Sub-Sahara African Academic Research Publications
September, 2020, Editions

JPAS
Journal of Pure and Applied Science
Vol..16, No.9, ISSN 2318-9315

SEASONAL VARIATION OF THE LEVELS OF SOME HEAVY METALS IN KOFAR MARUSA IRRIGATION WATER

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ABSTRACT
Seasonal variations of the levels of Cd, Cr, Cu, Fe and Pb in KofarMarusa irrigation water were studied over one year period. Water samples were taken at different points of the irrigation area mixed and homogenized and then digested and analyzed using AAS for the presence of the metals on quarterly basis. Results obtained showed that Cd and Cu were totally absent throughout the study period while Cr, Fe and Pb were present at levels that varied seasonally. Pb levels were found to exceed the NSDWQ and WHO standards significantly. It was concluded that consumption of the vegetables grown with the water would pose serious health hazards. It was then recommended among others that more researches are needed on the irrigation water as well as the vegetables grown with it for the presence of other heavy metals especially the toxic ones and the metals levels should be monitored on continuous basis.

Keywords: *Seasonal variation, Heavy metals, Irrigation Water, Vegetables, Kofar Marusa*

INTRODUCTION
While the demand for fresh and clean water for Consumption increases on one hand, the use of municipal and industrial wastewater in agricultural sector on the other hand is becoming a common Practice in many parts of

the world (Singh, Mohon, Singh and Dalwani, 2004).It has been estimated that at least twenty million hectares of land are irrigated in 50 countries worldwide using raw or partially treated wastewater and this is bound to increase markedly during the next few decades with increasing intensity in water demands (Hussein, Raschid, Hanyara, Marikar and Van der Heek, 2001; Scott, Faruqui and Raschid-Sally, 2004; Hamilton, Stagnitti, Xiong, Kreidl, Benke and Maher, 2007). The use of untreated or partially treated waste water for agriculture in irrigation systems is more frequent and Severe in arid and Semi-arid regions and metropolitan centres where unpolluted water is a scarce commodity while waste water containing large quantities of plant nutrients is markedly available and serves as an important drought-resistant resource for farmers (WHO, 2006).

Waste water from the municipal or industrial settings contains different heavy metals at different concentrations. Plants have the natural tendency to absorb metals some of which are essential plant nutrients such as Mn, Fe, Zn and Co while few others like Hg, Cd, Ni and Pb are toxic to plants (Chen, Wang and Wang, 2005). Irrigation with wastewater contributes Significantly to the heavy metal content of soil (Olaitan, Kenneth, Elijah, Mestura, Kasim and Daodu, 2013). Untreated wastewater may as well contain a wide range of pathogenic organisms including bacteria, Parasites, Viruses, toxic chemicals from agriculture, industry and domestic sources (Amoah, Drechsel and Abaidoonn, 2010).

Heavy metals are toxic and thus very harmful due to their non-biodegradable nature, long biological half-lives and their tendencies to accumulative in different body organs (Olaitan*et. al.,* 2013).

Wastewater containing substantial amounts of the above-stated contaminants (Heavy metals and Pathogens) causes problems to human health culminating from Soil contamination to food poisoning (Chen Wang and Wang, 2005; Singh, Mohan, Sinha and Dalwani, 2004; Muchuweti, Birkett, Chinyanga, Zvauya, Scrimshaw and Lester, 2006).

Toxic heavy metals such as lead, mercury, cadmium, Nickel, chromium and other toxic chemicals like phenolic compounds discharged from domestic sewage and pharmaceutical, textile, petrochemical and other industries also affects surface and ground water quality (Foess and Ericson, 1980).

Heavy metals are natural components of the environment and are released into Soil and water environment through natural processes such as weathering erosion textile printing, municipal sewage and Volcanic activity. Anthropogenic activities such as mining, smelting, electroplating, pesticide and fertilizer applications also provide a good sourceof heavy metals in the environment (Modaihsh, Al-suwailem, Malijoub, 2004; Sabiha-Javied, Mehmood, Chaudhry, Tufai, Irfan, 2009).

The possibility of sewage irrigated vegetables to be contaminated with metals, toxic chemicals and pathogens can not be ignored. Thus, this research intends to investigate the level of heavy metal contamination and their seasonal variations in the sewage water used for irrigation at KofarMarusa irrigation site of Katsina town.

DESCRIPTION OF THE STUDY AREA:

KofarMarusa is a particular area in Katsina town, Katsina State. The area represent parts of the city, which is narrowed down and bounded by the streets/roads:Daura Road, Ibrahim Babangida way, Marusa Road, Nagogo Way and Rest House Road.

KofarMarusa irrigation area consists of sites along a water way that runs from KofarKaura through KofarMarusa, KofarDurbi to KofarSauri in the eastern and north-eastern parts of Katsina Metropolis. The waterway gets it supplies from various township water channels and sewage systems. Thus, a lot of irrigation activities take place along the waterway.

MATERIALS AND METHODS

Sample Collection and Pretreatment

The irrigation water sample was collected at three different points along the irrigation sites at KofarMarusa stream whose major supplies are drainages receiving wastewater from domestic Sewages. The samples were well mixed in a plastic bottle rinsed with small amount of Conc. HNO_3. Few drops of HNO_3 were then added and the sample was taken to Isa Kaita college of Education Chemistry laboratory and stored before digestion.

The sampling was done four times within the year corresponding to the following quarters:

1[st]Sampling => November 2017 – January 2018 (Early dry Season)
2[nd]Sampling => February 2018 April 2018 (Late dry Season)
3[rd]Sampling => May 2018 - July 2018 (Early wet Season)
4[th]Sampling => August 2018 – October 2018 (Late wet Season)

Sample Digestion and Metal Analysis

The water samples were digested using a standard procedure reported in a joint publication of the American Water Works Association, American Public Health Association and Water Environment Federation (AWWA/APHA/WEF, 2014).

To 50 cm^3aliqout of well mixed sample, 5 cm^3 of Conc. HNO_3 and a few boiling chips were added in a 125 cm^3 beaker. The mixture was heated on a hot plate until it boiled. Heating was continued while the mixture boils slowly until it was evaporated to about 20 cm^3. This was further heated with gradual addition of Conc. HNO_3 as necessary until digestion was complete as indicated by light coloured clear solution.

It was then removed, allowed to cool and then filtered with Whatman filter paper. The filtrate was then poured into a 100 cm^3 standard volumetric flask and made up to the mark with deionised distilled water. Portion of this solution was used for heavy metal analysis at ABU Zaria using Atomic Absorption Spectrophotometer AA280FF model of USA make.

RESULTS AND DISCUSSION

Results

Results obtained in this research are presented in Table 1.0

Table 1.0: Levels of some heavy metals in irrigation water of KofarMarusa

		Heavy Metal Levels (PPM)				
Sampling Period		Cd	Cr	Cu	Fe	Pb
1[st]:	Nov. 2017 – Jan 2018 (Early dry Season)	0.000	0.000	0.000	0.546	0.216
2[nd]:	Feb 2018 – Apr 2018 (Late dry Season)	0.000	0.000	0.000	0.557	0.122
3[rd]:	May 2018 – July 2018 (Early wet Season)	0.000	0.055	0.000	0.000	0.319

4th	Aug. 2018 – Oct. 2018					
	(Late wet Season)	0.000	0.036	0.000	0.000	0.065
	Mean	0.000	0.0023	0.000	0.276	0.181
	±Standard Deviation	0.000	0.0362	0.000	0.3185	0.111
	WHO MPL(For Drinking water)	0.003	0.05	1.20	0.300	0.01
	NSDWQ(Nigerian standard)	0.003	0.05	1.00	0.300	0.01

Key: WHO = World Health Organization,
MPL = Maximum Permissible Level
NSDWQ = National standard for Drinking water quality.

From the Table 1.0, it could be observed that with the exception of Cd and Cu, whose levels remained undetectable throughout, there were Variations in the level of the metals in the irrigation water as the seasons changes. For instance, Cr had its lowest level of 0.000ppm during the dry seasons which rose to 0.055ppm and 0.036ppm during the early and late wet seasons respectively.

Iron had its lowest level of 0.000ppm during the early and late wet seasons but had its highest level of 0.557ppm during the late dry season. This may not be unconnected with the fact that substantial amount of the water must have evaporated making the solution to be more concentrated.

However, Pb had been observed to be present in the irrigation water throughout the year with lowest level of 0.065ppm during late wet season and a highest level of 0.319ppm during the early wet season. This observation may be linked to inflow of Pb wastes from various car battery charging points in the town washed into the stream by rain. The concentration of Pb becomes less as more rain falls.

Thus, it could be concluded that the levels of the contaminants in the irrigation water is largely a function of both natural and anthropogenic activities (Romocea*et.al.,* 2018; Beketova*et.al,* 2019).

It was observed that the mean level of Pb (a toxic metal), 0.181±0.111 is by far greater than its NSDWQ and WHO standards. Since Pb is a highly toxic metal, the implication is that the irrigation water may contaminate the vegetables and that serious health hazards could be the outcome when such contaminated vegetables are eaten by humans as the recommended standards set by national and international water quality regulating bodies are exceeded (USEPA 2002; Olusola*et.al.,* 2017).

Lead toxicity is known to cause a variety of health problems such as dysfunction of Kidney, reproductive and cardiovascular systems, joints problems, lessening in hacmoglobin formation, and enduring impairments to the central and peripheral nervous systems (Ogwuegbu and Muhanga, 2005). Thus, it could be very dangerous to consume vegetables grown with this irrigation water.

CONCLUSION

From the results of this research in Table 1.0, it was concluded that Cd, and Cu were absent in the irrigation water throughout the study period while traces of Cr were detected only during the wet seasons. On the contrary, high levels of Fe were observed during the dry seasons but it had undetectable concentration during the rainy seasons. However, levels of Pb were observed throughout the year which were far above the NSDWQ and WHO guidelines. These high values of Pb concentrations were linked to inflow of battery changing wastes from the town carried into the irrigation water by rain and domestic sewage.

Due to high toxicity of Pb, it was finally concluded that the consumption of the vegetables grown with this irrigation water could be very dangerous.

RECOMMENDATIONS

Results obtained from this research led the following recommendations:

1. More researches should be carried out on other metals especially the toxic ones in the same irrigation water.
2. Heavy metal levels of vegetables grown using the same water should be determined and monitored continuously.
3. Heavy metal removal technology should be employed on the water before it is applied to the crops.
4. Lead detoxification therapy should be applied to the inhabitants of the area who might have taken excessive quantities of the crop fruits grown with the water.

5. Enlightenment campaigns are needed for the irrigation farmers to understand the dangers associated with the use of contaminated water for irrigation activities.

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