DETERMINATION OF THE IODIDE CONTENT OF TABLE SALTS COLLECTED FROM NIGERIAN MARKETS AND LOCAL EATERIES

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Iodine is a key regulator of the body's basic metabolic activity and insufficiency of this micronutrient can lead to a non-cancerous enlargement of the thyroid gland (goiter) as well as physical and mental disorders in both adults and children. Addition of 40 to 60 ppm of potassium iodide to table salt as recommended by Universal salt iodization (USI) mandate in 2000 can solve all these health problems. Quantitative analysis of iodine was performed on salt samples from different local markets, supermarkets and local stores in Adamawa, Benue, Lagos, Rivers and Kano State. The result showed that the majority of the Nigerian manufactured table salts were compliant with the standards of the World Health Organization standards and USI mandate. However, one had a value of 26.31ppm due to long term storage and exposure to harsh weather conditions. Salts tested from the local eateries had average iodine levels of 71ppm which will be adjusted to permissible limits due when the concentration is reduced by approximately 10% when exposed to high temperatures during cooking. Both commercially available salts and those from local eateries are compliant with the USI mandate and are therefore provide dietary intake of preventing nutritional problems such as Iodine Deficiency Disorders.

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INTRODUCTION

Iodine deficiency disorder (IDD) is an important disease that affects 800 million people worldwide, especially those living in preindustrial countries. Essentially, in pregnant women, iodine deficiency can result in birth defects and spontaneous miscarriages. In children, it causes hypothyroidism, retards cognitive development, and is also responsible for diminished physical development and school performance. On the other hand, in adults, iodine deficiency results in goiter, impaired mental functioning, and lower energy and productivity. Yet, only a teaspoon of iodine is all that a person needs in a lifetime.[8] For iodine deficiency elimination, most governments, including Nigeria have implemented the program of iodized salt with the addition of potassium iodate to manufactured salts. Iodine deficiency can be caused by consumption of iodine containing salt below the minimum requirement.[4,11] According to the UNICEF, 97% of Nigerian salts are iodized. 50mg Iodine/kg salt should be used in the industrial manufacture of refined salt. Also, through the concerted regulatory and enforcement action of the NAFDAC, which is productively backed-up by UNICEF, Nigeria has won the Universal Salt Iodization (USI) certification award which was held in 2007 at Istanbul, Turkey.[1,6,10,]

Notes on detection of iodine methods

In Nigeria, effort towards eradicating iodine deficiency took off effectively in 1993 after the adoption of the Universal Salt Iodization Program (USI). Fifteen years on, impact evaluation identifies Nigeria as not only one of many nations succeeding in eliminating iodine deficiency disorder and but also in setting standards for other countries to follow. In fact, Nigeria ranks second behind Kenya in having the highest number of households with iodized salt across the African continent.[3] For instance, in a 2003 WHO global survey, 42% of African school children were found to have insufficient intake of iodine [2], while only a 2.3% of Nigeria household were found not to have access to sufficiently iodized salts.[12] Clearly, Nigeria's success in improving its IDD status is a direct result of the national commitment to USI programs.

Prior to the adoption of USI in 1993, only 40% salts consumed in Nigeria were sufficiently iodized. The total prevalence of goiter (GTP) during this time stood at 20%,[12] and posed serious public health problems in this country. Despite lack of initial political commitment and available resources, USI program progressively took off in Nigeria, creating significant impact within a period of only five years. Today, on average 98% of households have to iodized salt and with a reduction of TGP to 7%.[6]

Despite Nigeria's overall USI success however, some previously IDD endemic regions of the country still pose challenges. For instance, the IDD status in states like Edo, Ekiti, Enugu, Cross River, Oyo and Benue is yet not as impressive as the national status.[6,10] This is because cassava; a powerful goitrogen that inhibits utilization of dietary iodine is the most available and cheapest staple food in these parts of the country.

However, despite these setbacks, Nigeria impressive progress towards meeting global USI/IDD target is an exemplary story of multispectral cooperation and collaborations.[1] Each organ of constituted national IDD/USI task force is not only assigned specific responsibility, but also works closely to achieve common goals. Primarily for instance, the national planning commission serve as the main planning organ of the government while Standard Organization of Nigeria (SON) monitors and inspects consignments at ports and performs at least bi-annual inspections of salt Companies. More also, the Federal Ministry of Health and Community Development and Population Activities (FMOH, CDPA) is involved with the ISU and IDD policy formulation through monitoring and evaluation of impact. The National Agency for Food and Drug Administration and Control (NAFDAC) primarily carries out routine factory inspections, monitors commodities at the distributor, wholesale and retail levels, with enforcement at factory level.[6,10]

In summary, international, national and local agencies both governmental and non-governmental as well as private enterprise in Nigeria have all made concerted efforts to ensure that table salt is maintained at the USI standards thereby effectively helping to reduce the prevalence of IDD in this most populous West African nation.

MATERIALS AND METHODS

Materials

Concentrated sulphuric acid (Sigma Aldrich, UK), chemical Starch, distilled water, reagent grade sodium chloride (Fisher Scientific, Nigeria), potassium Iodide (KI), sodium thiosulphate (1.24%) is prepared by diluting 1.24g of sodium thiosulphate in 1000mL of distilled water.

EXPERIMENTAL

Iodometric method of titration was used in this experiment 2004.[5]

Observations

Iodized salt solutions changed to yellow color when 5 milliliters (mL) of potassium iodide was added. The solution further changed to bluish-purple as 2 mL of starch solution was added. Non-iodized salt did not have any color changes on addition of both KI and starch solution.

RESULTS AD DISCUSSION

World Health Organization has mandated that commercial salt should have an average of 50ppm of iodine [7]. In order to ensure that commercially available salt and table salt used at local eateries have the required level of iodine, an assay has been developed in order to monitor iodination levels in Nigerian salts. The salt samples used for this experiment included salts from local eateries in Adamawa state (E) and commercial salts (C).

Table 1. Salt codes for both commercial salts (C) and eatery salts (E)

Commercial salts	**Name of salt & country of origin**
C1	Dangote A (Sac, Yola Nigeria)
C2	Table Salt, Nigeria
C3	Mr. Chef A (Yola, Nigeria)
C4	Uncle Palm, Rivers, Nigeria
C5	Best Palm, Benue, Nigeria Nigeria
C6	Dangote B, (Nylon, Yola) Nigeria
C7	Mr. Chef B, (Kano, Nigeria)
Eatery salts	**Name of salt & country of origin**
E1	Continental Restaurant (Yola, Nigeria)
E2	Government girls School (Yola, Nigeria)
E3	Tasty Menu (Yola, Nigeria)
E4	Frank Bite (Yola, Nigeria)
E5	Feed Well (Yola, Nigeria)
E6	Dummas (Yola, Nigeria)
E7	Kucheli (Yola, Nigeria)
E8	Special Food (Yola, Nigeria)

The concentration of iodine in each of the salt samples was calculated from the titrated levels of sodium thiosulphate (Tables 2 and 3) using the formulae outlined in Table 1. The observable difference in value of Dangote A and Dangote B was due to the packaging material. Dangote A was packed in a transparent nylon and whilst the latter was sold wholesale in the local market in Yola in a sack. The extra step in preparing the Dangote A sample at a factory for a more marketable product for the retailers will further prolong the time period before it reaches the consumer. This is clearly indicated by the 10% difference between this two Dangote samples. These results verify that wholesale marketing may not appear to be appealing to customers, but they will be of higher quality nutritionally in the long run.

Table 2. Commercial salts assayed from vendors in Nigeria (in ppm)

Code	**Name of Salt & Country of Origin**	**Iodide, ppm**
C1	Dangote A [Sac] = (Yola, Nigeria)	75.05*
C2	Table Salt = Nigeria	106.82*
C3	Mr. Chef A= (Yola, Nigeria)	74.55*
C4	Uncle Palm = (Rivers, Nigeria)	73.95*
C5	Best Palm = (Benue, Nigeria Nigeria)	26.31**
C6	Dangote B [Nylon] = (Yola, Nigeria)	68.42*
C7	Mr. Chef B= (Kano, Nigeria)	56.05*

*Compliant with WHO guidelines. **Do not compliant with WHO guidelines

Table 3. Salts assayed from eateries in Yola, Adamawa State (in ppm)

Code	**Commercial Name**	**Iodide, ppm**
E1	Continental Restaurant Yola	75.08*
E2	Government girls School	67.89*
E3	Tasty Menu	68.42*
E4	Frank Bite	68.32*
E5	Feed Well	58.16*
E6	Dummas	58.69*
E7	Kucheli	105.75*
E8	Special Food	68.42*

*Compliant with WHO guidelines. **Do not compliant with WHO guidelines

Further differences were observed from salt analyzed from the same company have been observed with Mr. Chef A, bought in local grocery store and assayed straight away and Mr. Chef B which was purchased in Kano, stored for several months then transported to Yola and then assayed 4 months later.

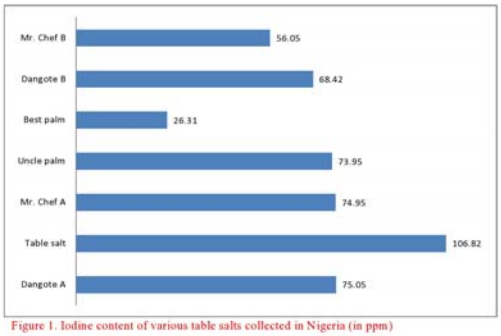

Figure 1. Iodine content of various table salts collected in Nigeria (in ppm)

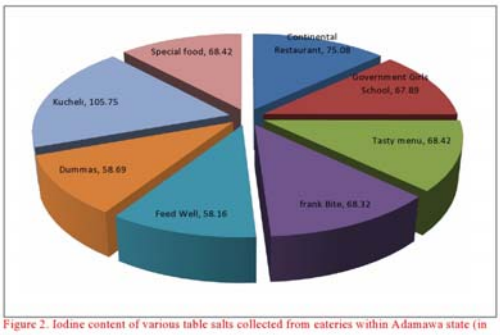

Figure 2. Iodine content of various table salts collected from eateries within Adamawa state (in ppm)

The results for Best Palm were the lowest with only 26.31 ppm of iodine. The package for this sample of salt was found to be torn when it was purchased and it was tested along with the other samples several months later after arrival in Yola.

The assay results for Dangote A were shown to be 68.42 ppm which falls within the USI mandate range. However, the concentration on the label on the package for this salt stated that it contained 50 ppm. The discrepancy of these results could be due to the use of less sensitive techniques to assess the iodine concentration. This confirms the need for close monitoring of manufacturing standards and regular inspection of goods not just at the factory sites but at the retail level.

These results verify that temperature and moisture as well as long term storage will affect the viability of the iodine. However, the results clearly show that Nigerian companies and local eateries are compliant with the WHO guidelines for the amount of iodine in commercially available salt in Adamawa State.

The average iodine levels for the local eateries were 71 ppm which is slightly above USI range of 40 to 60 ppm (Fig. 1 and 2, Table 2 and 3). It should be recommended that their sources of table salt are monitored and assayed in order to ensure that the levels are keep within the limits outlined earlier. However, given the fact that approximately 15% of iodine levels are reduced in the process of cooking, this would shift the concentrations to the limits of iodine.[13]

CONCLUSION

It is extremely important for companies to follow the guidelines of international agencies such as the WHO. This will help reduce the levels of preventable diseases such as IDD which can be solved by eating table salt with the required amount of iodine. Today, iodine awareness has become a major concern, which is especially aimed towards eliminating iodine deficiency disorders (IDD). Hence, the strength of association between the cause- iodine deficiency and the effect - IDDs such as goiter, cretinism and other birth defects is relatively high. As the association of iodine deficiency is highly specific to IDDs, the association is also coherent and equally consistent at different conditions, place and times. A gradient of risk to IDDs is associated with a degree of exposure to low iodine intake. To assess the impact of iodization of salts to IDDs, We can compare case studies of those countries with iodine insufficient salts (e.g. UK and USA) to countries who iodize their salts efficiently (e.g. Kenya and Nigeria).[6]

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