Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.3, No.5, 2013

Iodine and Selenium Distribution In The Local Environment Of Selected Villages In Anambra State, Nigeria

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ABSTRACT

The level of iodine and selenium in soil, *Vernonia amygdalina,* cassava tubers and drinking water samples were determined for Nanka community (an erosion devastated area) and Oba community to assess their risk to Iodine Deficiency Disorders (IDD). Results show that total concentrations of soil total iodine and selenium were higher in Oba compared to Nanka. Also, the total concentrations of iodine and selenium in *Vernonia amygdalina* are higher for Oba compared to Nanka. Mean concentration of water total iodine (105.25±10.44µg/L) value from Oba is significantly higher ($p<0.05$) compared to the mean value of water samples from Nanka (89.8±6.42µg/L). The concentrations of iodine and selenium in cassava tubers from both communities are low (≤98.4 µg/L for iodine and ≤0.16ppm for selenium). Cassava, contains goitrogens, which exacerbate iodine deficiency problem is a major staple food in both communities. The incidence of IDD is multi-factorial, involving trace element deficiencies' and other factors such as poor nutrition and goitrogens in food stuff. The study was aimed at assessing the level of iodine and selenium intake of the communities and the risk of the communities to IDD.

Keywords: Iodine, Selenium, IDD, Soil, Cassava, Water, Goitrogens, *Vernonia amygdalina*

INTRODUCTION

Trace elements, iodine and selenium, are essential to human and animal health in small doses. Iodine forms an important constituent of the thyroid hormones, thyroxine (T4) and triiodothyronine (T3). These hormones play fundamental biological role controlling growth and development (Hetzel and Maberly, 1986). If the amount of utilizable iodine reaching the thyroid gland is inadequate or if the thyroid is not functioning properly, the hormone production would be reduced resulting in a group of conditions in man, collectively referred to as Iodine Deficiency Disorders (IDD) (Fernando, et al., 1987). These disorders include goiter, mental and growth retardation, reproductive failure, childhood mortality and defects in the development of nervous system. Extensive dietary supplementation programmes, often based on the addition of iodized oil, iodized salt, or iodination of irrigation water (DeLong, et al., 1997) have successfully lowered the incidence of IDD in countries such as China, the USA, Switzerland, Papua Guinea and India. Despite the success of these programmes, endemic IDD remain a serious global health issue affecting so many people.

Although endemic IDD are attributed to mainly iodine deficiency, other factors such as goitrogens, other trace elements, and genetic factors have been implicated in the aetiology of these disorders (Gaitan and Dunn, 1992). It was suggested that selenium deficiency may be an important factor in the onset of IDD (Fordyce, et al., 2000). Selenium plays an important role in thyroid hormone metabolism as an active component of type I and also possibly type II iodothyronine deiodinase (Arthur, et al., 1993; Kohrle, 1999). The selenoenzyme, type I iodothyronine deiodinase is responsible for the conversion of the prohormone T4 to the active hormone T3 which exerts a major influence on cellular differentiation, growth and development, especially in the fetus, neonate and child. Selenium deficiency inhibits the conversion of T4 to T3 adversely affecting thyroid hormone metabolism (Arthur and Beckett, 1994; Arthur, et al., 1999).

The oceans are the major sink of iodine in the environment which is volatilized from seawater and deposited on land during precipitation (Fuge, 1996). The availability of iodine and other trace elements in the soil are affected by soil erosion. Soil erosion leaches off these elements from the soil. Nanka is presently being devastated by soil erosion and the effect of these erosions to the iodine and selenium distribution in Nanka will be assessed.

METHODOLOGY

Sampling: Ten villages (5 from each community) were investigated. Soil, cassava tubers, drinking water and *Vernonia amygdalina* were collected. The samples were collected in May during rainy season. Spring water and streams are sources of drinking water in Nanka while private water boreholes are sources of drinking water in

Oba. In each village investigated, spring, stream or boreholes were samples as applicable. At each site, 10ml of water was collected and filtered for iodine and selenium analysis. The water samples were kept in sealed containers until analysis. Composite near-surface soil samples were collected from each village under investigation. Sample sites were selected to represent the cultivated fields around each village. Cassava tubers and *Vernonia amygdalina* were harvested from the same sites where the soil samples were collected.

Analytical methods: Levels of iodine in water was measured using the method of Dunn, et al., 1993 while the level of selenium in water was measured using Atomic Absorption Spectrophotometer (AAS). 1g each of dried Cassava tuber, soil and *Vernonia amygdalina* samples were subjected to acid digestion and analysed for iodine using the method of Dunn, et al., 1993. Also, 1g each of the dried samples were digested and analysed for selenium using AAS.

RESULTS AND DISCUSSION

Mean values of iodine of all the samples from Oba and Nanka were compared (Table 1). Iodine levels in soil, *Vernonia amygdalina,* water from Oba were higher than the level in samples from Nanka. Mean iodine level (105.25±10.44μg/L) in water samples from Oba is significantly higher ($p<0.05$) than mean iodine level ((89.8±6.42μg/L) in water samples from Nanka. The mean iodine concentration in the soil samples from Nanka (110.6±21.22) is lower than that in soil samples from Oba (121.5±13.65). However, both values are higher than the range of 0.13 - 10 μg/L reported for soil samples from endemic goiter region of Sri Lanka (Fordyce, et al., 2000). Iodine content of drinking water generally reflects the iodine content of rocks and soil of a region and hence of locally grown foods. Mean iodine value for in water samples from Oba (105.25±10.44) is significantly higher than the mean values in water samples from Nanka (89.8±6.42). Low levels of iodine have been reported for water in high endemic goiter areas (Fordyce, et al., 2000).

Mean selenium level in soil and *Vernonia amygdalina* from Oba are higher than the level in the same samples from Nanka. The levels of selenium in cassava and water from both communities are comparable. Mean selenium concentration in soil samples from Nanka is lower than the mean concentration in soil samples from Oba. However, both values are higher than 136ng/g reported for soil samples from Heber Province (Keshan disease belt) of China (Johnson, et al., 2000). Thorton, et al (1983) observed that concentrations of selenium in soils were almost always higher than the rocks from which they were derived. Selenium availability in the environment is controlled by several factors. Factors affecting uptake from soil to food chain include geology, organic matter and clay content (McNeal and Balistrieri, 1989).

The values of iodine and cassava in cassava from both communities are low (≤98.4μg/L for iodine and ≤ 0.16ppm for selenium).

CONCLUSION

The main environmental source of iodine is seawater. Iodine occurs in fairly constant amounts in ocean water but is distributed very unevenly in the earth's crust. Inland regions far from the ocean have the greatest risk of iodine deficiency. Continuous rain over a period of 5-7 months in the year leaches iodine from the soil, this is aggravated by deforestation and soil erosion. The results from the study show that iodine concentrations in the soil samples from Nanka are lower than that in soil samples from Oba. Since the two communities are within the same region of Nigeria, the lower soil iodine concentrations found in Nanka could be ascribed to the soil erosion ravaging the community. Soil erosion is the main control on iodine and selenium distributions in soil and plants in Nanka.

Iodine does not occur naturally in specific foods (except sea foods), rather iodine concentrations in plants are very susceptible to differences in the content and availability of iodine in the soil. In addition, the atmosphere is an important source of iodine in plants and atmospheric adsorption rather than soil-root uptake may contribute to plant iodine concentrations. The incidence of IDD is multi-factorial, involving trace element deficiencies and other factors such as poor nutrition and goitrogens in food like cassava. Soil erosion may significantly affect the distribution of iodine and selenium in the environment, thereby placing the affected communities (especially children) at the risk of IDD.

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Table 1. Level s of iodine and selenium in soil, water, cassava tubers and *Vernonia amygdalina* samples from selected villages in Oba and Nanka communities

Sample	Community	Iodine (µg/L)	Selenium (ppm)
Soil	Oba	121.5±13.65	0.48±0.32
	Nanka	110.6±21.22	0.37±0.32
Vernonia amygdalina	Oba	106.0±18.04	0.56±0.85
	Nanka	98.6±19.27	0.37±0.56
Cassava tubers	Oba	96.0±7.12	0.16±0.03
	Nanka	98.4±10.53	0.15±0.02
Water	Oba	105.25±10.44*	0.03±0.01
	Nanka	89.8±6.42	0.04±0.01

*represents $p<0.05$
Values shown are mean ± SD
t-tests were used.