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Seasonal Variation in Trace Minerals Content (Zn, Cd, As, Pb, Mn, Cr) of Irrigation Water, Soil and Vegetables along Shagari Quarters Irrigation Site of Kano State

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Abstract This work involves studying the variations of trace mineral contents (Zn, Cd, As, Pb, Mn and Cr) of irrigation water, soil and vegetables at *shagari* quarters irrigation site of Kano State of Nigeria between the months of June to December 2020. The irrigation water, Soil and vegetables samples were collected from *shagari* quarters irrigation site and analyzed using Standard analytical methods. The result of the analysis revealed that the concentrations *(ppm)* of the minerals ranged from Zn (0.71 to 1.75 for sample 5 to sample 2), Cd (0.00 to 0.003 for samples 3, 4, 5, 6, 7, 8 and to 2), As (0.00 to 0.48 for samples 6, 7, 8 and 9 to 2), Pb (0.00 to 0.008 for samples 3, 4, 5, 6, 7, 8 and to 1 and 2), Mn (0.11 to 1.50 for sample 4 to 2) and Cr (0.05 to 0.34 for sample 4 to 5 and 9). The minerals analysed are within the specification set by National Agency for Foods, Drugs Administration and Control (NAFDAC) and as such the *Shagari* quarters irrigation site as at June to December 2022 is not polluted and the crops are safe for human consumption. However, continuous monitoring is required.

Keywords Trace Minerals Content, Irrigation Water, Soil, Vegetables

Introduction

The problem of environmental pollution due to toxic metals is now a concern in most major metropolitan cities. The toxic heavy metals entering the ecosystem may lead to geo-accumulation and bio-accumulation [1]. The use of water from non-conventional resources like polluted water of industrial and household discharge is a common practice in most African countries that are facing the problem of water shortage [2]. This uncontrolled irrigation of crops with sewage water leads to the accumulation of some potentially toxic metals in agricultural soil and have very adverse effects on the growth of the plants [3]. It is now a common practice in many parts of Nigeria to use municipal sewage water that contain both industrial effluents and domestic liquid waste for irrigation purpose [4].

The study is aimed at studying the trace the mineral content of irrigation water, soil and crops along Shagari Quarters irrigation site of Kano State, Nigeria between the months of June to December 2020.

Materials and Methods

Materials

The following materials were use in this research; Weighing balance, Muffle furnace, Crucibles, Desiccators, Mortar and pestle, Atomic Absorption Spectrophotometer.

Sample Collection

The sample were collected and coded appropriately as: Sand (top most layer = sample 1), Sand (lower level = sample 2), Onions bulbs (sample 3), Carrots bulbs (sample 4), moringa roots (sample 5), cabbage bulbs (sample 6), Spinach (sample 7), lettuce roots (sample 8) and irrigation water (sample 9).

Sample Preparation

The samples collected were air dried in the oven for 2-3 hours at 100.00°C, after that, they were grinded in a mortar and then filtered to get the sample in powdered form. The irrigated water sample was evaporated dryness. A clean crucible containing 5.00 g of the sample each were weighed into an empty dish and placed into the furnace with a temperature of 550.00°C for eight hours, until a white ash result was observed, the samples were removed and cooled in the desiccator. The samples were removed and cooled in the desiccators. 0.1N HNO_3 was prepared and 50.00 ml was used to dissolve the ash and then were taken for mineral analysis using Atomic Absorption Spectrophotometer (AAS). The digested samples were then taken to Atomic Absorption Spectrometer (AAS) for absorbances and the concentrations of the metals read from standard calibration curves [5-8].

Results and Discussions

Table 1: The concentrations of heavy metals in the samples

	Zn (ppm)	Cd (ppm)	As (ppm)	Pb (ppm)	Mn (ppm)	Cr (ppm)
Sample 1	1.69±0.01	0.002±0.01	0.39±0.01	0.08±0.01	1.39±0.01	0.34±0.01
Sample 2	1.75±0.02	0.003±0.02	0.48±0.02	0.08±0.02	1.50±0.02	0.37±0.02
Sample 3	1.39±0.03	0.00±0.00	0.10±0.03	0.00±0.00	0.30±0.03	0.13±0.03
Sample 4	0.81±0.04	0.00±0.04	0.25±0.04	0.00±0.00	0.11±0.04	0.11±0.04
Sample 5	0.71±0.05	0.00±0.00	0.05±0.05	0.00±0.00	0.26±0.05	0.05±0.05
Sample 6	0.97±0.06	0.001±0.06	0.00±0.06	0.00±0.00	0.37±0.06	0.09±0.06
Sample 7	1.36±0.07	0.00±0.07	0.00±0.00	0.00±0.00	0.30±0.07	0.06±0.07
Sample 8	0.98±0.08	0.00±0.00	0.00±0.00	0.00±0.00	0.30±0.08	0.06±0.08
Sample 9	0.76±0.09	0.00±0.00	0.00±0.00	0.00±0.00	0.24±0.09	0.05 ±0.09

Heavy metals are known as major culprit in some diseased conditions when consumed, inhaled or ingested into the human system [9]. They are known to be toxic to the blood system, kidney and liver. Therefore, they are called toxicants in food system. Plants grown around areas where you have industrial waste have been shown to contain these elements in quantities more than the tolerable. The work involves monitoring the levels of selected minerals in soils, spinach, onions, moringa roots, cabbage bulbs, lettuce and irrigation water in the study area for wet season. Zn is a well-known micro element needed for enzyme stimulation and also transport mechanism intracellular, intravascular and for hormonal synthesis and stimulation so it is normally been sourced by man as supplement because they cannot be easily obtained from food in the required quantity [4]. Therefore, the presence of Zn in the samples is an advantage because of its physiological importance. The level of Zn ranges from 1.69±0.01, 1.75±0.02, 1.39±0.03, 0.81±0.04, 0.71±0.05, 0.97±0.06, 1.36±0.07, 0.98±0.08, 0.76±0.09 was revealed for sample 1-9 respectively. Cd was only found in sample 1 and 2 at a concentration 0.02±0.01 and 0.03±0.02 ppm respectively while other samples, cadmium was not detected. As is present only in sample 1, 2 ,3, 4 and 5 in the concentration of 0.39±0.01, 0.48±0.02, 0.25±0.03, 0.10±0.04, 0.05±0.05 ppm respectively, while other samples do not contain Arsenic. Pb was found in the concentration 0.08±0.01 ppm in both samples 1and 2 and absent in other samples. Mn was found in all the samples though present in larger amount in sample 1 and 2 compared to the others. Cr is also present in all the samples with a significant amount in samples 1 and 2 (0.34±0.01, 0.37±0.02) respectively the amount found in the other samples are as follows, Sample 3 (0.11±0.03 ppm) Sample 4 (0.13±0.04 ppm) Sample 5 (0.03±0.05 ppm) Sample 6(0.09±0.06 ppm) Sample 7 (0.06±0.07 ppm) Sample 8 (0.06±0.08 ppm) Sample 9 (0.05±0.09 ppm).

Cd is a known heavy metal of serious concern the principal toxic of cadmium is his toxicity to the kidney, all though it has been associated with lungs damage, induction of lung tumours. It is principally absorbed into the body, it doesn't get into the body but when absorbed it is slowly excreted like other metals and accumulate in the kidney causing renal damages [10]. Therefore, the kidney of animal is a major source of getting Cd in the diet, moreover only the sand samples showed traces of cadmium. All other samples did not show any trace of cadmium, these is an indication that the environment is not a polluted environment, because the maximum amount of cadmium permissible in meat is 0.05 ppm which is far less than the 0.02 ppm for the sand sample.

As is also a toxicant of concern majorly found in aquatic organisms, they are potent carcinogen responsible for cancer of different sites when expose to heat either at work, in the environment and through the diet [11]. As is also more acutely toxic than other metallic compounds that is been used as rodenticides, continuous exposure to it led to skin, vascular and nervous system disorder, the presence of arsenic in sample1, 2, 3, 4 and 5 calls for concern which is the sand and the grass sample, naturally the grass is not been consumed directly by humans but by cattle. Therefore, the possibility of it affecting the human population maybe through consumption of kidneys of cattles raised in that area [12-14].

Pb is also a potent compound, the effect has been noted even on the short term responsible for damage to the brain, paralysis (Pb palsy) anemia, gastrointestinal symptoms, long term exposure can cause damage to the kidney, the reproductive immune and the nervous system. The result from the study revealed only the sand sample contains Pb which could still be tolerated to 0.1 ppm in fruits and vegetables, 0.02 ppm in cereals, legumes and pulses (toxicology fact sheet series). The sand in this study, which is the only sample containing Pb had a concentration of 0.08 ppm which is far below the worrisome level. This indicates that the sites where the samples are sourced from its relatively safe of Pb toxicity [12-15].

Mn is an important micro elements which is required as a divalent metal in minimum many biochemical cellular reactions, in the real sense of its chemistry and availability in the living system ,it is not considered a toxic metal to biological systems, though it is needed in very small quantities and supplied and supplied majorly through supplement therefore the presence ,manganese in all our samples, though present more in the sand samples is a plus rather than a disadvantage that the mineral can be obtained for both cattle and human who consume the plants source from site [15-16].

Cr also is an important micro element needed in the body for pigmentation and blood formation, it is also used as co-factors in many biochemical reactions in the body. It is also a known anti diabetic and sugar metabolizing mineral element, therefore it presence in all the samples in an appropriate quantity is an indication of the variety of the site, where the samples resolves. Generally, the sites could not be counted or refer to as a polluted because the presence when found of heavy metals in minimal and within tolerable limits and the presence of the beneficial micro elements like Zn, Mn, Cr in appropriate quantity [12-14].

Conclusion

Conclusively, from the results obtained, the samples are not polluted when the values obtained are compared to specifications set by NAFDAC and as such safe for human consumption within the period under study.

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