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Evaluation of Selenium in Soils of Kogi State - Nigeria

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Abstract: Samples of Soils of Lower Benue river Basin Development Authority Project sites of Kogi States were obtained and their selenium status determined using UV Spectrophotometric method at 520 nm wavelengths. From the results, the range of the concentrations of selenium of these locations were; 0.071 – 0.904, 0.074 – 0.295, 0.011 – 0.172 for locations A, B and C respectively. On average the results were; 0.172, 0.131, 0.085 representing A, B and C respectively. Sample no. 9 of Oguma (A) location has high concentration of selenium (Se) that portends toxicity because it has concentration exceeding the standard level of 0.5mg/kg. And the rest were below the deficiency threshold of 0.15mg/kg in Lower Benue project sites in Oguma (Bassa L.G.A.), Kogi State. All the samples in Ejule – Ojebe location (B) were deficient in selenium except samples no. 1, 2 and 4. Lower Benue project sites in Kogi State, Ofarachi (Idah L.G.A.) location (C) have concentrations of selenium lower than the 0.15mg/kg except sample no. 3. In a nutshell, these soil samples analyzed indicated low levels of Se. This will have direct link to the bioavailability of selenium in the area.

Keywords: Selenium, Lower Benue, Kogi,

1. INTRODUCTION

Interest in selenium (Se) has escalated in the past two decades. Se is an essential micronutrient and has important benefits for animal and human nutrition. At high dosages, however, it may be toxic to animals and human[1]. It occurs naturally in soils, aquifers, fly-ash, and agricultural drainage [2 - 4]. It is released through both natural processes and human activities. It was shown that it form part of the important antioxidant enzyme, glutathione (GSH) peroxidase. Other health benefits include carcinoma suppression and the relief of certain symptoms associated with AIDS [5]. Selenium exposure takes place either through food or water, or when we come in contact with soil or air that contains high concentrations of selenium. The toxicity of Se has been known for many years. However, it was not until the Kesterson Reservoir controversy in the 1980s that scientists, regulators, politicians, and the general public of the United States were made acutely aware of the importance of Se as an environmental contaminant. Selenium present in the waters at the natural wildlife refuge at Kesterson Reservoir, California was shown to be the agent responsible for mortality, developmental defects, and reproductive failure in migratory aquatic birds and in fish. The contamination of the Kesterson Reservoir arose from Se-laden agricultural drainage water that had been allowed to flow into it from neighbouring farms [6]. Selenium deficiency is associated with decreased immune cell counts, increased disease progression, and high risk of death in the HIV/AIDS population. HIV/AIDS gradually destroys the immune system, and oxidative stress may contribute to further damage of immune cells. Antioxidant nutrients such as selenium help protect cells from oxidative stress, thus potentially slowing progression of the disease [7]. High risk of diseases such as cancer, cardiomyopathy, myocardial deaths, and arthritis rheumatoid are because of Selenium deficiency[8]. Soils, the loose material that covers the land surfaces of earth and supports the growth of plants vary widely from place to place. Selenium abundance in the earth's crust is unevenly distributed and is in the range 0.05 to 0.5 mg/ kg [6]. Selenium is abundant in different parts of the world but its level in soil varies with native substrate, climatic conditions and vegetation cover[7]. Selenium content in soil typically decreases with depth because it binds with proteins, fulvic acids and other organic compounds that are rich in nitrogen contents. As organic matter decreases along soil profile, so does total selenium [8]. In the report of John *et al* [9]., Selenium (Se) concentrations in food are highly variable, and may reflect Se concentration and availability from the soil in which they were grown. Their results showed that selenium concentrations in foodstuffs are unreliable and if an accurate determination of Se intake is needed, Se concentration should be determined for food consumed. Therefore, this paper reports the levels of selenium in kogi state (project sites of the lower Benue river basin development authority) – Nigeria.

2.MATERIAL AND METHOD

2.1 Description of the study area

The Lower Benue River Basin Development Authority was established in 1976. It covers four (4) States, namely, Benue, Plateau, Nasarawa and the east senatorial District of Kogi State - Nigeria. In addition to Administrative Headquarters at Makurdi, there are 12 LGA area offices with 24 farm projects for continuous development to irrigate agricultural activities, as the people are largely agrarian. Samples were taken from the three locations, namely: Oguma (Bassa local government area) in the north; Ejule-Ojebe (Ibaji local government area) in the west and Oforachi (Idah local government area) in the western part of the state. Twelve samples were taken from each of the three different locations at an approximate depth of 0 – 20 cm. In this study, cultivated soils samples were collected in labeled black polyethylene bags. Twelve samples were collected randomly from the three locations.

2.2 Selenium Determination

Soil samples collected were air-dried and sieved through a 0.25 mm nylon mesh which were stored in polyethylene bags until analysis. Two grams of the soil sample was weighed into a 100 mL beaker and 10 mL of concentrated nitric acid was added. This mixture was heated to near dryness. Another 10mL of concentrated HNO_3 was added to the residue, which was allowed to cool and filter. 10 mL concentrated hydrochloric acid was added to the filtrate and heated to expel chlorine and oxides of nitrogen. The concentrated solution was diluted to 50 mL with distilled water and the standard procedure applied [10]. Reagent blank solution was prepared using the same procedures as for the sample solution but without the sample. Prepared samples were analyzed at the National Research Institute for Chemical Technology (NARICT) Laboratory, Zaria, Nigeria by UV Spectrophotometric method at 520 nm wavelengths.

3. RESULTS AND DISCUSSION

3.1 Results

The results of selenium status of soils in Kogi State project sites of the lower Benue river basin development authority of Nigeria are presented in **Tables 1.0** and **Figures 1.0 and 2.0**

Table- 1: Selenium levels (mg/kg) of soils in Kogi State project sites of the lower Benue river basin development authority of Nigeria.

S. NO.	SITES		
	A.	B.	C.
1.	0.113	0.295	0.090
2	0.092	0.225	0.172
3	0.122	0.110	0.045
4	0.091	0.178	0.011
5	0.071	0.075	0.107
6	0.096	0.086	0.120
7	0.115	0.081	0.071
8	0.150	0.132	0.109
9	0.904	0.098	0.096
10	0.103	0.074	0.051
11	0.122	0.130	0.070
12	0.081	0.091	0.081
Range	0.071 – 0.904	0.074 – 0.295	0.011 – 0.172
Mean	0.172	0.131	0.085

A. **Lower Benue project sites in Kogi State , Oguma (Bassa L.G.A.)**
B. **Lower Benue project sites in Kogi State, Ejule – Ojebe (Ibaji L.**G.A.).
C. **Lower Benue project sites in Kogi State , Ofarachi (Idah L.G.**A.)

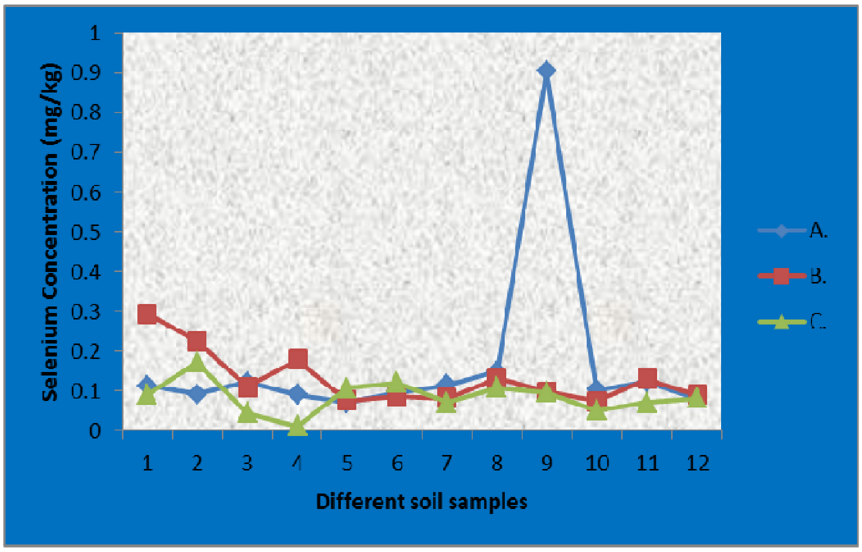

Fig. 1: selenium concentration (mg/kg) of soils in Kogi State project sites of the lower Benue river basin development authority of Nigeria

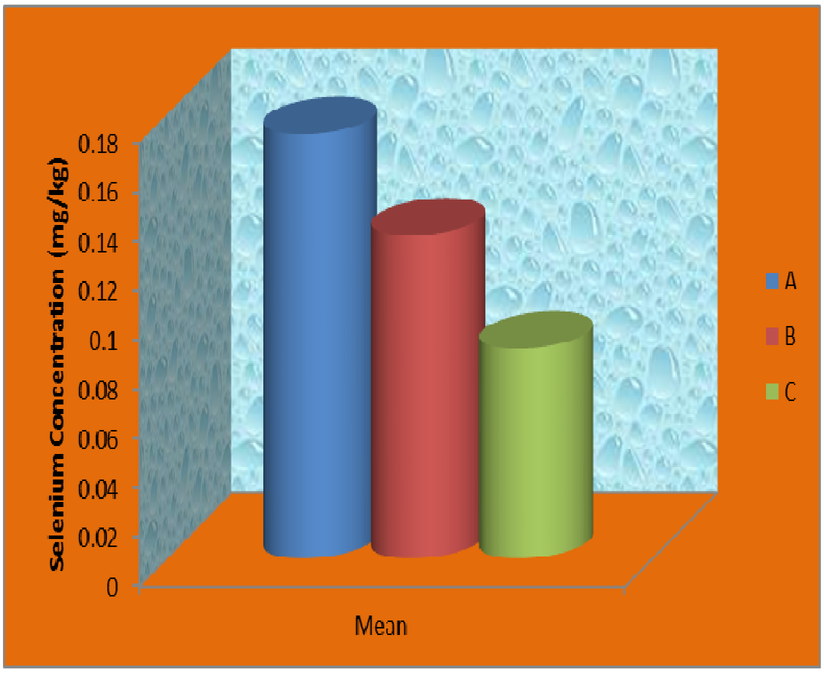

Fig. 2: Mean selenium levels (mg/kg) of soils in Kogi State project sites of the lower Benue river basin development authority of Nigeria

3.2 Discussion

From the results presented above, the range of the concentrations of selenium of these locations were; 0.071 – 0.904, 0.074 – 0.295, 0.011 – 0.172 for locations A, B and C respectively. On average the results were; 0.172, 0.131, 0.085 representing A, B and C respectively. According to Kubota & Allaway [11], soil selenium content greater than 0.5 mg/Kg implies potential toxicity. According Tan's *et al.*,[12] classification, total soil Se content below 0.15 mg/Kg connotes Se deficiency.

From our results, Sample no. 9 of location A portent toxicity because it has concentration exceeding 0.5mg/kg[11]. And the rest were below the deficiency threshold of 0.15mg/kg[12] in Lower Benue project sites in Oguma (Bassa L.G.A.), Kogi State. All the samples in location B were deficient in selenium except samples no. 1, 2 and 4[12]. Lower Benue project sites in Kogi State, Ofarachi (Idah L.G.A.) – location C- have concentrations of selenium lower than the 0.15mg/kg except sample no. 3. They can be said to be deficient in terms of Se[12].

The major determinant of Se status in humans is the level of available Se in the soil, where plants are grown or animals are raised [13, 14]. Most Se ingested by animals and humans comes from the soil, through plants. Levels of Se available in soils are highly variable globally. Areas that are notably low in Se include parts of China, Siberia, Central Africa, Eastern Europe, and New Zealand[14]. Although large areas have not yet been mapped for Se, it is apparent that many people have too little Se to support maximum selenoenzyme expression[13]. In the study, for the first time it was found that, there were significant difference among the total soil Se rate in selected areas of North, South, and Center of Iran. The highest total soil Se was found in central regions of Iran, and the lowest amount was found in the north of Iran. Also, Se in many European countries is relatively low due to the low soil Se concentrations or poor bioavailability of soil Se in a great part of Europe. It can be seen from the results that the soils in Kogi State project sites of the lower Benue river basin development authority of Nigeria contain low selenium. This will imply low bioavailability of selenium in the area.

REFEREES

1. K.Hori , D.Hatfield,F. Maldarelli,B.J. Lee and K.A.Clause,. Selenium supplementation supresses tumor necrosis factor alphainduced human immunodeficiency virus type 1 replication in vitro. *AIDS Res. Hum. Retrovir.1997,* 13:1325–32.
2. S.J.Deverel, R.G. Gilliom, R. Fujii, J.A. Izbicki, and J.C.F ields. Areal distribution of selenium and other inorganic constituents in shallow ground water *of* San Luis Drain Service Area, San Joaquin Valley, California: A preliminary study. U.S. Geol. *Surv.* Water Resour. Invest. Report 84-4319, U.S. Gov. Print. Office, Washington,1984.
3. C.G.Wilber, Toxicology of selenium: a review. *Clin. Toxicol.,1980*, 17:171–230.
4. L.Wu,P.J.V. Mantgem,X. Guo,. Effects of forage plant and field legume species on soil selenium redistribution, leaching, and bioextraction in soils contaminated by agricultural drainwater sediment. *Arch. Environ. Contam. Toxicol.,1986,* 31:329–38.
5. K.Hori,D.F. Hatfield,B.J. Lee,K.A. Clause, Selenium supplementation Suppresses Tumor necrosis factor alpha induced human immunodeficiency virus type1 replication in vitro. *AIDS Res. Hum. Retrovir.1997*, 13; 1325 – 32.
6. H.F.Mayland,L.F. James, K.E. Panter, and J.L.Sonderegger, Selenium in seleniferous environments. In: Selenium in Agriculture and Environments, Ed. L. W. Jacobs, *Soil Sci. Am. Special Pub,1989*, .23, 15-50.
7. N.Singhal and J.A.Austin, A clinical review of micronutrients in HIV infection. *J. Int. Assoc. Physicians AIDS Care.* 2002,1:63-75.
8. F.Kosar,I. Sahin,C. Taskapan,Z. Kucukbay,H. Gullu,etal. Trace element status (Se, Zn, Cu) in heart failure. *Anadolu Kardiol Derg.2006,* 6, 216-220.
9. W.John Finley, R.D.Lori Matthys, B.S. Terry Shuler, . Selenium Content of foods Purchased in North Dakota. *Nutrition Research*,1996,16 (5): 723-728. http:// dx.doi.org/10.1016/0271-5317(96)00062-0
10. L.Krishnaiah,K. Suresh,K. Suvardhan and P. Chiranjeevi, “Simple Spectrophotometric Determination of Traces of Selenium In Environmental Samples” in Martin J. Bunch, V. Madha Suresh and T. Vasantha Kumaran, eds., *Proceedings of the Third International Conference on Environment and Health, Chennai, India,2003, 15-17*
11. J.Kubota and W.H.Allaway, Geographical Distribution of Trace Element Problems in Agriculture. *Micronutrient in Agriculture:1972,* 523 – 553.
12. J.A.Tan,W.Y. Wang,D.C. Wang, & S.F.Hou, Adsorption Volatilization and Speciation of Selenium in dferent types of soils in China. In: Selenium in the Environment (Eds W.T. Frankberger, S. Benson).Marscel Dekker, Inc. New York: 1994, 47 – 68.

13. M.P.Rayman,. The argument for increasing selenium intake. *Proceedings of the Nutrition Society*, *2002*, **61**, 203–215.
14. G.F.Combs ,Selenium in global food systems. *Br J Nutr*,*2001*, **85**, 517-547.
15. K.Hori,F. Hatfield D,Maldarelli,B.J. Lee,K.A. Clause,, Selenium supplementation supresses tumor necrosis factor lphainduced human immunodeficiency virus type 1 *replication in vitro*, AIDS Res. Hum. Retrovir.*1997*, **13**:1325–32

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