

DETERMINATION OF MANGANESE, LEAD, CHROMIUM AND ZINC IN SOME VEGETABLES FROM `YARRUTU IRRIGATION AREA OF DAWAKIN TOFA LOCAL GOVERNMENT AREA, KANO

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ABSTRACT

Some elemental composition in Pepper, Roselle, Spinach and Tomato from `Yarrutu irrigation area of Dawakin- tofa Local Government of Kano State was investigated. The results obtained showed that the mean [Zn] is $2.57 \pm 0.09\text{mg/dm}^3$, [Mn] $0.49 \pm 0.16\text{mg/dm}^3$, [Cr] $1.76 \pm 0.33\text{mg/dm}^3$ and [Pb] $0.79 \pm 0.15\text{mg/dm}^3$. The mean concentrations of Mn and Zn were within the acceptable limits of 0.5mg/dm^3 and 5.0mg/dm^3 respectively while the mean concentrations acceptable of Pb and Cr were above the permissible limits of 0.05mg/dm^3 and 0.05mg/dm^3 respectively set by United States Environmental Protection Agency (USEPA). The moisture contents of all the samples were determined, with Tomato having the highest mean moisture content of 90.97% and Pepper with lowest value of 61.99%.

KEYWORDS: Yarrutu, Concentration, Elements, Vegetables.

INTRODUCTION

The concentration of elements in the air, water and land may increase beyond their natural levels due to agricultural, domestic and industrial effluents (Oboh and Edema, 2007). Heavy metals enter the human body through inhalation and ingestion, the latter being the main route of exposure to these elements in human population. Vegetables constitute essential diet components by contributing proteins, vitamins, iron, calcium and other nutrients which are usually in short supply. They also contain both essential and toxic elements over a wide range of concentrations. Metals in vegetables may pose a direct threat to human health. Vegetables take up elements by absorbing them from contaminated soils and waste water used for irrigating the vegetables as well as from deposits on different parts of the vegetables exposed to the air from polluted environment (Funtua, *et al.* 2008).

Regular high consumption of fruits and vegetables is recommended as part of healthy eating. Epidemiological studies have shown that high intake of lycopene-containing vegetables is inversely associated with the incidence of certain type of cancer, for example habitual intake of tomato products has been inversely associated with the risk of cancer of the digestive tract among Italians (Njoku, 2008). The aims of this research are to assess and compare the same metal content of some vegetables that are irrigated at `Yarrutu irrigation area in Dawakin-tofa Local Government of Kano State. This analysis will reveal the metal content of these vegetables and as such, their consumers will either be encouraged or discouraged from consuming them. Researchers working in the related field will be informed so as to further exploit them to solve the nutritional and health problems of the populace.

MATERIALS AND METHODS

In the preparation of reagents, chemicals of analytical grade purity and distilled water were used. All glasswares were washed with detergent and rinsed with water before drying in the oven at 105°C , for 2 hours.

Sample Collection and Preparation

Forty eight samples of vegetables (viz: Pepper, Roselle, Spinach and Tomato) collected from `Yarrutu irrigation area in Dawakin tofa Local Government of Kano State were investigated. All the samples were washed with water to remove any adhered materials and soil and stored in polythene bags for analysis. The vegetable samples were cut into small pieces with plastic knife, dried at 105°C for 2 hours in an oven and were pounded in a mortar and pestle until a powder was produced which was stored in airtight plastic container before analysis. All samples were analyzed in triplicate and mean values reported.

Procedure

1.0g portion each of the ground vegetable samples was weighed into a 250cm^3 beaker and 10cm^3 of a mixture of HNO_3 and HCl (1:3) was added. The mixture was digested on a hot plate until the mixture dissolved in the solution was obtained, the beaker was cooled and the content was diluted with 20cm^3 distilled water, filtered and made up to 50cm^3 mark in a volumetric flask (Funtua, *et al.* 2008). Blank solution were prepared. The solutions were analysed for manganese, lead, zinc and chromium using ALPHA 4 model, Atomic Absorption Spectrophotometer (AAS). A calibration plot of absorbance against concentrations of each element under investigation was constructed and finally the concentration of each element was determined from the calibration curve by extrapolation.

RESULTS AND DISCUSSION

Moisture contents

The result obtained showed that water is the major constituent in vegetables sometimes constituting up to 95% of the total weight. The highest moisture content of 90.97% was found in

tomato and the least 61.99% was in pepper (Fig.1). Tomato > Spinach > Roselle > Pepper. High moisture content aids microbial activities and vegetables with least moisture content are easier to preserve (Kurawa, 2004).

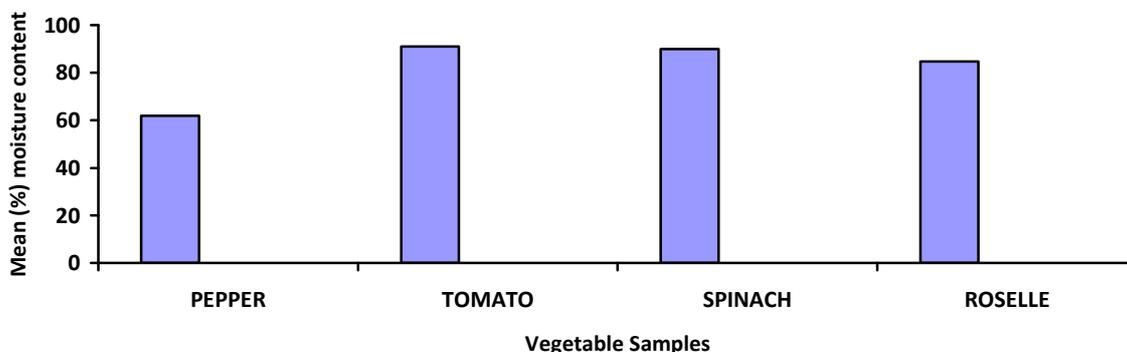


Fig. 1 Mean percent (%) moisture content of the samples analysed.

Chromium (Cr)

The frequency distribution pattern for chromium in the samples analysed is as shown in Fig. 2. This shows the scenario of the metal in the area, with mean concentration and standard deviation of $1.76 \pm 0.33\text{mg/dm}^3$. Its high concentration could be attributed to increased dumping of waste in the area. This is in comparison with Agumadu (2009) findings, that chromium and its

salts used in industries have affected water quality.

The concentration and standard deviation of chromium in Pepper from `Yarrutu sample area is $1.30 \pm 0.87\text{mg/dm}^3$, Roselle has a concentration of $1.62 \pm 0.11\text{mg/dm}^3$, Tomato with a concentration of $2.03 \pm 0.15\text{mg/dm}^3$ and Spinach with the highest concentration of $2.11 \pm 0.20\text{mg/dm}^3$ respectively.

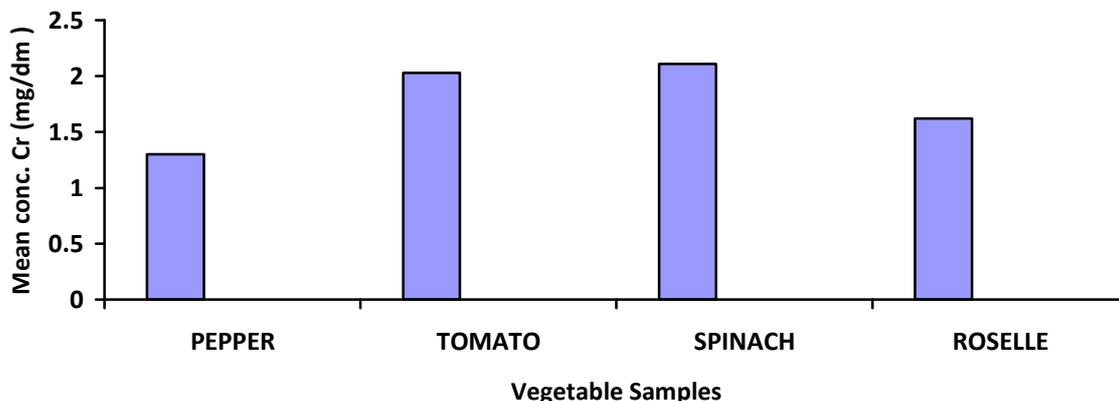


Fig. 2 Mean concentrations of chromium (mg/dm³) in the samples analysed.

The mean chromium concentration displayed may be due to dumping of waste, as well as the use of chromium and its compounds in the manufacture of fungicides, paints, pigments and tanneries. The occurrence of chromium in soil is often the result of human activities, also noted that the use of chromium salts in the manufacture of catalysts, ceramics and

chromium metal production has aided the distribution of chromium USEPA (1987).

Manganese (Mn)

The frequency distribution pattern for manganese in the samples analysed is shown in Fig. 3. The mean concentration and standard deviation of the metal is $0.49 \pm 0.16\text{mg/dm}^3$.

This may be attributed to the fact that manganese occurs together with iron naturally, this is in agreement with WHO (1999) report. The concentration and standard deviation of manganese in Tomato from `Yarrutu sample area is $0.20 \pm 0.04\text{mg/dm}^3$, a concentration of $0.30 \pm$

0.18mg/dm^3 was obtained in Roselle, with Spinach having a concentration of $0.33 \pm 0.10\text{mg/dm}^3$ and Pepper has the highest concentration of $1.13 \pm 0.34\text{mg/dm}^3$ respectively.

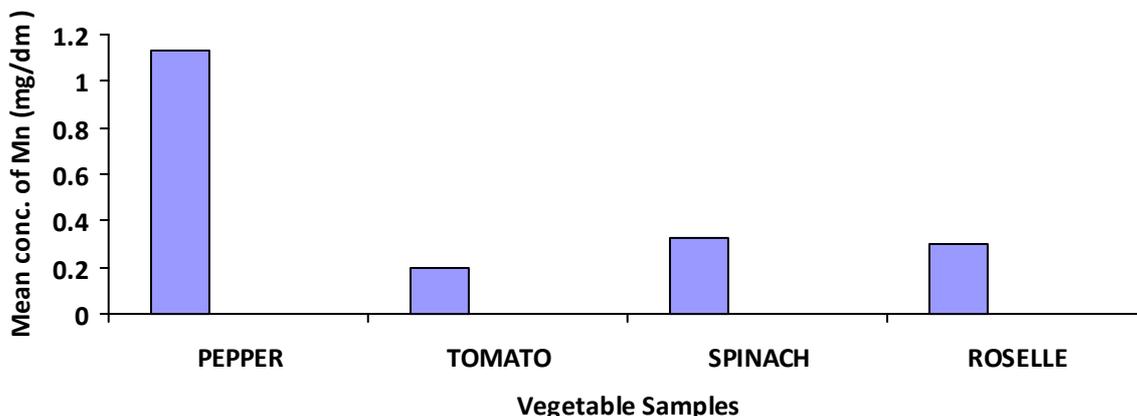


Fig. 3 Mean concentrations of manganese (mg/dm^3) in the samples analysed.

The observed distribution pattern in all these areas may be due to the soil formation of the area. The maximum permissible limit of manganese is 0.5mg/dm^3 (WHO, 1999). Its ability to absorb onto soil to an appreciable extent depends on the organic content of the soil as stated by United State Department of Health and Human Services (Agumadu, 2009).

metal is $0.79 \pm 0.15\text{mg/dm}^3$. This may be due to the presence of high concentration of lead which usually occurs in the surface soil at depths of 1-5cm, this is in line with Agumadu (2009). The concentration and standard deviation of lead in Spinach from `Yarrutu sample area showed a concentration of $0.5 \pm 0.02\text{mg/dm}^3$, Tomato has a concentration of $0.75 \pm 0.16\text{mg/dm}^3$, a concentration of $0.89 \pm 0.21\text{mg/dm}^3$ was observed in Pepper and the highest concentration of $1.05 \pm 0.22\text{mg/dm}^3$ was obtained in Roselle respectively.

Lead (Pb)

The frequency distribution pattern for lead in the samples analysed is as shown in Fig. 4. The mean concentration and standard deviation of the

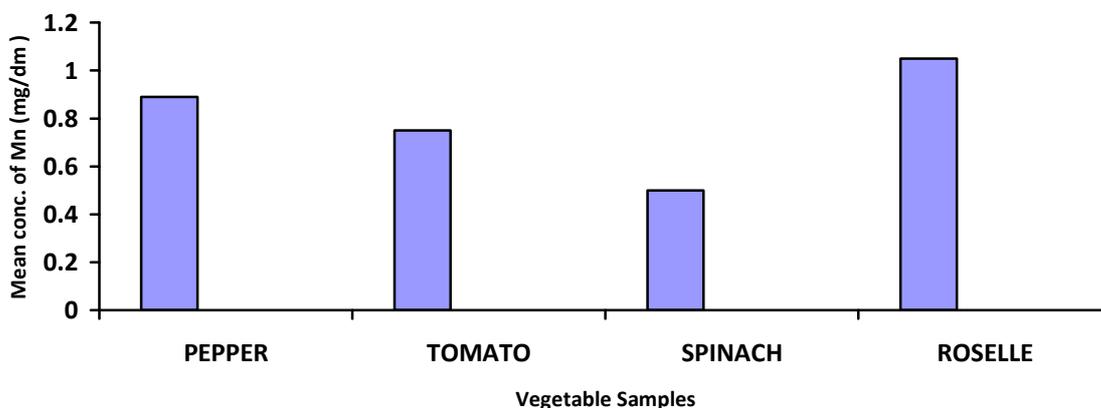


Fig. 4 Mean concentrations of lead (mg/dm^3) in the samples analysed.

The observed distribution pattern in all these areas may be due to wide distribution of lead in the earth`s crust; the frequent use of lead acid

batteries, solder, rust inhibitors and plastic stabilizers (Ayodele and Ahmed, 1996).

Zinc (Zn)

The frequency distribution pattern for zinc in the samples analysed is as shown in Fig. 5. This shows the scenario of the metal in the areas with mean concentration and standard deviation of $2.57 \pm 0.09\text{mg/dm}^3$. Zinc is an essential element

in all living organisms and many enzymes including aldolases, pepsidases and others contain zinc (Agumadu, 2009). This shows zinc concentration is below the maximum permissible limit of 5mg/dm^3 set by WHO (2003).

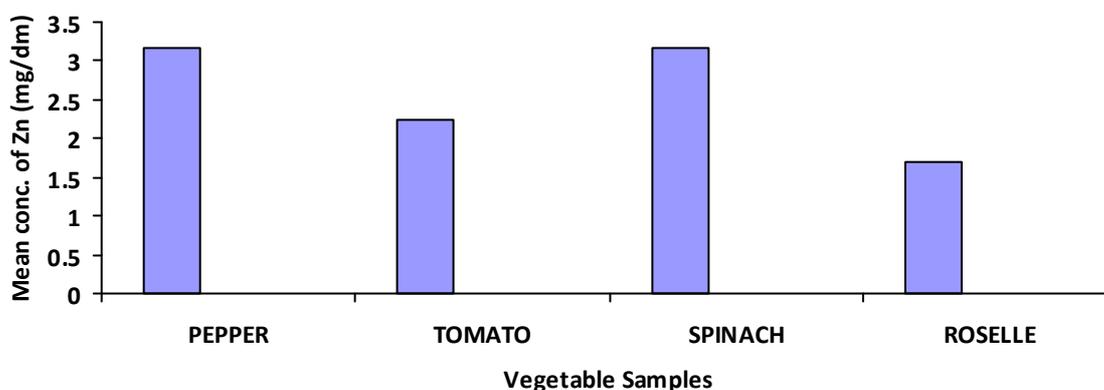


Fig. 5 Mean concentrations of zinc (mg/dm^3) in the samples analysed.

The concentration and standard deviation of zinc in Roselle from Yarrutu sample area is $1.70 \pm 0.11\text{mg/dm}^3$, Tomato has a concentration of $2.25 \pm 0.14\text{mg/dm}^3$, while Pepper and Spinach have concentration of $3.16 \pm 0.06\text{mg/dm}^3$ respectively.

General Discussions

The mean chromium concentration of $1.76 \pm 0.33\text{mg/dm}^3$ from all the samples analysed exceed the maximum permissible limit of 0.05mg/dm^3 set by WHO (2003). The result is in agreement with the report of Godwin (2005). Chromium and its compound are known to cause cancer of the lung, nasal cavity and suspected to cause cancer of stomach and larynx (Hueper and Finch, 1982).

The principal vehicle for the transport of lead from the intestine to the various body tissues is the red blood cell in which lead is bound primarily to haemoglobin (Moore, 1988). The displayed mean concentration of $0.79 \pm 0.15\text{mg/dm}^3$ found for lead from the samples analysed was much higher than the tolerable limit value of 0.05mg/dm^3 reported by WHO (1999). Acute lead poisoning in man causes severe disfunction in the kidney, reproductive system, liver, the brain and central nervous system (Bhatia, 2006). Lead poisoning from environmental exposure may cause mental retardation in children, while mild lead poisoning causes anaemia (Bhatia, 2006).

Zinc is an essential element in all living organisms and many enzymes which are involved in a number of physiological functions such as

protein synthesis and energy metabolism (Sale, 1990). Exposure to zinc fumes lead to neusea, irritation of eyes, nose and throat, pains in the chest with coughing, further inhalation also causes severe headache and vomiting (Sale, 1990). The mean zinc concentration of $2.57 \pm 0.09\text{mg/dm}^3$ from all the samples analysed is within the maximum permissible limit of 5.00mg/dm^3 set by WHO (2003). This is also in line with the results reported by Alinnor (2008) report.

Manganese is an essential element for many living organisms including humans (Ibrahim, 2008). The mean manganese concentration of $0.49 \pm 0.16\text{mg/dm}^3$ from the samples analysed was within the maximum permissible limit of 0.50mg/dm^3 set by WHO (1999). Manganese deficiency in animals exhibits impaired growth, skeletal abnormalities, reproductive deficits, ataxia of the new born and defects in lipid and carbohydrate metabolism (USEPA, 1984).

CONCLUSION

The analyses of the different types of vegetables showed that the concentrations of Mn and Zn are within the tolerable limits while that of Pb, and Cr were above the permissible limits set by USEPA (1984), this variation may be due to climatic conditions, soil fertility, maturity of the vegetables, the time they were harvested and the genetic control of the soil contents in which these vegetables were developed. All these are factors which contribute in the variation of the concentrations of the elements present in the vegetables.

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