IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 18, Issue 12 Ser. 1 (December 2024), PP 06-10
www.iosrjournals.org

Measurement of Minor and Major Elements in Crops Samples at Jebel Mun area Western Sudan

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Abstract
A study was carried out on the concentrations of constituent (major, minor and trace) elements present in crops samples collected from different farmlands around Jebel Mun. The current study was designed to investigate the potential human health risks associated with the consumption of crops, by X-ray Fluorescence (XRF) spectroscopy was measured. The results showed that the maximum concentration of metals in crops samples in ppm determined were K(17484), Ca (3085), Ti (61.0),V (99.0), Mn (74.0), Co (32.0), Ni (3.00), Cu (1337) and Zn(237) .

Keywords: Minor and Major Elements in Crops Samples - Jebel M

Date of Submission: 01-12-2024 Date of Acceptance: 10-12-2024

I. Introduction

Minor and major metals are demanded by the body in good quantities for valid metabolism and Functions of body organs the trace elements have a beneficial or harmful impact on the animal plant, and human being depending upon the concentration (Hassaan, Nemr and Madkour , 2016). These metals include potassium, calcium, titanium, vanadium, manganese, cobalt, copper and zinc these metals are required by the body in trace amounts and are essential for preserving various body functions and metabolic activities. Metals such as nickel, cobalt, manganese, and vanadium are essential but toxic at higher levels. The concentrations of major and trace elements in the environment are very significant because they play a role in studying elemental compositions in bioenvironmental samples, plant uptake has a major pathway of food chain exposure by race elements in the soil (Olowoyo et al., 2012). The pollution of the natural environment caused by metals is an increasing worldwide problem however these metals are indestructible and many of them have a toxic impact on a living organism, especially when they have a high certain threshold (Omoniyi, Oludare, and Oluwaseyi, 2013). Therefore, some transition metals at trace levels in our metabolism are essential for proper health (O. Venkata, Subb Raju,2014). Mineral macronutrients are essential for plants in relatively high amounts when compared with other elements such as (N, P, K, Ca, Mg, Fe, and S) can be classified into primary and secondary categories, primary macronutrients micro-trace elements such as (B, N, P, Cl, Cu, Fe, Mn, and K) are often main components of fertilizers which are entered to the soil in different chemical forms (Pogrzeba, Rusinowski and Krzyżak, 2018; FAO, 2006) .Moreover, the micronutrients, involved Zn, Ni, Cu, Mo, and Mn, are essential for plant growth and development because they have the responsibility for a variety of cellular functions like energy metabolism, the regulation of gene expression, hormone synthesis (Dalcorso et al., 2014).

Samples preparation and analysis measurement

XRF techniques are characterized by simple sample preparation, mainly sample homogenization, and fast and multi-elemental analysis over a large concentration range from % to $mg.kg^{-1}$, which makes the procedure fast and cheap and therefore suitable for application to a large number of samples (Nečemer et al., 2008).

II. Results and Discussion

Potassium

Potassium is major element for humans and is absorbed primly from ingested food (WHO, 2008)**.** Potassium could result in significant health effects in people with kidney disease or other conditions, like heart-disease,coronary,artery-disease,hypertension,diabetes,adrenal insufficiency and pre-existing hyperkalemia (Rasheed., 2013)**.** The results showed

Potassium concentrated values ranged from 1045 to 17484 ppm. Observed all crops samples recorded high concentration of potassium, especially cajanus crops.

Calcium

Calcium is an essential element in human metabolism. It is the main element in the production of very strong bones and teeth in mammals(Duruibe,J.Ogwuegbu,M. O. Cegwurugwu, 2007) The concentration of calcium found to be 907.0 to 3085 ppm at Cajanus Cajan crop traditional name Adassia , in Aburymel farm site. This indicates that the Cajon plant which a comparatively high capacity for accumulating potassium and calcium.

Titanium

Titanium is the second abundant transition metal, after iron most Studies on biomass of crops have reported that plants transported titanium ion by root uptake, leaves absorption and seed absorption (Hussain *et al.*, 2019; Phothi and Theerakarunwong, 2020).The results from the literature in general propose that titanium has positive effects on plant growth and crop quality However, titanium is not an essential element for plant nutrition based on the criteria for essentiality (Lyu *et al.*, 2017). The result revealed concentration of titanium was ranged 3.00 to 61.0 ppm, study showed high concentration at vigan *lubiahen* crop.

Vanadium (V)

Vanadium is considered a minor pollutant that depends on its abundance the vanadium is readily reduced and mobilized by soil organic matter, under oxidizing conditions. (Ahmed, 2000; Langmuir et al., 2005). The results obtained showed a high concentration of vanadium was found to be 27.0 to 99.0 ppm at pennisetum traditional name dukhun.

Manganese

The Manganese has toxicity it can be found at approximately1000 ppm dependent on the temperature. Toxicity occurs most often at low temperatures and is generally associated with low pH (Baker et al., 2000). However, manganese has found a variety of uses in industry craft, and agriculture owing to their physical and chemical properties. Poisoning induced by a high concentration of these metals adversely influences on kidney, hematopoietic cells, nervous system, and bones (Ichiro Inoue, 2011). The measured concentrations of manganese were recorded between 10.0 to 74.0 ppm in the Sorghum crop.

Cobalt

Cobalt naturally occurs in the earth's crust as cobaltite [Co-AsS], erythrism [$Co_3(AsO_4)^2$], and smaltite [$CoAs_2$] (Yadav, 2010). Many researchers suggest that cobalt can be carcinogen animal laboratories suffer from cancer when exposed to breath air polluted with cobalt or feed on food polluted with cobalt (Abbas et al., 2018). The concentration of cobalt was obtained from 2.00 to 32.0 ppm, however high value was recorded for the cajanus cajan crop.

Nickel

Nickel is widely distributed in the environment, and can be found in air, water, and soil. Natural sources of atmospheric nickel involve dust from volcanic emissions, forest fires, and vegetation. and the weathering of rocks and soils (Duda, Chodak, 2008; Cempel and Nickel, 2006). The absorption of nickel by plants depends on the total amount of nickel present in the soil, the properties of the soil, soil pH, and the organic matter content (Rathor, Chopra,2014). The World Health Organization recommends a daily intake of nickel 10μg for humans, whereas excesses of nickel are both toxic, causing dermatitis and gastric irritation, and carcinogenic diseases (Völgyesi, 2015). The concentrations of Ni in the crops of the study area ranged from 2.00 to 3.00 ppm. High concentrations showed in sorghum and pennisetum crops.

Copper

Copper is an essential nutrient that plays key roles in photosynthesis, respiration, carbon and nitrogen metabolism, and protection against oxidative stress (Dalcorso et al., 2014). Therefore, excess intake of copper in humans can cause hemolysis and nephrotoxic effects. containable ingestion of copper from food may induce chronic copper poisoning in men (Olowoyo et al., 2012). The concentration of copper ranged from 1.00 to 1337 ppm high concentration at pennisetum crop.

Zinc

Zinc is an essential component of several enzymes in plants and its functions in plants are related to the metabolism of carbohydrates, proteins, and phosphates (Kopijyvä,2011). Approximately one hundred enzymes from all of the six enzyme kinds require Zn to perform their catalytic activity (Ozyigit et al., 2018). The concentration of zinc was found to be as 20.0 to 237 ppm in the Cajanus Cajan crop. Zinc was found highest values in cajanus cajan crops justification of the range in the soil environmental conditions, climate, and the soil moisture and root-feeding depth as well as the concentration of the element available for plant uptake in different layers of the soil. Comparative Sorghum and millet crops in the study with similar data in different regions and countries, such as Jebel Mara south Kordofan, and Kassala can be seen in Table 3.

Table 1: Major and minor elements in crops *in ppm*

S.NO	*Crops Type*	*Location*	*K*	*Ca*	*Ti*	*V*	*Mn*	*Co*	*Ni*	*Cu*	*Zn*
CR1	*Cajanus Cajan*	Aburymel	17484	3085	ND	ND	10.0	ND	ND	9.00	47.0
CR2	*Cajanus Cajan*	Aburymel	12289	1983	53.0	ND	10.0	32.0	ND	3.00	237
CR3	*Cajanus Cajan*	Mostareiha	6659	1089	ND	ND	ND	ND	ND	ND	64.0
CR4	Pennisetum	Jebel Mun	6500	907.0	ND	ND	30.0	ND	ND	ND	26.0
CR5	*Sorghum*	Falco	6028	1369	ND	ND	28.0	6.00	ND	1.00	53.0
CR6	Pennisetum	Beiby	3068	ND	ND	ND	32.0	ND	ND	1.00	42.0
CR7	*Sorghum*	Beiby	6011	2409	ND	ND	ND	ND	ND	ND	33.0
CR8	Pennisetum	Beiby	6622	ND	ND	ND	18.0	ND	ND	1337	48.0
CR9	Pennisetum	Komi	7584	ND	3.00	ND	63.0	ND	2.00	2.00	ND
CR10	*Sorghum a*	Deikrat	2268	ND	ND	37.0	64.0	ND	ND	ND	48.0
CR11	Pennisetum	Deikrat	8012	2413	ND	99.0	ND	2.00	ND	ND	39.0
CR12	*Vigan Lubiahen*	Manzola	8112	1078	61.0	27.0	39.0	ND	ND	ND	45.0
CR13	Pennisetum	Amara	9326	1613	ND	ND	19.0	ND	ND	6.00	ND
CR14	*Sorghum*	Falko	1045	2333	ND	53.0	74.0	ND	3.00	ND	126
CR15	*Sorghum*	Armoo	5400	1201	8.00	94.0	ND	ND	3.00	ND	20.0
CR16	Pennisetum	Frako	8252	1030	34.0	29.0	19.0	ND	ND	ND	52.0
CR17	*Sorghum*	Mostareiha	5989	1218	ND	ND	ND	ND	ND	8.00	36.0

ND: Not detection Limit.

Table 2: Summary statistical analysis of major, and trace element in crop samples

Summary statistics	K	Ca	Ti	V	Mn	Co	Ni	Cu	Zn
Minimum	1045	907.0	3.00	27.0	10.0	2.00	2.00	1.00	20.0
Maximum	17484	3085	61.0	99.0	74.0	32.0	3.00	1337	237
Average	7095	1671	31.8	56.5	33.8	13.3	2.67	170.9	61.0
S .Deviation	3763	697.4	25.9	32.4	21.9	16.3	0.58	471.2	54.3
Median	6622	1369	34.0	45.0	29.0	6.00	3.00	4.50	47.0

Table3: Comparison between trace, and major element concentrations (ppm) in sorghum and Millet from different parts of Sudan

Location	Crops type	K	Ca	V	Mn	Co	Cu	Zn	References
Jebel Mara	Sorghum	-		-	4.19	0.34	1.26	5.26	(Mohamed ,2001)
Kassala	Sorghum	-		-	-	11.0	5.00	42.0	(Mohamed, 2001)
Khartoum	Sorghum	-		-	21.0	1.00	5.00	41.0	(Mohamed, 2001)
S. Kordofan	Sorghum	4115	179.0	-	29.0	0.60	11.0	26.0	(Elrashid, 2015)
Abugebeha	Sorghum	4215	175.0	-	39.0	14.0	14.0	31.0	(Elrashid, 2015)
Red Sea	Sorghum	8658	518	-	43.0	-	8.00	67.0	(Elrashid, 2015)
Khartoum	Sorghum	8403	28791	-	213	-	23.0	84.0	(Ahmed ,2000)
Al Kamleen		2330	1510	-	-	-	2.01	1.33	(Ahmed ,2000)
Atbara	Sorghum	35900	6210	-	-	-	7.28	3.38	(Ahmed ,2000)
Current Study	Sorghum	6028	2409	94.0	74.0	6.00	8.00	126	

S.Korodofan = South Kordofan

Table4: Correlations between trace and major elements

Elements	*K*	*Ca*	*Ti*	*V*	*Mn*	*Co*	*Ni*	*Cu*	*Zn*
K	1.00								
Ca	-0.42	1.00							
Ti	0.35	-0.04	1.00						
V	0.05	-0.18	0.15	1.00					
Mn	-0.21	-0.22	0.11	-0.02	1.00				
Co	-0.44	0.22	-0.12	-0.15	-0.16	1.00			
Ni	-0.16	0.09	-0.07	0.50	0.38	-0.14	1.00		
Cu	0.11	-0.31	-0.10	-0.16	-0.07	-0.08	-0.12	1.00	
Zn	-0.64	0.34	-0.07	-0.05	0.03	0.85	0.01	-0.03	1.00

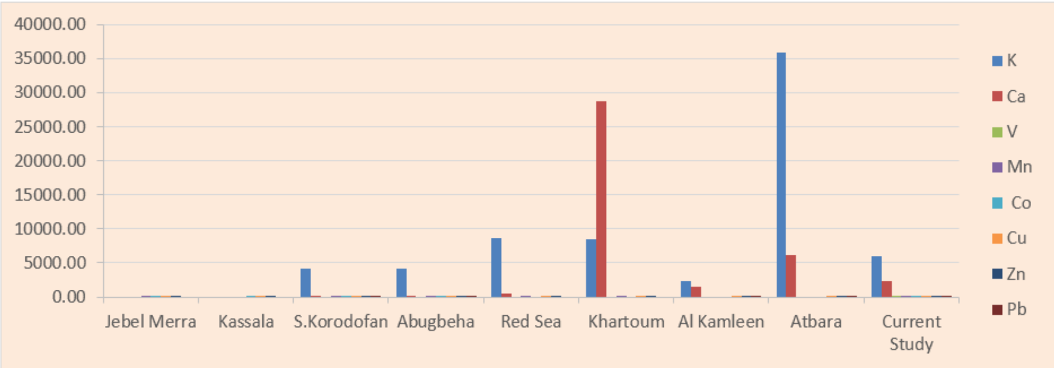

Fig: 1 Comparative concentration of trace metals in different location

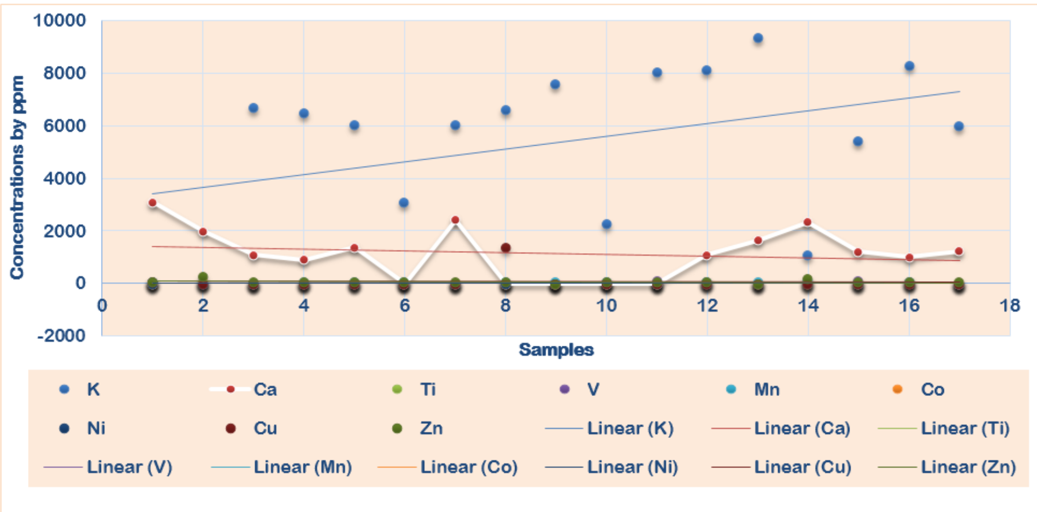

Fig: 2Correlation concentration linear between minor and major in crops

III. Conclusion

About eight elements consisting major, minor metals and essential mineral elements were analyzed in crops diet products using XRF. The Pearson correlation analysis shows poor interactions between elemental concentrations. Strong positive correlations were observed among most elemental pairs suggesting the same origin and similar.

Authorship contribution statement

Hamdi Abdelnabi Abdalla Amin: Writing – original draft, Visualization, Validation, Methodology, Form analysis atacuration. BakheitMustafa: Visualization, Validation, Methodology, Investigation, Formal analysis. Athar Mohammed: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Data curation, Conceptualization. Suzan Z.A. Makawi: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The authors would like to thank the deanship graduate studies and scientific research at Qassim university for financial support (QU-APC-2024-12-1)

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