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DISTRIBUTION OF IODINE AND SOME GOITROGENS IN TWO SELECTED WATER BODIES IN ONDO-STATE, NIGERIA

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ABSTRACT

The study was designed to investigate the distribution of iodine and goitrogens in Igbokoda brackish and Ogbese fresh water bodies in Ondo State, Nigeria. The parameters determined include iodine and goitrogens (Ca^{2+}, NO_3^-, Cl^-, SCN^-, Mg^{2+}, magnesium hardness, calcium hardness, total hardness and total coliform counts) in water and sediments of the water bodies. The calculated I/goitrogen ratios (I/Ca^{2+}, $I/NO3^-$, I/Cl^-, and I/SCN^-) were higher for Igbokoda water (125.00,2061.86,133.94, and 0.0431) compared with Ogbese water (33.33,ND, 37.50 and 0.0023) with similar results in the sediment samples of both studied areas with the exception of I/Mg^{2+} ratio. This was equally reinforced by the total coliform counts and total hardness (potential goitrogens), which was higher in Ogbese (3.0×10^3, 70.67±1.15) than Igbokoda (2.7×10^3, 40.67±1.15) respectively. Considering the iodine goitrogen ratio, Igbokoda brackish water would be a better source of iodine than Ogbese fresh water body for the population dependent on it.

KEYWORDS: Iodine, Goitrogens, Fresh Water And Brackish Water

INTRODUCTION

Iodine is an essential trace element of great importance in human nutrition obtained mainly from diet and water. Concentration of iodine in unpolluted water in various parts of the world has been found to be generally less than 3µg/l while drinking water has been shown to contain an iodine level of less than 15µg/l, except in a few cases where much higher levels are reported (Underwood, 1977). The element is an essential part of the thyroid hormones triiodothyronine (T3) and tetraiodothyronine (T4), which in turn are necessary for human growth and development (Cavalieri, 1980). Goitre is not the only one manifestation of iodine deficiency and the wide spectrum of manifestations are now commonly termed Iodine Deficiency Disorders (IDD)(Hetzel and Dunn, 1989). These disorders include endemic cretinism, infant mortality, infertility, miscarriage, mental retardation, neuromuscular defect or dwarfism.

Goitrogens on the other hand are substances, which impair iodine uptake by the thyroid or impair iodine incorporation into thyroxin (JECFA, 1989). It has been shown that there are some connections between the geogenic origin of water and the incidence of goitre (Lindsay, 1997). Poor quality of drinking water has been discovered for years to cause goitre (Gaitan, 1983, Ubom, 1991). Moreover, water, which caused goitre, was found to be grossly polluted containing nitrate, humic acid and some of their degradation products (Seffner, 1995). It has also been shown that certain cations and anions present in water (nitrate, fluoride, calcium and magnesium) are goitrogenic (Ubom, 1991)

Studies conducted in Plateau State, Nigeria on the effect of drinking water, soil mineral composition and nutrition on the incidence of goitre reveals that water used for drinking and cooking in the goitrous areas are low in iodine content but high in mineral content including calcium, magnesium, nitrate, total hardness, organic, inorganic and bacteriological pollution (Ubom, 1991).

Research had shown that goitre is common in certain areas of the world where iodide content of food and water are high enough to prevent goitre development. This anomaly has been attributed to the presence of goitrogens, which prevent the thyroid from being able to use the iodide. (Gaitan, 1983). Endemic goitre in iodide sufficient areas of US and Columbia has been linked to water –soluble goitrogens (Lindsay, 1997), such as compounds derived from coal; 2 and 5- methyl resorcinol. Other compounds with less potent activity include thiocyanate, disulphides and hydroxypyridines. Experimental work in rat supports the idea that calcium salt exacerbates an underlying state of iodine deficiency (Powell-Jackson and Day, 1972) and that the occurrence of goitrogen in hard water has been noted. In many parts of the world,

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iodine content of drinking water has being inversely correlated with the incidence of endemic goitre (Clugston and Hetzel, 1994). Little information on the distribution of iodine and goitrogens in fresh and salt-water bodies used for drinking and cooking in Ondo-State, Nigeria. The present work therefore seeks to evaluate the le·v l of iodine and some goitrogens in a selected fresh and brackish water body in Ondo State.

MATERIALS AND METHODS.

Materials

Water and sediment samples were collected from Igbokoda brackish and Ogbese fresh water bodies in Ondo State, Nigeria. Water samples were collected into a clean plastic container with tight fitting lids and frozen fresh for later analysis by grab sampling methods (Monday and Lindstorm, 1977). Composite sediment samples were collected by combining separate collections from different portions of the water by using a hand scoop to gather the sub samples of the bottom of the water bodies (Parker, 197?). The sediment samples were treated according to the method of Parker (1972). Water samples were collected into a sterile container aseptically for bacteriological studies (Fawole and Oso, 1995). The chemicals used were analar grade while the water used apart from the sample was de-ionized water.

Sample analysis

The chemical parameters (calcium hardness, magnesium hardness, total hardness, chloride and nitrate) of the water and sediment samples were determined using the standard American Public Health Association (1992) methods. Thiocyanate content was determined using Pettrigrew and Fell (1972) method, while iodine was determined using Lambert et.al (197?) method. Calcium and magnesium conten. were determined by the established flame atomic absorption spectophotometry procedure using a Perkin-Elmer (1982) atomic absorption spectrophotometer (Model 372). Assessment of bacteriological pollution of water samples was carried out using the method of Fawole and Oso, 1995.

Table1. Levels of iodine and some goitrogens in Ogbese and Igbokoda water bodies (mean±SD)

Sample	Ca^{2+} (ppm)	Mg^{2+} (ppm)	NO_3^- (ppm)	Cl^- (ppm)	I (µg/l)	SCN^- (µmol/l)
Ogbese Water	$30.00^a \pm 0.00$	$10.00^a \pm 0.00$	ND**	$26.67^c \pm 1.15$	$1.00^b \pm 0.00$	$7.50^c \pm 0.00$
Ogbese sediment	$35.00^b \pm 0.00$	$13.00^b \pm 0.00$	ND	$8.00^a \pm 0.00$	$0.60^a \pm 0.00$	$6.50^a \pm 0.00$
Igbokoda water	$40.00^c \pm 0.00$	$20.00^c \pm 0.00$	$0.97^b \pm 0.00$	$37.33^d \pm 1.50$	$5.00^d \pm 0.00$	$2.00^a \pm 0.00$
Igbokoda sediment	$70.00^d \pm 0.00$	$60.00^d \pm 0.00$	$1.10^c \pm 0.00$	$15.33^b \pm 1.15$	$4.40^c \pm 0.00$	$2.00^a \pm 0.00$

Number of replicates is 3
Means with the same superscript in a column are not significantly ($p > 0.05$) different.
**ND, Not detected

Table 2: Levels of hardness in Ogbese and Igbokoda water bodies (mean±SD)

Sample	Ca^{2+} hardness	Mg^{2+} hardness	Total hardness
Ogbese water	$48.67^c \pm 1.15$	$22.00^b \pm 0.00$	$70.67^b \pm 1.15$
Ogbese sediment	$133.33^d \pm 5.77$	$126.67^d \pm 0.00$	$260.00^c \pm 0.00$
Igbokoda water	$26.00^a \pm 0.00$	$14.67^a \pm 1.15$	$40.67^a \pm 1.15$
Igbokoda sediment	$40.00^b \pm 0.00$	$30.67^c \pm 1.15$	$70.67^b \pm 1.15$

Number of replicates is 3
Means with the same superscript in a column are not significantly ($p > 0.05$) different.

RESULTS AND DISCUSSION

Iodine/goitrogen balance in water and food is an index for predicting the bioavailabilty of iodine to the population dependent on it as a source of iodine. However, there is no standard value at which iodine and goitrogens must be present in water or food to make iodine more available. It greatly depends on iodine goitrogen balance expressed as iodine goitrogen ratios (Gaitan, 1983).

Table 1 shows the level of iodine and goitrogens (calcium, magnesium, nitrate, chloride and thiocyanate) in Igbokoda brackish and Ogbese fresh water bodies in Ondo State, Nigeria. Iodine concentration (µg/l) was found to be higher in water and sediment samples of the brackish water body (5.00±0.00,4.00±0.00) respectively. Higher iodine concentration in the brackish water body is consistent with the report of Karen and Amund (1997) who obtained higher values in salt water compared to the fresh water body examined. Clugston and Hetzel (1994) reported similar results with higher concentration in seawater compared to the fresh water body. The results agree with the established fact that iodine concentration increases with salt level in a given water body (Karen and Amund 1997). The evaluated goitrogens were found to be high in the brackish water body than the selected fresh water body. Higher value of calcium (40±0.00,70.00±0.00ppm), magnesium (20.00±0.00,60.00±0.00ppm), nitrate (0.97±0.00,1.10±0.00ppm) and chloride (37.33±1.50,15.33±1.15ppm) in the water and sediment samples of the brackish water body could be attributed to the fact that brackish water body has a higher salt level than the fresh water body under investigation and the different values of the parameters in water and sediment is simply because of the degree of their solubility. Although, the evaluated cations and anions are within the standard for drinking and cooking water (WHO, 1982), the higher value in Igbokoda water body support the fact that it is a salt water body which was further substantiated by the higher iodine concentration. Thiocyanate (a water soluble goitrogen) was found to be higher in water and sediment samples (7.50±0.00,6.50±0.00µmol/l) of Ogbese water body than the value obtained in the brackish water body (2.00±0.00,2.00±0.00µmol/l) for water and sediment samples respectively. Higher value of thiocyanate in the fresh water body could be as a result of higher inflow of the pollutant to the water body.

The level of hardness in Igbokoda brackish and Ogbese fresh water bodies is presented in Table 2. Higher value (mg/l) was found in Ogbese water body: calcium hardness (48.67±1 15,133.33±5.77), magnesium hardness (22.00±0.00,126.67±5.77) and total hardness (70.67±1 15,260.00±0.00). The different hardness values in the two selected water bodies could be attributed to the different geographical locations of each water body. However, the hardness value of the two studied areas were within the standard for drinking water (WHO, 1982). Occurrence of goitrogen in hardwater has been noted (Powell-Jackson and Day,1972).However hardness might be more important in determining goitre

Table 3: Total plate counts (cfu/ml) of water samples from Igbokoda and Ogbese water bodies.

Sample	Total plate count
Ogbese water	3.0×10^3
Igbokoda water	2.7×10^3

Table 4: Calculated I/goitrogen ratios for Ogbese and Igbokoda water bodies

Sample	I/Ca^{2+}	I/Mg^{2+}	I/NO_3^-	I/Cl^-	I/SCN^-
Ogbese water	33.33	750.00	ND*	37.50	0.0023
Ogbese sediment	17.14	46.15	ND	75.00	0.0016
Igbokoda water	125.00	250.00	2061.86	133.94	0.0431
Igbokoda sediment	62.86	73.33	4000.00	287.02	0.0379

*ND-Not detected.

prevalence than the absolute level of iodine where iodine is not plentiful

Table 3 shows the total plate count (cfu/ml) of the water samples from Igbokoda brackish and Ogbese fresh water bodies. Coliform counts of the two-studied areas showed that the two water bodies are grossly polluted (WHO, 1982). High *coliform* counts ($3.0x10^3$, $2.7x10^3$), a potential goitrogen was found in the two-studied areas. This by implication could contribute to the possible interference with the uptake of iodine by the thyroid gland of the human population dependent on the water for drinking and cooking (Ubom, 1991 and Gaitan, 1983).

The calculated iodine/goitrogen ratios are presented in Table 4. This established the possible relationship between the evaluated goitrogens and iodine availability. The calculated I/goitrogen ratios (I/Ca^{2+}, I/No_3^-, I/Cl^-, and I/SCN^-) were higher for Igbokoda water (125.00, 2061.86,133.94 and 0.0431) compared with Ogbese water (33.33, ND, 37.50 and 0.0023). The reverse was the case with I/Mg^{2+} (250.00, 750.00) in Igbokoda and Ogbese waters respectively. Similar results were obtained in the water sediments from the two water bodies. Considering the iodine-goitrogen balance, Igbokoda water body appears to be a better source of iodine than Ogbese water body with low iodine /goitrogen ratios (Gaitan, 1983). This is in agreement with the report of Akindahunsi (1992) who obtained lower I/SCN^- in the serum of subjects in goitre endemic area and higher value in the goitre free subjects, since iodine uptake is a function of iodine/goitrogen ratio in any given area. This was equally reinforced by the total coliform (a potential goitrogen), which was higher in Ogbese water body than Igbokoda water body. This by extension may affect negatively the thyroid status of the aquatic and human population dependent on Ogbese water body.

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