the aerobic organisms in their respiration process while the concentration of Pb in Onion Bulb was also found to be above the permissible limit with a value of 0.81mg/kg meanwhile the Soil has a concentration amount 19.4mg/kg of Fe which is below the permissible limit set by the FAO/WHO lastly the concentrations of vegetables in Maiha LGA were found to be 0.55mg/kg (Cd), 5.5mg/kg (Cu), 0.46mg/kg (Pd), 2.44mg/kg (Cr), and 9.08mg/kg (Fe) for Onion Bulb which revealed that Pb was found to be above the permissible limit while in Tomato fruits it was revealed that the concentration of

Cd (0.9mg/kg), Cu (5.55mg/kg), Pd (0.46mg/kg), Cr (2.44mg/kg) and Fe (9.08mg/kg) which shows that Pd was slightly above the permissible limit also Cu was present which plays a vital role in the prevention of copper toxicity while in Irrigation Water the concentration of Cd, Cu, Pd, Cr and Fe were all found to be below the permissible limit. Trace elements(Pb, Cd and Cr) showed high concentration in all the irrigation sites. This may pose a serious health risk to the consumers of these vegetables. The presence of high level of cadmium, copper and lead in vegetable samples can cause liver damage, kidney damage, anemia, bone disease and many more health risks. Samples selected in Mubi North, Mubi South and Maiha LGA Irrigation Sites were highly contaminated with Pb in all the three local governments which may pose a major health challenge.

Keywords: Heavy Metals, Tomato Fruits, Onion Bulb, Hydrochloric Acid, Irrigation Site, Atomic Absorption Spectroscopy.

Introduction

Metals are substances with high electrical conductivity, malleability and luster, which voluntarily lose their electrons to form cations. Metals are found naturally in the earth's crust and their compositions vary among different localities, resulting in spatial variations of surrounding concentrations (Khlifi & Hamza 2010). Heavy metals are described as those that are at least five times denser than water. These metals can be either essential (such as Mo, Mn, Cu, Ni, Fe, and Zn) or non-essential (such as Cadmium, Nickel, Arsenic, Mercury, and Lead) (Kiran *et al.*, 2022). Heavy metals are generally referred to as those metals which possess a specific density of more than 5g/cm^3 and adversely affect the environment and living organisms, these metals are quintessential to maintain various biochemical and physiological functions in living organisms when in very low concentrations, however, they become noxious when they exceed certain threshold concentrations. Although it is acknowledged that heavy metals have many adverse health effects and last for a long period of time, their exposure continues and is increasing in many parts of the world. Heavy metals are significant environmental pollutants and their toxicity is a problem of increasing significance for ecological, nutritional and environmental reasons (Jaishankar *et al.*, 2013).

Heavy metals contamination of vegetables cannot be underestimated as these foodstuffs are important components of human diet. Long term weathering and soil mineralization may lead to the accumulation of heavy metals in agricultural soils and plants. Food safety issues and potential health risk make this as one of the most serious environmental concern (Cui *et al.*, 2004).

Vegetables accumulate heavy metals in their edible and non-edible parts, some of these heavy metals such as Cadmium (Cd), Lead (Pb) and Chromium (Cr) are not essential for plant growth, since they do not perform any known physiological function in plants. Others such as Copper (Cu), Cobalt (Co), Iron (Fe) Nickel (Ni) and Zinc (Zn) are essential elements required for normal growth and metabolism of plants, but these elements can easily lead to poisoning when their concentrations are greater than the optimal values (Garrido *et al.*, 2014). Hence, this work deals with the quantification of heavy metals concentrations in vegetables grown at

Irrigation sites in Mubi North, Mubi South and Maiha LGA, Adamawa State as well as the water and soil, being the duo the middling of growth of the vegetables.

There are five heavy metals which are concerned based on this work. These are Cu, Cd, Pb, Cr and Fe. These heavy metals (Cu, and Fe) are commonly found in the environment and in our diet. In small amounts, they are required for maintaining good health but in larger amounts, they can become toxic and dangerous to our body system. Cd, Pb and Cr are however toxic to human health (Mosby *et al.*, 2014). In addition to heavy metal presence in the soil, the water used for irrigation can also contain heavy metals from various sources such as industrial runoff, mining activities and atmospheric deposition (Khan *et al.*, 2010). When such contaminated irrigation water is used for farming, metal accumulation can occur in the soil and are taken up by edible plants, including vegetables. These metals are taken up by the roots from the soil and translocate to the edible parts, which pose serious negative health risk to humans, plants and animals. For example, Cadmium when found above the permissible limit by FAO/WHO is implicated in the causing diarrhea, stomach pains and severe vomiting, as well as bone fracture, reproductive failure and perhaps even infertility. It also causes damage to the central nervous system, the immune system or even cancer development (Noler *et al.*, 2006).

It has been reported that metals such as cobalt (Co), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se) and zinc (Zn) are essential nutrients that are required for various biochemical and physiological functions (WHO/FAO/IAEA 2006). Inadequate supply of these micro-nutrients results in a variety of deficiency diseases or syndromes (WHO/FAO/IAEA 2006).

Plants absorb Cd mainly through their roots via cation transporters that are also responsible for uptake of essential metals like Zn and Fe. Following absorption, Cd is moved to the plant's aerial sections, especially the leaves and fruits, where it builds up. This uptake is non-selective and varies depending on plant species, genotype, and environmental conditions. Some plants develop tolerance to Cd through binding Cd with phytochelatins and metallothioneins, sequestering Cd in vacuoles, root exudation to limit Cd availability and activation of antioxidant systems. Plants such as *Amaranthus* and Vetiver grass are used to remediate Cd-contaminated soil. Techniques include phytoextraction, phytostabilization, and rhizofiltration. Cd enters the food chain through plant consumption and bio-accumulates in human tissues, especially the kidneys and liver. Chronic exposure causes renal dysfunction, skeletal damage, and cancer. Cd bio-accumulates in the kidney cortex and liver, causing renal tubular dysfunction, osteoporosis, and cancers. Long-term exposure leads to Itai-Itai disease, hypertension, and reproductive toxicity. A provisional acceptable monthly consumption (PTMI) of 25 µg/kg body weight has been established by the Joint FAO/WHO Expert Committee on Food Additives (JECFA, 2011) as a global standard for the safe consumption of cadmium (Lee *et al.*, 2025). Cadmium levels in fruiting vegetables are limited to 0.05 mg kg⁻¹, according to the Food Safety and Standards Authority of India (FSSAI, 2011). Soni *et al.*, (2024) reported Cd levels exceeding WHO limits in Rohtak's peri-urban agricultural soils. Sources included wastewater irrigation, industrial discharges, and phosphate fertilizer overuse. Vegetable crops grown in this area showed elevated Cd content, raising food safety concern.

Heavy Metals in Vegetables (Onion Bulb and Tomato), Soil and Water

It has been reported that sewage, industrial effluents and municipal waste water discharge into rivers or streams contain appreciable amount of major essential plant nutrient and therefore the fertility levels of the soil are improved considerably under sewage irrigation of farmlands, treated sewage water also contain variable amount of heavy metals such as Pb, Ni, Cd, Hg, Zn and Cr which have the potential of contaminating crops growing under such irrigation (Rajesh *et al.*, 2004),

Heavy metals are one of the important types of contaminants that can be found on the surface and in the tissues of fresh vegetables. The prolonged human consumption of unsafe concentrations of heavy metals in foodstuffs may lead to the disruption of numerous biological and biochemical processes in the human body. Vegetables, especially leafy vegetables grown in heavy metal-contaminated soils, accumulate higher amounts of metals than do those grown in uncontaminated soils because they absorb these metals through their leaves (Delibacak *et al.*, 2002).

Heavy Metals in Irrigation/Drinking Water

Disposal of sewage water and industrial wastes is a great problem. Often it is drained to the agricultural lands where it is used for growing crops including vegetables. These sewage effluents are considered not only a rich source of organic matter and other nutrients but also they elevate the level of heavy metals like Fe, Mn, Cu, Zn, Pb, Cr, Ni, Cd and Co in receiving soils (Singh *et al.*, 2011). Concentration of Pb, Cr and Fe was found to be higher than the standard limit indicating imperilled state of canal water of Chittagong city, Bangladesh (Singh *et al.*, 2011). All water samples from farming sites in Accra (Ghana) contained detectable concentrations of each of the seven heavy metals except for irrigation water which had no detectable chromium, cadmium and cobalt, most of our water sources are gradually becoming polluted due to the addition of foreign materials from the surroundings (Singh *et al.*, 2011).

Benefits of Heavy Metals

In a small amount or minor quantity, certain heavy metals are nutritionally essential for a healthy life. Those elements, or some form of them, in fruits and vegetables and in commercially available multivitamin products (WHO, 2006). This research work focuses on vegetables (Onion Bulb and Tomatoes Fruit) because they are widely consumed in Nigeria both raw, boiled or cooked, Water and Soil on irrigation sites, so it is important to know about their relationship with heavy metals. Some heavy metals play essential roles in our body like helping in the functioning of critical enzymes in the body. Physiological roles are known for iron (haemmoeties of hemoglobin and cytochromes), copper (amine oxidases, dopamine hydrolase and collagen synthesis) and zinc (protein synthesis, stabilization of DNA and RNA) (Suruchi & Khan, 2011)

MATERIAL AND METHOD

Study Area

The Fresh vegetable samples (tomato fruits and onion bulbs), soil were randomly collected at different spots at different farms (A, B and C) and also the water from Irrigation site was also collected in Mubi North, Mubi South and Maiha LGA Adamawa State.

Chemicals (Reagents)

The chemicals used were the products of Central Drug House LTD and Eagle Scientific and BDH Chemicals; these include Conc. Trioxonitrate (V) acid (HNO_3) 20% Conc. Hydrochloric acid (HCl) 35% Tetraoxochlorate (VII) acid (HClO_4) 40% and Hydrogen peroxide (H_2O_2) 20% distilled water and Kjeldhal catalyst tablet.

Equipment's

The equipment's used include Hot Plate, Analytical weighing Balance, Sieve, moisture Can, oven, desiccators, silica disk, mottle furnace, steam bath, 500 ml round bottom flask, conical flask, filter paper, 500 ml Kjeldhal flask, Markham distiller, pestle and mortar, milling machine and atomic absorption spectrophotometer (AAS).

Samples Collection

Fresh vegetable samples (tomato fruits and onion bulbs) and soil were randomly collected at different spots in different farms (A, B and C). The water from irrigation site in Mubi North, Mubi South and Maiha LGA Adamawa State. All collected vegetable samples, soil samples and water samples were labelled in the below order:

- i. For Tomato: TF-MN (tomato fruits Mubi North), TF-MS (Tomato fruits Mubi South) and TF-MH (Tomatoes Fruits Maiha).
- ii. For Onion Bulb:- OB-MN (onion bulbs Mubi North), OB-MS (onion bulbs Mubi South) and OB-MH (onion Bulb Maiha).
- iii. For Soil:- S-MN (Soil Mubi North), S-MS (Soil Mubi South) and S-MH (Soil from Maiha)
- iv. For Water: W-S (Water Sample).

The samples collected were stored in cleaned polythene bags (tomatoes fruit, onion bulb and soil) and polythene bottles (water) according to their types and was brought to the laboratory for digestion and analysis.

Vegetable (Tomatoes Fruit and Onion Bulb) Samples Preparation and Digestion Procedure

Preparation: The collected samples were washed thoroughly with fresh tap water and rinsed three times with distilled water to remove surface pollutants and any items adhering to the surfaces. Vegetable samples were sliced into small pieces and open air dried on paper for about two hours to eliminate excess moisture. Each sample was weighed, dried in an oven at 80°C for several hours and it was reweighed to constant weight. The dried samples was grounded using mortar and pestle until it could pass through a 2mm sieve mesh and was stored in a cleaned and dry polyethylene bag appropriately labeled (Larry and Morgan, 2005).

Digestion: 1.0g of each dried vegetable sample was weighed in an analytical weighing balance and was transferred into a beaker. 20ml of (3:1) Conc. HNO_3 and HClO_4 was measured in a measuring cylinder and it was transferred into a different beaker containing the dried vegetable samples. The beaker was further placed on a hot plate to digest at 150°C . After an hour of digestion, 2ml of Conc. HCl was added to the reacting mixture and will be allowed to digest for two hours. Digestion was completed for different vegetable samples when the solution became colorless and white fumes evolved. The digested samples will be allowed to cooled at (25°C room temperature), it was filtered and it was been transferred into

a 50ml volumetric flask and diluted to mark with distilled water. The resulting solution was analyzed for the presence and concentration of some selected heavy metals (Cadmium, Chromium, Copper, Iron, and Lead) Standards of each metal in the samples was run with corresponding lamps using air acetylene flame integrated mode and the concentration of each metal is obtained by extrapolation from the calibration curve of standards (Salem *et al.*, 2016).

Soil Samples Preparation and Digestion Procedure

Preparation; The soil samples were collected from the upper 1-2 inches of the soil from different spots in the farm. The samples were mixed thoroughly by shaking for 2min and it was sieved using 2mm mesh sieve. In the laboratory, the soil samples were spread on glass plates and then dried in an oven at 100°C for 15 minutes. After the soil is dried, the non-decomposed vegetal remains, foreign materials and gravels will be manually removed from the soil and larger earth clods were all smashed as much as small as possible (Joel & Amajuoyi, 2009).

Digestion: The soil sample was digested using a method adopted from (Adefemi & Eyitayo 2013). The soil sample was grounded using a mortar and pestle and it was passed through 2mm sieve mesh. All metallic determination from soil samples was based on the fine particles obtained. A measured quantity of the samples was then transferred into a digestion tube; 20ml of concentrated nitric acid (HNO_3) was added and the sample pre-digested by heating gently for 20mins. More acid was then added and the digestion was continued for 30min - 40mins. Digestion was stopped and a cleared digestion was obtained. The flask is allowed to cool down and the content was transferred into a 50ml volumetric flask and made to the mark with distilled water. The resulting solution was tested for the presence and concentration of some selected heavy metals (Cadmium (Cd), Chromium (Cr), Copper (Cu), Iron (Fe), and Lead (Pb) using Atomic Absorption Spectrophotometer (AAS).

Water Sample Preparation and Digestion Procedure

Preparation: Sampling bottles were cleaned and rinsed with deionized water and filled with 1% nitric acid (HNO_3). At the sampling sites, the acid was removed and the bottles were rinsed three times with the sample prior to filling, capping and being returned to the plastic bag. The Sample was taken at a depth of 1m using an acid-cleaned bottle.

Digestion: In the laboratory, the Irrigated Water sample was digested using a method adopted from (Kisku *et al.*, 2000), 5ml of Conc. Nitric Acid (HNO_3) was added to 100ml of sample of water in a 250ml beaker. The solution was heated on a hotplate to boiled until the volume got to about 20ml and it was allowed to cooled down. Another 5ml of Conc. Nitric Acid (HNO_3) was added and the beaker was covered with a watch glass and the heating continued for about 10 more minutes. It was then filtered using a Filter paper and the solution is poured into a 100ml volumetric flask and topped with distilled water to the mark. The resulting solution was analyzed for the presence and concentration of some selected heavy metals (Cadmium, Chromium, Copper, Iron, and Lead) using Atomic Absorption Spectrophotometer (AAS).

RESULT AND DISCUSSION

Analyzed Result for Cadmium

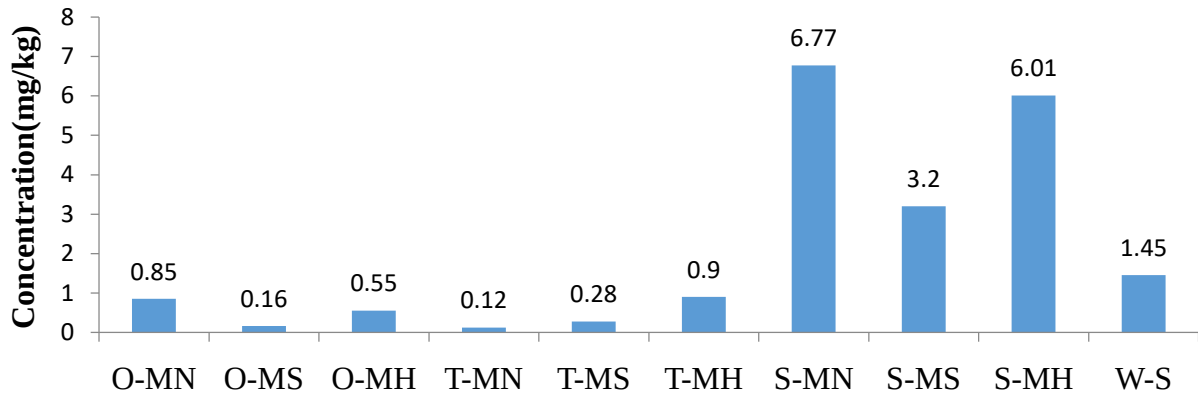


Figure 1: Mean concentrations of cadmium in vegetable (Onion Bulb and Tomato Fruit) samples, soil and water samples

From figure 1 the concentrations of cadmium found in Mubi North LGA ranged from 0.85mg/kg in O-MN, 0.12mg/kg in T-MN, and S-MN 6.77mg/kg, also in Mubi South the concentration was found to be 0.16mg/kg in O-MS, 0.28mg/kg in T-MS and 3.2mg/kg in S-MS meanwhile in Maiha Local Government the concentration of Cd was found to be 0.55mg/kg in O-MH, 0.9mg/kg in T-MH and 6.01mg/kg in S-MH, and the concentration of cadmium in water was 1.45mg/kg, from the result obtained the amount of cadmium in Onion Bulb in Mubi North (O-MN) 0.85mg/kg in Irrigation farming was higher, also the concentration of Tomato in Maiha LGA (T-MH) was found to be 0.9mg/kg which was higher compared to Mubi North and Mubi South and also the amount of cadmium found in the soil in Mubi North (S-MN) with a concentration was 6.77mg/kg was also higher. The result revealed that both O-MN (0.85mg/kg) and O-MH (0.55mg/kg) were slightly above the permissible limit set by the (FAO/WHO, 2006) which was 0.2mg/kg. The Onion Bulb in Mubi North and Maiha LGA were all above the permissible limit set by FAO/WHO (2006), meanwhile the Onion in Mubi South LGA was below the permissible limit 0.2mg/kg set by FAO/WHO (2006), these were in agreement with a research carried out by Bedassa *et al.*, (2017) whom found out that the average concentrations of cadmium in onion bulb at Mojo, Meki and Ziway were 0.05, 0.03 and 0.06 mg/kg respectively. These results were all below the permissible limits 0.2 mg/kg by FAO/WHO (1998). Thus Cd when found in high concentration and consumed in vegetables can contribute to bone disorder, cancer of lungs, anaemia, renal damage and Cd is highly toxic and non-essential heavy metals also it does not play a role in biological process of living organism and it can be harmful to human Ambedkar and Muniyan (2012). Also the high levels of cadmium in the analyzed vegetable samples in the area of study may be attributed to automobile emissions as a result of its proximity to the roadside, the indiscriminate use of pesticides and fertilizer on farmlands which may affect the soil and in turn affect the vegetable associated with this contaminated soil.

Result of Copper Analysis

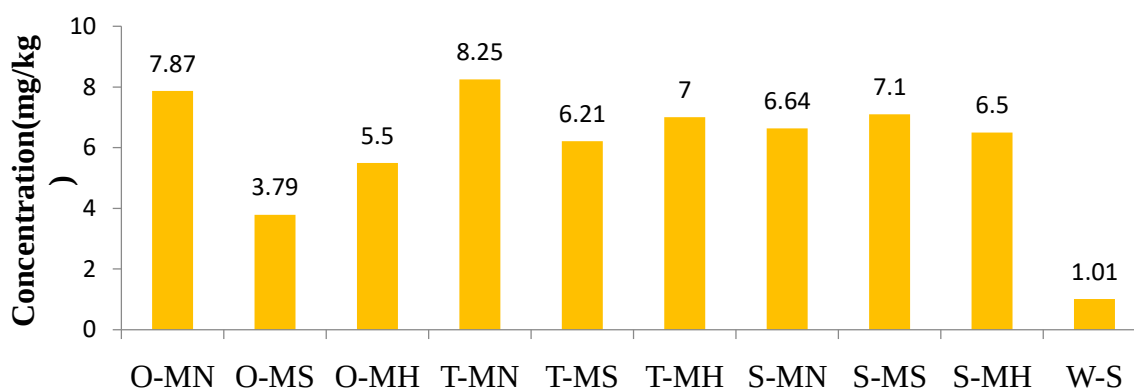


Figure 2: Mean concentrations of copper in vegetables (Onion Bulb and Tomato Fruit), soil and water sample

The result obtained showed the levels of concentration of Copper were all within the permissible limit set by FAO/WHO (2016) 73.3mg/kg, in an irrigation site in Mubi North were found to be (7.87, 8.25, and 6.64) mg/kg in O-MN, T-MN and S-MN respectively, also the concentrations in Mubi South were 3.79mg/kg (O-MS), 6.21mg/kg (T-MS) and 7.1mg/kg (S-MS) and lastly the concentration of copper found in an irrigation site in Maiha LGA were 5.5mg/kg (O-MH), 7.0mg/kg (T-MH) and 6.5mg/kg in (S-MH) whereas the concentration in water was 1.01mg/kg in the irrigation site. Although copper homeostasis plays an important role in the prevention of copper toxicity, exposure to excessive levels of copper can result in a number of adverse health effects including liver and kidney damage, anemia, immunotoxicity, and developmental toxicity. Many of these effects are consistent with oxidative damage to membranes or macromolecules. Copper can bind to the sulfhydryl groups of several enzymes, such as glucose-6-phosphatase and glutathione reeducates, thus interfering with their protection of cells from free radical damage (ATSDR, 2007).

Results of Lead Analysis

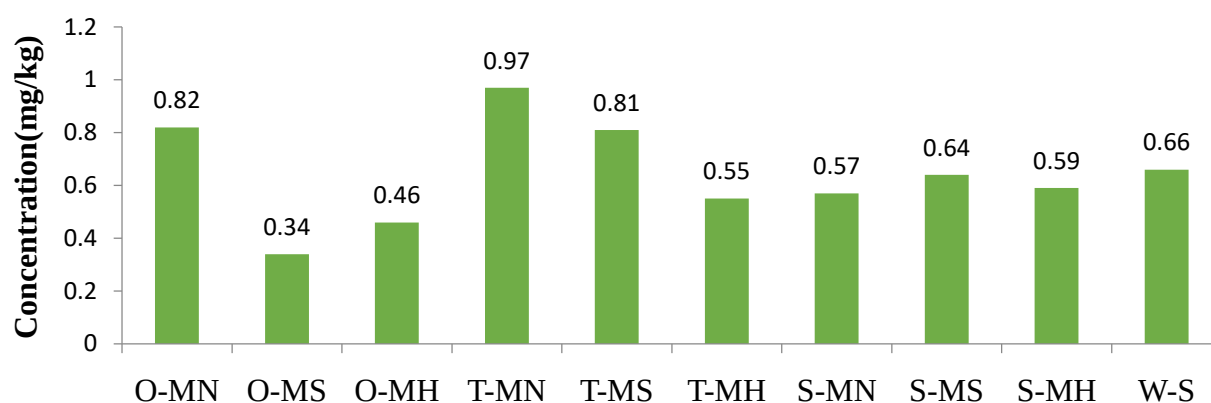


Figure 3: Mean concentrations of lead in vegetables (Onion Bulb and Tomato Fruit), soil and water samples

From the above result obtained in an irrigation farming in Mubi North, the amount of concentration of Pb were 0.82mg/kg (O-MN), 0.97mg/kg (T-MN), 0.57mg/kg (S-MN) and also the result showed that in Mubi South the concentration of Pb were 0.34mg/kg (O-MS), 0.81mg/kg (T-MS) and 0.64mg/kg (S-MS) whereas in Maiha LGA the Pb concentration were found to be 0.46mg/kg (O-MH), 0.55mg/kg (T-MH) and 0.59mg/kg (S-MH) meanwhile the irrigation water were analyzed to contained the amount of Pb to be 0.66mg/L. The results indicated that the levels of Pb in all vegetables from all the Local Government Areas were above the permissible limit set by FAO/WHO (2016) which are in line with a study conducted by Jibrinand Joshua (2015) which he recorded the amount of Pb to be higher in vegetables by Okro and Achi, Ofor from Garki, respectively. The concentration of Pb in Mubi North, Mubi South and Maiha LGAs are high due to the influence of nature of soil, use of too much organic and inorganic fertilizer, climate change, atmospheric deposition, deposition of waste disposal on which the vegetables are grown. These concentrations of Pb in Mubi North, Mubi South and Maiha LGA were higher than those detected in Abuja Market, Nigeria affirmed that the heavy metals contents in vegetables varied depending on the country or region, environmental pollution levels, plant part and technological processes. It is also believed that a combination of factors including the use of polluted water, bad practice in post harvesting handling of the vegetables products with disregard to the food safety guidelines, and the physical market environments in these locations surrounded by a heavy urban pollution deposition may have exacerbated contamination levels of these vegetable samples. Jibrin and Joshua (2015).

Result of Chromium Analysis

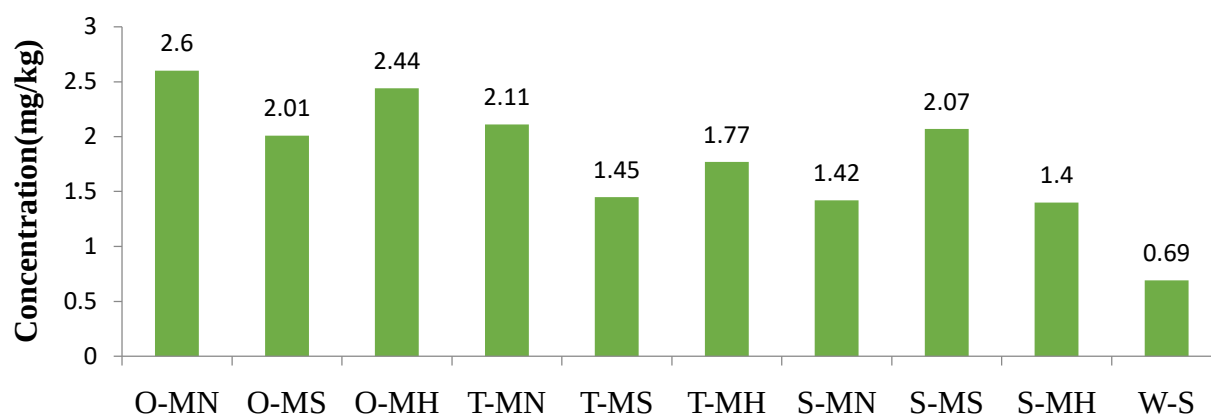


Figure 4: Mean concentrations of chromium in vegetables, soil and water samples

The result obtained for Chromium in Mubi North were 2.6mg/kg (O-MN), 2.11mg/kg (T-MN), 1.42mg/kg (S-MN), whereas in Mubi South the concentration of Chromium in the vegetable samples was found to be 2.01mg/kg (O-MS), 1.45mg/kg (T-MS), 2.07mg/kg (S-MS) meanwhile in Maiha Local Government Irrigation sites the concentration of chromium were obtained to be 2.44mg/kg (O-MH), 1.77mg/kg (T-MH), 1.4mg/kg (S-MH) whereas the concentration of chromium in water was 0.69mg/k. The concentration level of Chromium in vegetables (Onion Bulb and Tomato Fruit) in Mubi North were all within the permissible limit set by FAO/WHO (2006) 2.3mg/kg except in O-MN where the concentration was 2.6mg/kg and 2.44mg/kg in O-MH which is above the permissible limit this relate the study

conducted by Bedassa M., *et al.*, (2017) where he found out that the amount of chromium in vegetables where above the permissible limit with a concentration level of Cr in onion at Mojo, Meki and Ziway were 4.87 mg/kg, 4.13 mg/kg and 3.33 mg/kg respectively, So the levels of Cr obtained in area of Mubi North and Maiha LGA in the present study could become health risk to consumers. The reason is that Cr is retained in the roots and only a minor portion reaches the shoot while in Mubi South, since the concentration where below the permissible therefore Cr (III) can play an essential role required for normal sugar and fat metabolism. It is effective to the management of diabetes and it is a cofactor with insulin. Cr (III) and its compounds are not considered a health hazard, while the toxicity and carcinogenic properties of Cr (VI) have been known for a long time Kalagbor and Diri (2014).

Result of Iron Analysis

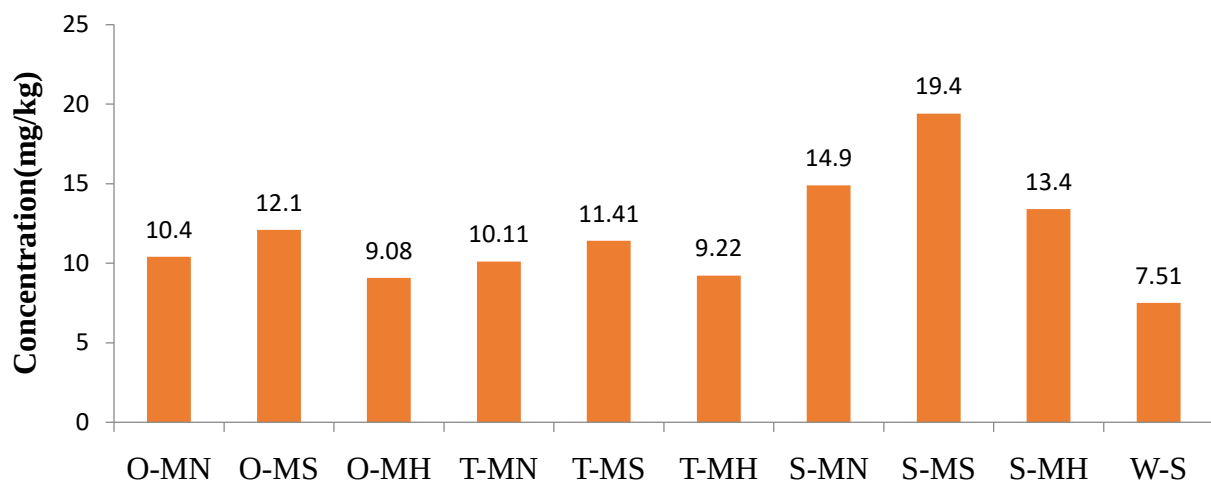


Figure 5: Mean concentrations of iron in vegetables, soil and water samples

From the result obtained, the amount of Iron were all within the permissible limit set by FAO/WHO (2016), the result indicated that the concentration of Iron (Fe) found in vegetables (Onion Bulb and Tomato fruit) in Mubi North were 10.4mg/kg (O-MN), 10.11mg/kg (T-MN), 14.9mg/kg (S-MN), while the concentration of Fe in vegetables in Mubi South was 12.1mg/kg (O-MS), 11.41mg/kg (T-MS), 19.4mg/kg (S-MS) meanwhile in Maiha LGA the concentration of vegetables was found to be 9.08kg/kg (O-MH), 9.22mg/kg (T-MH) and 13.4mg/kg (S-MH) while the amount of Iron in water was found to be 7.5mg/L (W-S) this correlates with a study carried out by Bedassa *et al.*, (2017) in Mojo, Meki and Ziway with a value of an Onion Bulb to be 20.87 mg/kg, 24.33 mg/kg and 0.80 mg/kg which were all within the permissible limit, Iron is the most abundant transition metal in the earth's crust. Biologically, it is the most important nutrient for most living creatures as it is the cofactor for many vital proteins and enzymes. Iron mediated reactions support most of the aerobic organisms in their respiration process. If it is not shielded properly, it can catalyze the reactions involving the formation of radicals which can degraded biomolecules, cells, tissues and the whole organism. Iron poisoning has always been a topic of interest mainly to pediatricians. Children are highly susceptible to iron toxicity as they are exposed to a maximum of iron containing products (Suleiman 2025).

Conclusion

Different vegetable species have different ways to absorb heavy metals since their amounts used for metabolic process in different plants are also varied. The concentration of copper in all the three local government in the vegetables samples (Onion Bulb and Tomato Fruits) soil and water were all within the permissible limit set by FAO/WHO (2016) 73.3mg/kg, except the concentration of Cd in Mubi North and Mubi South were all above the permissible limit while that of Maiha where below the permissible limit, where the concentration of heavy metals was higher than the standard limit set by the (FAO/WHO, 2016). Consumption of these vegetables by people living in that area means exposing the entire population to adverse levels of these heavy metals and this may pose a serious health risk to them. The study also indicated that the levels of Pb in all vegetables from both Mubi North, Mubi South and Maiha Local Government Areas irrigations sites were above the permissible limit set by FAO/WHO (2016) due to the influence of nature of soil, using of too much organic and inorganic fertilizer, climate change, atmospheric deposition, deposition of waste disposal on roads which the vegetables are grown. So the levels of Cr obtained in area of Mubi North and Maiha LGA in the present study could become health risk to consumers. The reason is that Cr is retained in the roots and only a minor portion reaches the shoot while in Mubi South, since the concentration where below the permissible limit, Cr (III) can play an essential role for normal sugar and fat metabolism. It is effective to the management of diabetes and it is a cofactor with insulin Kalagbor and Diri (2014). From the present study, both Mubi North, Mubi South and Maiha LGA Irrigation farms the amount of Iron were all within the permissible limit set by FAO/WHO (2016) which is 425.5mg/kg, therefore people consuming these vegetables (Onion Bulbs and Tomato Fruits) containing iron can have more hemoglobin production, immune system support, skin nourishment, reduction of dark circle, reduce fatigue and also enhance their memory. Therefore, from the results of the present investigation, it could be concluded that in the vicinity of the irrigation farming in Mubi North, Mubi South and Maiha LGA Adamawa State, the uptake of these heavy metals which were above the permissible limit in these vegetables crops increases especially during the dry season. This is due to the fact that the water may be contaminated by sewage sludge, fertilizers, pesticides, etc. that are usually used for irrigation purpose at the farms.

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