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DETERMINATION OF HEAVY METAL IN TOMATOES (Lycopersium escalentum) AND SOIL GROWN IN PANSHEKARA CHALLAWA INDUSTRIAL AREA OF KANO STATE.

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Abstract: Determination of heavy metals in soil and tomato grown in Panshakara Challawa Industrial Area of Kano state was analyzed using Atomic Absorption Spectrophotometer (AAS) the study was only on one species (Cheery) which was collected from Challawa industrial area of Kano state, the samples were identified at Biological Science Department Ahmadu Bello University, it was washed blended and the samples were digested and analyzed the result obtained shows the concentration of heavy metals such as *Fe*, *Cr*, *Cd*, *Pb* in fruits tomatoes grown in Panshakara Industrial area of Kano state to be 0.0477 ppm, 0.0036 ppm, 0.1699 ppm, 0.0069 ppm. And the concentration in soil to be 0.2000 ppm, 0.2324 ppm, 0.0064 ppm, 0.0560 ppm. As a result, the relative abundance of heavy metals in tomatoes samples was observed as Fe, Cr, Cd, Pd. According to the result of this study it can be said that tomatoes fruits reflect heavy metals amount well in polluted areas such as Challawa industrial area road side when compare to unpolluted (control) areas with their wash and unwashed sample.

1.0 INTRODUCTION

The Tomato (*Lycopersiconesculentum*) is herbaceous plants. It is perennial that usually grown outdoors in temperature climates as an annual plant. It has a weak and woody stem that often vines over other plant. The tomato is grown worldwide for its edible fruits with varying fruit types, cultivated tomatoes vary in size from cherry tomatoes about 1-2cm up to beefsteak tomatoes 10cm (Mel *et al*., 2009).

Beefsteak tomatoes are large tomatoes there kidney-bean shape makes commercial use impractical along with a thinner skin cherry tomato is a smaller garden variety. It is marked at a premium to ordinary tomatoes cherry tomatoes range in size from a thumb tip up to the size of a golf ball and can range from being spherical to slightly oblong in shape.

The consumption of tomatoes is believed to benefit the heart among other things. Inside of tomatoes it consists of double normal vitamin C, 40 times normal vitamin A, high level of anthocyanin, and two to four times the normal amount of *Lucopene*. Tomatoes contain *Lycopene*, one of the most powerful natural antioxidants which have been found to prevent prostate cancer; lycopene also can improve the skin's ability to protect against harmful UV rays. Tomato extract known as *Lycomato*useful for treatment of high blood pressure (Kachenko*et al*., 2006).

Tomatoes fruits are usually eaten whole in salad, cooked in sauces, soup and meat, fish dishes or consume as paste and cutup it contains, any nutrients, anti-oxidants and secondary metabolites such as vitamin C and E, B carotene, lycopene, flavonoids, organic acids phenolic and chlorophyII, which are importance for human health.

Increasing industrialization has been accompanied by the extraction and distribution of mineral substance from their natural deposits throughout the world, it is known that some heavy metals (Zn, Cu, Mn, or Mo) are micronutrient at low concentration, nevertheless metals most often found as contaminants in vegetable include As, Cd and Pb, these metals can be post as a significance health risk in humans when they reach high concentration in the body, these can be express in the inhibition or activation of certain enzyme processes affecting their productivity from both qualitative and quantitative aspect, contamination of soil by heavy metals is often a direct or indirect consequence of anthropogenic activities, source of anthropogenic metal contamination include Challawa industrial waste mining and smelting of non-ferrous metals and metallurgical industries.

Additional one of the main source of air pollution in Challawa industrial area are traffic industry and fossil fuel burning for heating purposes, food and vegetable crops production require access to fertile land, water and in some cases fertilizer, particularly in poor developing countries of the world. Thus it requires all the necessary input it deserves to realize these goals.

1.2 Statement of Problem

Many plants contain both essential and toxic metals over wide range of concentration. It is well known that plant takes up metals by absorbing them from contaminated soil as well from deposits on part of the plant exposed to the air from polluted environment; heavy metals contamination may occur due to irrigation with contaminated water, the addition of fertilizer, metals based on pesticides, industrial emission transportation, harvesting process storage and sale the contamination of vegetables with heavy metals in vegetable and fruit is associate with etiology of a number of disease especially cardiovascular kidney nervous system and bones diseases.

1.3 Justification

Vegetable constitute an essential dietary component by contributing protein, vitamins, iron, calcium and other micro-nutrient which are usually in short supply, they also act as buffering agent for acidic substance produced during digestion process. However, they contain both essential and toxic element over a wide a range of concentration metals accumulation in vegetable may pose a direct threat to human health hence this study tends to assess the presence of heavy metals presence in soil and tomatoes grown in Panshakara Challawa industrial area of Kano state Nigeria.

1.4 Aim and Objectives of the Study

1.4.1 Aim of study

The aim of this study is to determine the concentration of some heavy metals in soil and tomatoes grown in Panshakara Challawa industrial

1.4.2 Objectives of the Study

1. To investigate the concentration of heavy metals in soil and tomatoes grown in Panshakara industrial area of Kano state using Pb, Cr, Cd and Fe.
2. To compare the concentration of the heavy metals in soil and in tomatoes grown in Panshakara Challawa industrial area of Kano state with FEPA standard.
3. To sensitize the general public on the effect of heavy metals in soil and tomatoes grown in Panshakara Challawa industrial area.

CHAPTER TWO

2.0 LITERATURE REVIEW

Tomatoes are growing due to excellent source of many nutrients and secondary metabolites that are important for human health, mineral matter, vitamin C and E, B-carotene, lycopene flavonoids, organic acids, phenolic and chloriohyII. Tomatoes also consist of B-carotene and lycopene that related epidemiologically to a lower incidence of cardiovascular disease and of prostrate, gastrointestinal and epithelial cell cancer (Khan, 2008). Heavy metals and nutritive contents of tomatoes depend on growing condition compared to crops grown using conventional and organic methods, organic tomatoes contained more salicylic acid but less vitamin C and lycopene, organic tomatoes had high Cd and Pb levels but a lower cu content. Organic fruits had slightly higher protein content than conventionally cultivated fruits, but the difference was minimal and consequently the nutritive significance was poor (Radwan*et al*., 2006). Analysia carried out the similar studies in cultivars of tomatoes influence the types and concentration of heavy metals in tomatoes. For intensive cultivar about 83.8% of P, Na, K, Ca and Mg were present in tomatoes. For organic cultivar about 91.3% of P, Ca, Cu and Mn were present in tomatoes for hydroponic cultivar about 92.3% of K and mg were present in tomatoes (Nirupa *et al*., 2008). Another analysis that carried out the study about oil, micronutrients and heavy metals contents of tomatoes, he reported that the heavy metals in tomatoes consist of Pb 0.43 .(Abdullahi *et al*., 2007). The study of heavy metals contamination in water sample has been done by many researches. It involves a few types of water like river, sea, tap water, lake, dam and others. Most of the results have shown that heavy metals exist in these sample of water but the concentration of their contamination are different and some of the results do not detect the existence of heavy metals in water.

2.1 Taxonomical Classification of Tomato

Kingdom – Plantae
Division – Magnoliophyta
Class – Magnoliopsida
Order – Solanales
Family – Solanaceae
Genius – Solanum
Species – S.lycopersicum
(Khan *et al*., 2008.)

2.2 Types of Tomatoes

There are many variants of tomatoes and each provides the benefits listed above and more, here are the five most common types of tomatoes

Globe Tomatoes

These are your standard variant of tomatoes and are often referred to as beefsteak. Tomatoes or slicing tomatoes they are easily identifiable because they are large, round, and red. They can also weigh up to two pounds.

Cherry Tomatoes

These tomatoes belongs to the cluster variant, cherry tomatoes tend to be just about the same size as a cherry tomatoes. But they are much sweeter and juicier than the large varieties, such as Globe Tomatoes.

Roma Tomatoes

Also known as plum tomatoes, they are the least juicy of all tomatoes, because they are thick and contain fewer seeds than other tomatoes variants. Roma tomatoes are a fovote pasta sauces

Heirloom Tomatoes

This variety is gaining in popularity with government chiefs. This is because heirloom tomatoes come in large variety of shapes and colors. Their biggest downfall is that they tend to remain ripe for a very short period of time.

Pear Tomatoes

Another member of the cluster tomatoes variant, pear tomatoes get their name from their shape, which resembles a pear. They are only the size of a cherry tomatoes but

without the high juice levels treatment of high blood pressure (Kachenka *et al*., 2006)

THE CONTENTIONAL HISTORY OF CHERRY TOMATO (20TH JUNE,2016)

CHERRY TOMATO HANO SURPERSING ISREAL ROOT. (AUGUST,2017)

Figure 4.1 tomatoes diagram

2.3 Heavy Metal

The term "Heavy metals" refers to any metallic chemical element that has a relatively high density and is toxic or poisonous as low concentration. Example of heavy metals of which this project is based on includes lead, chromium, cadmium and copper, heavy metals are natural component of the earth. They cannot be degraded or destroyed to a small extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals are essential to maintain the metabolism of the human body. However at high concentration they can lead to poisoning. Heavy metals poisoning could result for instance, from drinking water contamination (e.glead pipes) high ambient air concentrations near emission sources or intake via the food-chain. Heavy metals can enter a water supply by industrial and consumer waste or even from acidic rain breaking down soil and releasing heavy metals into streams, lakes, and ground waters. This implies that heavy metals have both health and environmental risks. (Miteva et al 2001)

2.4 Toxic Effect of Some Heavy Metals

Heavy metals that are released to the environment at various concentrations become contaminated, mixed with the food and water, which when consumed affects both plants and animals.

Skinner reported that fiah can accumulate certain element such as copper, lead, etc. from surrounding water or food which in turn affects human health for eating the fish (Marmiroli and Macstri, 2008)

2.5 Importance of Heavy Metals

Heavy metals have effects on human body. Thus the importance of heavy metals is significant to man as it affect man's health (Srinivas *et al*., 2009). Arsenic causes skin disease and leukemia while antimony tartrate causes tropical disease. The arsenic

compounds are used as pesticides and for wood preservation. The phytotoxic effects of arsenic compounds made them as herbicide. But when the concentration of the metals arevey high beyond limits they become toxic. Nio-accumulation is a process whereby the heavy metals are stored up in living systems, acquired from their surrounding into their chelation process (Nriagu and Orthodox, 1990).

2.6 The Study of Some Heavy Metals and their Toxicity

2.7 Chromium

Chromium is released into the environment by a large number of processes such as electroplating, leather tanning, wood preservation, pulp processing, steel manufacturing etc., and the concentration levels of Chromium and Nickel in the environment widely varies.

These tow metals are of major concern because of their large usages in developing countries and their non-degradability nature. Hexavalent chromium is highly soluble in water and carcinogenic to human body. It is also known that this same hexavalent chromium is an important heavy metal widely used in the metallurgies refractory, chemical and tannery industries. Chrome plating, the deposition of metallic chromium imparts a refractory nature to materials rendering the resistant to microbial attack. More than 170,000 tons of chromium waste is discharged to the environment annually as a consequence of industrial and manufacturing activities. Several physical and chemical methods exist to remove heavy metals from the environment. However, these methods are reported to be impractical due to operational high cost and subsequent generation of solid waste which is difficult to treat. Biosorption method serves as a cheap efficient method for heavy metals like chromium. Trace amount of chromium is necessary in the diet of mammals and chromium (iii) is involved in maintaining the correct level of glucose in the blood (Sharma *et al*., 2004).

When the chromium salt is in higher amount, either ingested or on the skin is carcinogenic (i.e. likely to cause cancer).

2.8 Cadmium

Cadmium occurs naturally in ores together with zinc, lead and copper. Cadmium compounds are used as stabilizers in polyvinyl chloride products, colored pigment, several alloys and, now most commonly, in re-chargeable nickel-cadmium batteries. Metallic cadmium has mostly been used as an anti-corrosion agent. Cadmium is also present as a pollutant in phosphate fertilizers. EU cadmium usage has decreased considerably during the 1990s, mainly due to the gradual phase-out of cadmium products other than Ni-Cd batteries and the implementation of more stringent environmental legislation. Notwithstanding these reductions in Europe, however, cadmium production, consumption and emissions to the environment worldwide have increased dramatically during the 20th century. Cadmium containing products are rarely re-cycled, but frequently dumped together with household waste, thereby contaminating the environment, especially if the waste is incinerated.

Natural as well as anthropogenic sources of cadmium, including industrial emissions and the application of fertilizers and sewage sluge to farm land, may lead to contamination of soils, and to increased cadmium uptake by crops and vegetables, grown for human consumption. The uptake process of soil cadmium by plants is enhanced at low pH.

Cigarette smoking is a major source of cadmium exposure. Biological monitoring of cadmium in the general population has shown that cigarette smoking may cause significant increases in blood cadmium levels, the concentrations in smokers being on average 4-5 times higher than those in non-smokers. Despite evidence of exposure from environmental tobacco smoke, however, this is probably contributing little to total cadmium body burden.

Food is the most important source of cadmium exposure in the general non-smoking population in most countries. Cadmium is present in most foodstuffs, but concentrations vary greatly, and individual intake also varies considerably due to differences on dietary habits. Women usually have lower daily cadmium intakes, because of lower energy consumption than men. Gastrointestinal absorption of cadmium may be influenced by nutritional factors, such as iron status. Generally reflects current exposure, but partly also lifetime body burden, being proportional to the kidney concentration. Smokers and people living in contaminated areas have higher urinary cadmium concentrations, smokers having about twice as high concentrations as non-smokers (Wei *et al*., 2008).

2.9 Heavy Effect of Cadmium

Acute pulmonary effects and deaths are uncommon, sporadic cases still occur. Cadmium exposure may cause kidney damage. The first sign of the renal lesion is usually a tubular dysfunction, evidenced by an increased excretion of low molecular weight proteins (such as β_2-microgloblin and α_1 microglobulin) or enzymes (such as N-Acetyl-β -D-glucosamindase). It has been suggested that the tabular damage is reversible, but there is overwhelming evidence that the cadmium induced tubular damage is indeed irreversible.

WHO estimated that a urinary excretion of 10 nmol/mmol creatinine would constitute a 'critical limit' below which kidney damage would not occur However, WHO calculated that circa 10% of individuals with this kidney concentration would be affected by tubular damage. Several reports have since shown that kidney damage and/or bone effects are likely to occur at lower kidney cadmium levels. European studies have shown signs of cadmium induced kidney damage in the general population at urinary cadmium levels around 2-3 µg Cd/g creatinine.

The initial tubular damage may progress to more severe kidney damage, and already in 1950 it was reported that some cadmium exposed workers had developed decreased glomerular filtration rate.

This has been confirmed in later studies of occupationally exposed workers. An excess risk of kidney stones, possibly related to an increased excretion of calcium in urine following the tubular damage, had been shown in several studies. (Morris and Theodore, 1991).

Recently, an association between cadmium exposure and chronic renal failure was shown. Using a registry of patients, who had been treated for uremia, the investigators found a double risk in persons living close to (<2km) industrial cadmium emitting plants as well as in occupationally exposed workers. Long-term high cadmium exposure may cause skeletal damage, first reported from Japan, where the itai-itai (ouch-ouch) disease (a combination of osteomalacia and osteoporosis) was discovered in the 1950s. The exposure was caused by cadmium contaminated water used for irrigation of local rice fields. A few studies outside Japan have reported similar findings. During recent years, new data have emerged suggesting that also relatively low cadmium exposure may give rise to skeletal damage, evidenced by low bone mineral density (osteoporosis) and fracture.

Animal experiments have suggested that cadmium may be a risk factor for cardiovascular disease, but studies of humans have not been able to confirm this. However, a Japanese study showed an excess risk of cardiovascular mortality in cadmium exposed persons with signs of tubular kidney damage compared to individuals without kidney damage.

2.10 Iron

Iron is essential for the purphyrin enzyme of respiration where it acts as reodox (oxidizing and reducing agent. Iron is the fourth most abundant element on earth's crust, and occurs in seawater at about

3.5ppm. Fe is an essential element for all forms of life. It takes part in photosynthesis, respiration, DNA. Fe occurs mainly in forms of oxides and hydroxides as amorphous compounds small particles filling in cracks and veins and coating on other minerals or particles.

Fe is mostly used in steel industry as a raw material in plant industry with its oxidized form as pigment as a compound in carbon and other metals, in constructions and buildings

It is quite reactive iron is by far the most the important transition metal (heavy metal) with a functional role in having system. Iron containing proteins participate in two main process

Oxygen transport and electron transfer there are other molecules whose function is to store and transfer iron. In man and many other higher animals, the storage materials are ferritin and hemosiderin, which are present in liver, spleen, and bone marrow. Transferring is a protein that binds ferric ion very strongly and transports it from ferritin to red cells and vice versa. Symptoms of acute iron poisoning are increased respiration and pulse rates with congestion of blood vessels leading to hypotension, pallor and drowsiness in 6-8hrs, prostration, coma and finally death due to peripheral cardiac failure occur in 38hrs (Al-lanham *et al.,* 2007).

Chronic iron poisons in hemorrohyogis, necrosis of the gastro intestinal tract, hepatoxicosis, metabolic acidosis, greatly prolonged blood clotting time, and elevation of plasma levels of serotomin and histamine. Hepatic damage causes jaundice by raising the serum bilirubin level and inhibiting hepatic damage causes jaundice by raising the serum bilirubin level and inhibiting hepatic enzymes. Parenteral administration of an iron dextran complex induces malignant tumors at the site of injection, although most other iron salts and dextran alone do not induce tumors. Iron oxides enhance the carcinogenic action of organic carcinogenic such as benpyrene presumably becoming inert carriers of the carcinogens. Accumulation of particulate iron compounds in lysomes appears to be the only specific detoxication mechanism for Epidemiological evidence suggests that chronic inhalation of iron oxides ores (Fe2o3) induces bronchial cancer and also gastric cancer.

The need for iron in women is important especially during pregnancy as there is the need for iron in developing the mother and for this, women requires extra iron.

This is estimated at 1.0-2.5mg or more daily. Iron is also constituent of cytochromes, ferrodoxin, enzymes catalase and peroxidase within cells. Iron has also been found to be essential for the systhesis chlorophyll and its deficiency will lead to chlotrosis of young leaves, shoots and slender stems. Iron is an essential mineral being a heavy metal it requires to our diet for the development of our system.

Good source of iron include; liver, meat, beans, nuts, dried fruit, grains such as brown rice, fortified breakfast, cereals, soya beans flour and most dark green leafy vegetables some people think that spinach is a good source of won, but spinach contain a substance that makes it harder for the body to absorb the iron from it. Similarly, tea and coffee also contain iron. Women who

lost of blood during monthly period may need to think about taking iron supplement. Iron has a number of important roles in the body. For example it helps make red blood cell, which carry oxygen around the body. The iron effect of taking high dose of iron includes constipation, nausea; Vomitting and stomach path very high dose of iron can be fatal, particularly if taking by children (Georgopoulos *et al*., 2001).

2.2.0 Lead

Lead is a chemical element which has the symbol Pb it is the main group element with

atomic number 82, relative atomic mass 207.2, lead has electronic configuration of [Xe], $4f^{14}5d^{10}6s^{2}6p^{2}$It has the melting point of 327^{0}c and boiling point of 1744^{0}c.

Lead is the member of group 14, period 6 and is a p block element. Naturally, soil contain very small amount of lead, contamination of soil with lead comes primarily from borne, lead from auto mobile exhaust, from paint chips and dust from wood work coated with old lead pigmented paints. It is most concentrated within 100m of major road ways, near urban centers and in the soil near older homes.

Most of the lead is tied up in the soil as insoluble carbonate, sulphides and in combination with iron, aluminum and manganese oxides (miteva *et al*., 2001).

2.2.1 Health Effect of Lead

Excessive increase in the level of lead in soil due to the disposal of metal contaminated sludge on land or water can be harmful to plants and animals growth. Soils have contaminated globally by emission of car exhaust and concentrations of lead in soil examined are rising rapidly.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials

Measuring cylinder (100 ml)
Funnel
Volumetry Flask (100 ml)
Pyrex Bottom Flask (25 cm)
Whatman No 1 Filter Paper
Analytical Weighing Balance
Beakers (100 ml)

3.2 Instruments

Hot Plate
Atomic Absorption Spectrophotometer

3.2.1 Reagents

Hydrochloric acid
Hydrofluoric acid

3.3 Sample Collection

Randomized fresh tomatoes and soil sample were collected at the same location Panshakara Challawa Industrial area of Kano state.

3.4 Tomatoes Digestion

Conventional aqua regia digestion was performed in 250 ml glass beaker covered with watch glasses. A well-mixed sample of 0.5000 g was digested in 12 ml of aqua regia on a hot plate for 3hrs at 110 ˚C. after evaporation to near dryness the sample was diluted with 20 ml of 2 % (v/v. with H_2O) nitric acid was transferred into a 100ml volumetric flask after filtration through whatman no. 42 paper and diluted to 100 ml.

3.4.1 Soil Digestion

The soil sample was collected from Panshakara into 100 ml beaker followed by addition of 30 ml of hyrdofluoric acid using hot plat at 150 ˚C for 30 minutes until the fume be colourless the residue was allowed to cooled and filtered through no 1 Whatman filter paper into 100 ml volumetric flask and make to mark with distilled water, the extract were taken for analysis of heavy metal using Atomic Absorption Spectrophotometer. (Sanisa, 1994).

3.5 Element of Interest

Iron, lead, chromium and cadmium

CHAPTER FOUR

4.0RESULTS

Table 4.1 Concentrations of Heavy Metals in Tomato Grown in Panshakara Challawa Industrial Area

Heavy Metals	Concentration (ppm)
Chromium	0.0477
Cadmium	0.0036
Lead	0.1699
Iron	0.0069

Table 4.2 Concentrations of Heavy Metals in Soil

Heavy Metals	Concentration (ppm)
Chromium	0.2000
Cadmium	0.2324
Lead	0.0064

Iron	0.0560

Table 4.3 Federal Environmental Protection Agency F.E.P.A (Mg/L)

Heavy Metal	Federal Environmental Protection Agency F.E.P.A ((Mg/L)
Chromium	1.3
Cadmium	0.2
Lead	0.3
Iron	425.0

CHAPTER FIVE

5.0 DISCUSSION CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

The main values of cadmium, chromium, lead and iron concentration in tomato fruits are given in Table 4.1. the determination of heavy metal in these samples are quite variable such as Cd 0.0036, Cr 0.0477ppm, Pb 0.1699ppm and 0.0036 ppm, similar study quite lower Fe values were measured in tomato fruit obtained from different market of kano state Nigeria. Although ﴾ Akan et al,. 2009﴿ observed higher Cd, Cr and Cu values than the tomato sample in river challawa kano coast, Nigeria. In this study the higher level of Cr in the brook coast could be the result of many leather firms near the area, which discharge their waste in to the brook, their iron values were higher 0.3 mg/l than the value obtained 0.0069 ppm. Although this shows that the concentration of Pb was observed to be 0.1699 mg/l higher than some previous studies of concentration of lead in tomato fruit grown in different site is higher 0.1699 ppm than the permissible limit 0.3 of federal environmental protection agency Fe due to application of fertilizer and insectide.

5.2 Conclusion

The study carried out on determination of heavy metal in soil and tomato grown in panshakarah challawa industrial area of kano state of Nigeria shows that the concentration of heavy metal are found to be higher and in some cases lower. the concentration of heavy metal are given as Cd 0.0036ppm, Cr 0.0477ppm, Pb 0.1699ppm and Fe 0.0069ppm which shows that they are within the permissible limits Cd 0.2, Cr 1.3, Pb 0.3 and Fe 425.0. and can be consumed.

Recommendations

This result as mentioned shows that vegetable grown in open land have more heavy metals than the vegetables grown in the nurseries, it is obvious that air bore pollution is reduce to the minimal level in closed areas and affects the plant positively, in accordance to the result
obtained, there are some issues recommended before growing vegetable.

i. I recommend that further studies should be carried out on determination of heavy metal in soil, tomatoes and other rivers.
ii. I recommend less usage of fertilizer and pesticides.
iii. I recommend that waste product should be treated before disposing it to the river or lake.

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