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Analysis of Na, K and Ca in Soil along the Bank of River Kaduna Nigeria

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ABSTRACT: *In this study X-ray fluorescence techniques was used to analyse the concentrations of Na, K and Ca in Soil along the bank of river Kaduna Nigeria. The mean concentrations of Na, K and Ca are 882.20 ± 37.60 mg/kg, 3736.0 ± 86.0 mg/kg and 562.40 ± 27.8mg/kg respectively. The concentration of Na is in range of 690 ± 31.0 to 1080 ± 40.0 mg/kg, for K the range is between 360.0 ± 80.0 to 4710.0 ± 100.0 mg/kg while that of Ca is between 531.0 ± 26.0 to 711.0 ± 35.0mg/kg. The concentrations of Na, K and Ca in this work compared favorably with other published work and are below tolerable limit.*

KEY WORDS: *Concentrations, XRF Analysis, Na, K and Ca.*

I. INTRODUCTION

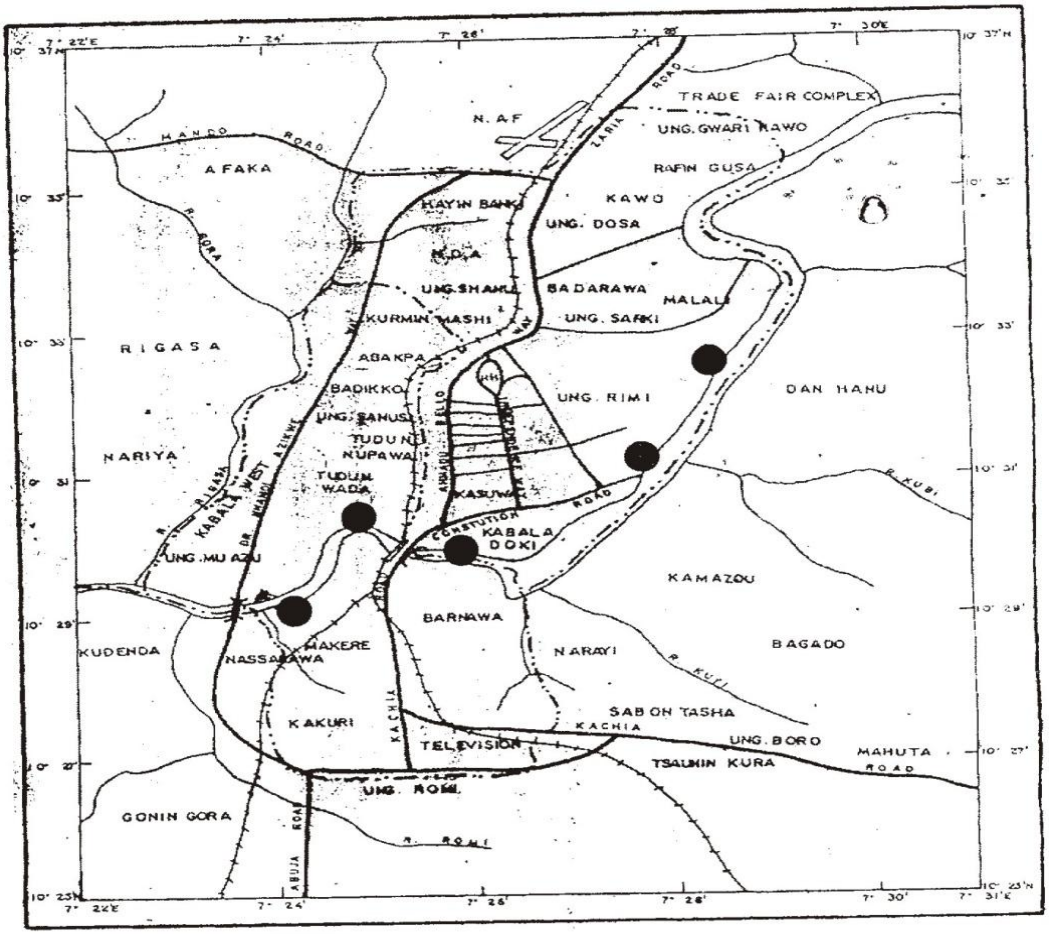
The environment contains abundance of man-made and naturally radio nuclides as well as polluting heavy metals. There accumulation and the inevitable impact on human is a matter for serious international concern. [1]. In many developing countries like Nigeria soil are affected by mine waste disposal acid deposition sewage sludge and other anthropogenic activities [2,3,4]. Moreover, many metal ions play dual roles in the human physiology some are essential for life, while most of them are toxic at elevated concentrations. Ions such as sodium, potassium, magnesium and calcium are essential to sustain life.

Additional metals such as manganese, iron, cobalt, copper, zinc, chromium, vanadium, selenium and molybdenum are also essential for optimal growth development and reproduction. These metals function mostly as catalysts for enzymatic activity in human bodies, but become, toxic when there concentration becomes excessive. Epidemiological occurrence to several disease in humans particularly diseases like kidney related disorder, neurocognitive effects and various forms of cancer. [5,6,7]. In this research work, the percentage concentration of Na Ka and Ca in soil samples obtained from the sampling locations of Kaduna Metropolis, Nigeria were determined using Energy Dispensive X-ray Flurescence (EDXRF) Spectrometer model minipal 4.

II. MATERIALS AND METHODS

Five (5) soil samples were collected at five (5) different locations along the bank of river Kaduna, Nigeria namely; Gamji Recreational Area (GRA), Kabala Costain (KC), Nasarawa (NS), Unguwan Rimi (UR) and Zango (Zg) as shown in figure -1, at 10cm depth using a mechanical digger. The 10cm depth was carefully chosen as the appropriate depth to obtain the samples in line with the facts established that these pollutants are highly absorbed to clayey materials and organic matters in the study areas.
The five (5) soil samples collected from the sampling locations were pretreated by oven drying them at a regulated temperature of 50^0c for 48 hours. After drying, a series of mesh size 35μm was used to remove large undesirable particle sizes.

The dry test samples were analyzed using the energy dispersive X-ray florescence (EDXRF) to determine the concentration of the metals (pollutant) in the soil samples.



LEGEND	
	Road
	Railway line
	Local governemnt boundary
	River Kaduna
	Sampling location

Fig 1: Map of kaduna metropolis showing the sampling locations

III. RESULT AND DISCUSSION

Soils samples obtained from the sampling location were analysed using energy dispersive X-Ray flurescence (EDXRF) techniques. The concentrations of the metals varied from one location to another.
Inferential statistics and one-way AVOVA were used to compare the concentration Nasarawa (NS), Unguwan Rimi (UR) and Zango (ZG) Sampling location of Kaduna metropolis. The mean percent weight of Na, K and Ca is given in Table -1. While the concentrations in mg/kg are given in Table – 2.

Table 1: percentage weight of Na, K and Ca

S/N	Location	%/weight		
		Na	K	Ca
1	GRA	0.690 ± 0.031	3.50 ± 0.08	0.587 ± 0.029
2	KC	1.08 ± 0.04	4.71 ± 0.10	0.711 ± 0.035
3	NS	0.823 ± 0.039	3.06 ± 0.08	0.424 ± 0.021
4	UR	0.768 ± 0.038	3.83 ± 0.09	0.559 ± 0.028
5	ZG	1.05 ± 0.04	3.58 ± 0.08	0.531 ± 0.026

Table 2: Concentration of Na, K and Ca in mg/kg

S/N	Location	mg/kg		
		Na	K	Ca
1	GRA	690 ± 31.0	3500 ± 80.0	587 ± 29.0
2	KC	1080 ± 40.0	4710 ± 100.0	711 ± 35.0
3	NS	823 ± 39.0	3060 ± 80.0	424 ± 21.0
4	UR	768 ± 38	3830 ± 90.0	559 ± 28.0
5	ZG	1050 ± 40.0	358 ± 80.0	531 ± 26.0
	Mean	882.20 ± 37.6	3736 ± 86.0	562.4 ± 27.8

Sodium (Na)

The result of the analysis revealed that KC and ZG had the highest enrichment if Na followed by NS, UR and GRA. The higher amount of Na in KC and ZG plays an antagonistic role to the uptake of K and Ca in the plants grown in there areas . Excess Na could damage the structure of natural soil to the point that water infiltration are prevented, and root growth is also restricted. As the size of Na^+ is smaller, rate of adsorption of Na on soil surface and substation are compacted [8,9,10]. The metal distribution in the various sampling location is give in figure 2.

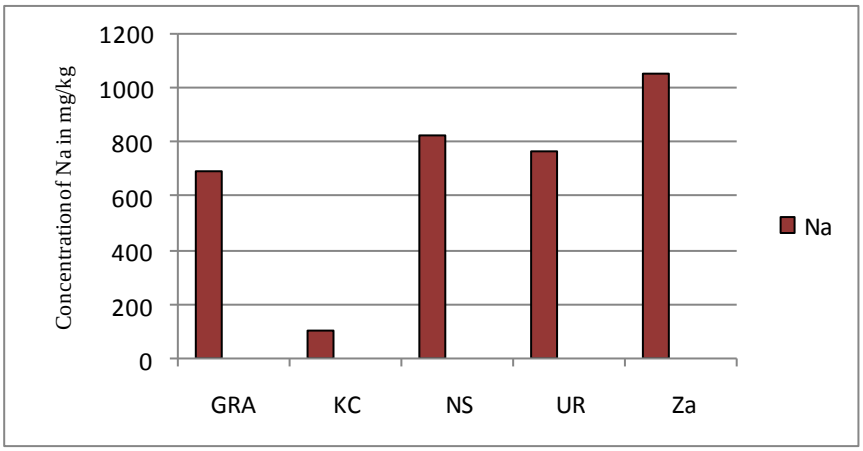
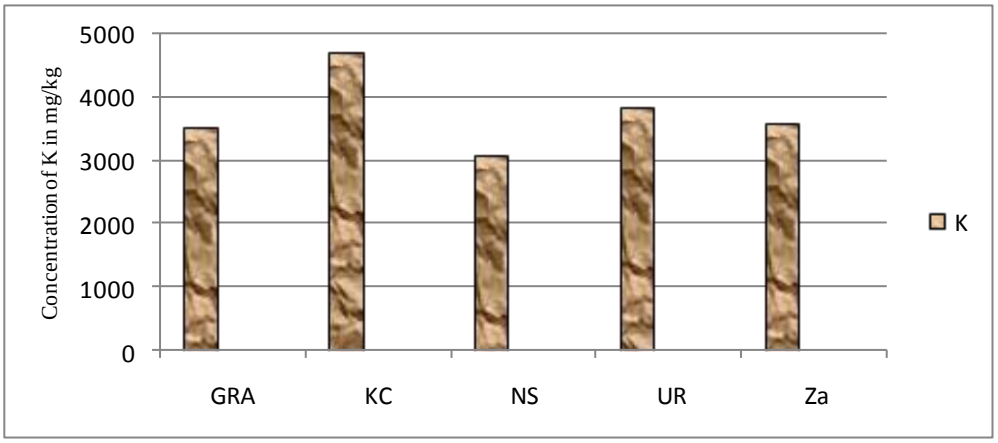


Fig. 2:, Plot of concentration of Na in mg/kg by location

Potassium (K)

The concentration of K was highest in KC and it follows the sequence; KC > UR>ZG>GRA>NS (Figure 3). The higher value of K in KC could be attribute to increased anthropogenic activities in this area which gave rise to the possibility of releasing hazardous chemicals and metals into the soils [11,12,13].



Calcium (Ca)

The concentration of Ca obtained from all the sampling locations showed that KC had the highest value and it followed the order KC>GRA>UR>ZG>NS (Figure 4) The sequence could be attributed to degree of anthropogenic activities from one sampling locations to another similarly, HCO_3 ions has higher tendency to precipitate Ca, as $(HCO_3)_2$ which result in low soil porosity and clogging air and water movement through soil [14,15,16,17].

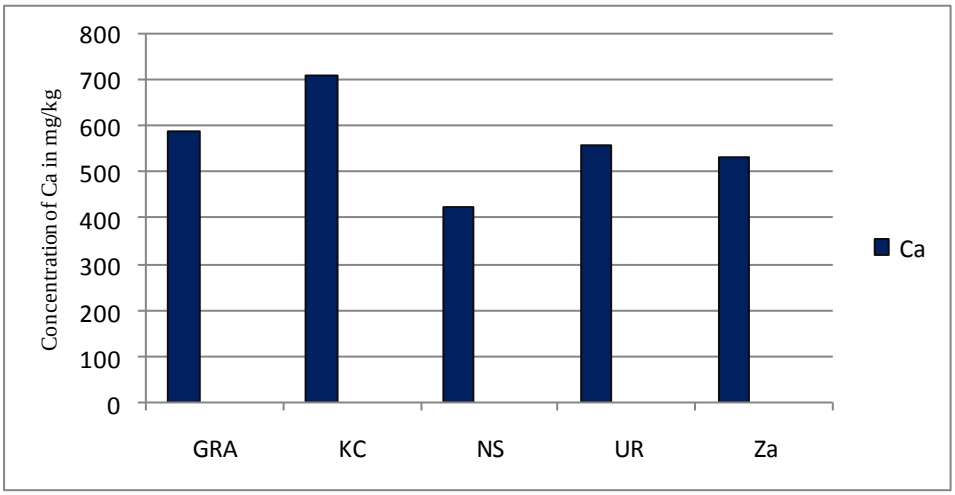


Fig.4:, Plot of concentration of Ca in mg/kg by location

In all the sampling locations K had the highest percentage followed by Na and Ca (Figure 5).The AVOVA indicated that there is no significant difference in the metals across concentrations. The AVOVA (0.000<0.05) also showed that there is a significant difference in the relative abundance of the various metals.Hence, some metals are more abundance than others in all the locations

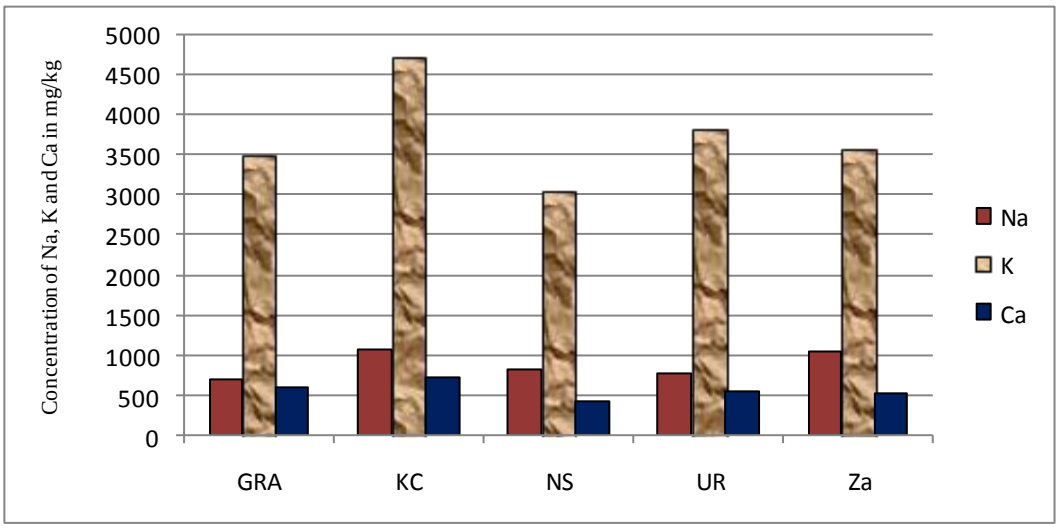


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Fig.5:, Plot of concentrations of Na, K and Ca in mg/kg by location

CONCLUSION

The concentration of Na, K and Ca in soil along the bank of river Kaduna Nigeria were investigated and the result showed that Na has a mean concentration of 882.20 ±37.40.0 mg/kg, in range between 768 ± 38.0 – 1080 ± 40.0 mg/kg , K has a mean concentration of 3736.0 ± 86.0 mg/kg with a range values of 3060 ± 80.0 – 4710.0 ± 100.00 mg/kg and Ca has a mean concentration 562.40 ± 27.80 mg/kg. The results obtained in this work compared well with other published works and the concentration of these metals are below the tolerable limit.

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