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Assessment of Iodine Content in Commonly Consumed Salts in Osun State, Nigeria.

[1]Akinola O.O, [2]Oguntade O.I, [3]Akinyemi A.O, [4]Adeyemo G.A.
[1]*Department of Nutrition & Dietetics, Federal Polytechnic, Ede, Osun State, Nigeria.*
[2]*Department of Nutrition & Dietetics, Olabisi Onabanjo University Ago-Iwoye, Ogun State, Nigeria.*
3Dietetics Department, LAUTECH Teaching Hospital, Osogbo, Osun State, Nigeria.
[4]*Department of Nutrition & Dietetics, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.*
Corresponding author: Akinola O.O

Abstract: *Background: Iodine is one of the most recognized micronutrient along with Vitamin A, Calcium, etc. It is needed in the human body in trace quantity and is a major component of the thyroid hormone. in the annual global production of over 200 million tons of salt, only about 6% is used for human consumption. This study assessed iodine content in commonly consumed salts in Osun State. Common salt is a mineral composed primarily of Sodium Chloride (Nacl).*
Materials and Methods: Three samples of commonly consumed salts of different households and eateries in Osun state, Nigeria were analyzed for iodine content. Mr. Chef, Dangote salts and the locally produced salts (unbranded) were the most popular salts found in all the households visited. Cross sectional study was used where 100 house hold including eateries were considered.
Results: Result of the study conducted shows that 80% of salt consumers store their salts in a closed plastic container, while 18% and 02% of the consumers keep their salts in a packaging material and in open container respectively. The result of analysis carried out to ascertain the iodine content of salt samples, it was observed that all salt samples analyzed contain certain percentage of iodine of which majority of the salt samples are above the minimum level but are below the NAFDAC approved iodine content in Nigeria, while the unbranded salt (locally produced salt) was extremely below the minimum level of 30 (ppm) recommended at retail sale. In conclusion, salts should be in good packaging materials and appropriately stored so as to prevent loss of iodine.
Conclusion: It is recommended that consumers should be informed or enlightened on the basic reason for consuming iodized salts.
Key words*: Salts, iodine, Packaging, storage.*

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I. Introduction

Salt is a chemical compound called Sodium Chloride, with the formula NaCl. Sodium Chloride consist of 40% sodium and 60% chlorine, (1). Iodine is one of the most recognized micronutrient along with Vitamin A, Calcium, etc. It is needed in the human body in trace quantity and is a major component of the thyroid hormone. Humans cannot synthesize iodine rather; consumption of crops grown on the soil where iodine is present creates a pathway for iodine ingestion. Sea foods have been identified as the richest source of dietary source of iodine since the oceans contain sufficient amounts of iodine.

Iodine is an element that is needed for the production of thyroid hormone. If there is no enough iodine in the body, there will not be enough thyroid hormone. Thus, the deficiency of iodine can lead to enlargement of the thyroid, hypothyroidism and mental retardation in infants and children whose mothers were iodine deficient during pregnancy (2).

The natural dietary sources of iodine include milk, vegetables, fruits, cereals, eggs, meat, spinach and sea foods (3). However, natural sources of iodine may not be in bioavailable form and the concentration of iodine may be loss. So, in order to achieve adequate iodine intake, consumption of iodized salt is necessary (4).

The low content of iodine in staple diet results in decline in the rate of synthesis of the thyroid hormone

Deficiency Disorder (IDD), these secondary factors result in IDD regardless of adequate intake of iodine in diet (5).

Salt is a vital substance for the survival of all living creatures particularly humans. Water and salt regulate the water content of the body

Salt forces some water to stay outside the cells. It balances the amount of water that stays outside the cells. There are two oceans of water in the body; one ocean is held inside the cells of the body and the other

ocean is held outside the cells. Good health depends on a most delicate balance between the volume of these oceans, and this balance is achieved by salt.

Iodine is an essential micronutrient required in trace amount of 150 – 200 micrograms daily per person and this dosage is determined after taking into consideration the anticipated iodine loss during transport

Iodine deficiency is a major public health problem for populations throughout the world (6), particularly for the pregnant women and young children. It is a threat to the social and economic development of countries. The most devastating outcomes of iodine deficiency are increased perinatal mortality and mental retardation. Iodine deficiency is the greatest cause of preventable brain damage in childhood, which is the primary motivation behind the current worldwide thrive to eliminate it

At least 350 million Africans are at risk of iodine deficiency, of which goiters affects 28.3% of the African population (7). In Nigeria, 48% of its citizens are suffering from iodine deficiency disorder of which 15% leads to death.

So, to prevent this deficiency, salt iodization is considered the most effective long-term public health intervention for achieving optimal iodine nutrition.

At the World Summit for children in 1990, a goal was set to eliminate iodine deficiency by 2000. At that time, 25% of households consumed iodized salt, a proportion that increased to 66% by 2006 (8).

Salt is an effective vehicle for distributing iodine to the public because it does not spoil and is consumed in more predictable amounts than most other commodities

In Nigeria salt iodization laws are enforced through two key regulatory agencies; The Standards Organisation of Nigeria (SON) which sets the standard and the National Agency for Food and Drug Administration and Control (NAFDAC) which enforce the standards. In turn the salt manufacturers have established an umbrella association for effective self-regulation and to ensure distribution of adequately iodized salt (9). The standard defines properly iodized salt as > 50ppm iodine at port of entry and salt factory level; > 30ppm iodine at distributor and retail levels and > 15ppm iodine at household level (10).

Several countries are successful in their salt iodization program while many developing countries still have a setback. Generally, the stability of iodine in edible salt is influence by a lot of factors:

- Variations in amount of iodine added during production.
- Uneven distribution within batches or individual bags produced due to poor mixing.
- Losses in distribution, retail, in the house (during storage) and meal preparation (cooking).
- Primitive method of salt production leading to poor salt quality (impurities) which contributes to moisture absorption and leaching of iodine from the salt.
- Inadequate packaging.
- Exposure to high relative humidity, light, moisture content in impurities.

(11) and (12) discovered that high humidity resulted in rapid loss of iodine from salt iodized with potassium iodate with 30% - 98% loss of original iodine content. Although with no clear correlations, the researchers observed most adverse effect on the stability of iodine due to the presence of reducing agents and hygroscopic compound of magnesium whereas carbonates had little effect on the stability.

The main objective of salt iodization program is to ensure that salt contains the recommended amount of iodine at the time of consumption. The retention of the iodine depends on iodine compound used, the type of packaging material, exposure to the prevailing climatic condition and time between iodization and consumption. The permitted compounds for fortification are sodium and potassium iodides or iodates (13).

Salt has been shown to be hygroscopic at relative humidity above 76%, hence iodized salt that is improperly packed and transported over long distance under humid conditions attracts moisture and becomes wet, carrying the iodate to the bottom of the bat. At humidity lower than 76%, salt can release surface moisture and this also may, result in some iodine loss. If the bag is porous, the iodine compound can leak so that little or no iodine is left in the salt by the time it reaches the consumer. To reduce this loss, iodized salt should be packed in air tight bags of either high density polyethylene (HDPE) or polypropylene (PP) laminated or non-laminated or low density polyethylene – lined jute bag (Grade 1803 DW), jute bags lined with 150-gauge polyethylene sheet (14).

II. Material And Methods

Study design and period: Cross-sectional study was done in selected towns and cities of the state including the state capital lasted for three months.

Study population and variables: All households and eateries were included in the study and have chances of being selected.

Sample size and sampling procedures: A single population proportion formula using EPINFO; Multistage sampling procedure was used. From the total population 100 households and eateries were selected randomly. The calculated sample size was allocated into the selected senatorial based on the number of households they had. Households were selected using systematic sampling strategy. The salt samples were collected in each

household and were analyzed in the laboratory and the concentration of iodine was measured in titration method. (15).

Data analysis: The collected data were checked for errors and completeness on daily basis. Data were entered into EPI- Info version 7 and exported to SPSS version 23 for analysis.Frequencies and percentages were equally done to see the magnitude of events in the study prospective comparative study was carried out on patients of Department of general Medicine at Dr. Ram Manohar Lohia Combined Hospital, Vibhuti Khand, Gomti Nagar, Lucknow, Uttar Pradesh from November 2014 to November 2015. A total 300 adult subjects (both male and females) of aged ≥ 18, years were for in this study.(10)

III. Result

Table 1: Types of salts used in different households and eateries

SALTS	HOUSEHOLDS	EATERIES	PERCENTAGE
MC	50	15	65
DA	25	05	30
UB	05	Nil	05
TOTAL	80	20	100

Note: MC= Mr. Chef Salt, DA= Dangote salt and UB= Unbranded Salt (locally produced.)

The table above shows that Mr. Chef is the most commonly used salt (65%), while 30% uses Dangote and 5% uses the unbranded salt (locally produced).

Table 2: Households and eateries practices of keeping salts

STORAGE USED	TOTAL NUMBER	PERCENTAGE
CPC	80	80
OPC	02	02
MC	Nil	-
PM	18	18
TOTAL	100	100

Note: CPC= Closed Plastic Container, OPC= Open Plastic Container, MC= Metal Container and PM= Packaging Material.

The table above shows that 80% of salt consumers store their salts in a closed plastic container; about 18% of the consumers keep their salts in a packaging material while only 2% of consumers keep theirs in an open container.

The result of analysis of iodine content in parts per million (ppm) are summarized on the table 4.1 below. 33.3% of the salts analyzed shows iodine content extremely below the NAFDAC approved standard of 50 ppm while 66.7% of the salt samples were slightly lower. Also, the data analysis showed that majority of the salt collected in different households contained iodine level above the minimum level of 30 ppm recommended at retail sale. The iodine level in the salt samples ranged between 28.9 ppm and 41.7 ppm. Just one sample was found to be below the minimum level.

Table 3: Result of iodine content of the samples analyzed

S/N	SAMPLE	MANUFACTURER	IODINE CONTENT (ppm)	*MINIMUM IODINE CONTENT LEVEL (ppm)	*APPROVED IODINE CONTENT (ppm)
1	A	MC	39.9	30	50.0
2	B	DA	41.7	30	50.0
3	C	UB	28.9	30	50.0

Note: MC= Mr. Chef Salt, DA= Dangote salt and UB= Unbranded Salt (locally produced. *(NAFDAC, 2004)Local branded salt is always open on larger container in retail shop this could not prevent open dust, and also to all climatic condition of the day

IV. Discussion

The aim of this study was to find out the iodine content of edible salt at household level and the factors that may affect iodine content

The salt samples analyzed were of different brands being sold in sachet and the other is a measured type of salt being sold in nylon (unbranded).

The study shows that Mr. Chef is the commonest branded salt (65%), while 30% uses Dangote and 5% uses the unbranded salt (locally produced), which is the least among the commonly consumed salts. This is in contrast with a previous study done by (16) that Anapunna is the commonest branded salt but this may due to change in the taste and unavailability of Anapunna salt.

it is shown from the study that majority of the samples collected were branded, majority were using unbranded salt. The sample of different salts collected for analysis was manufactured few months to the period they were used. Majority of consumers (about 70%) consumes the smallest sachet of salt within 2 to 6 weeks, while about 30% consumes salt within 8 to 12 weeks. Majority of the salt samples collected were bought in open markets by the consumers. Also, 80% of salt consumers store their salts in a closed plastic container; about 18% of the consumers keep their salts in a packaging material while only 2% of consumers keep theirs in an open container. It was shown through data collected that many of the consumers were ignorance of effect of storing salt in an open container.

From the analysis carried out to ascertain the iodine content of salt samples, it can be concluded that all salt samples analyzed contain a certain percentage it was discovered that some of the salt samples were above the minimum level but below the NAFDAC approved iodine content in Nigeria. This could be as a result of several factors such as transportation, method of storage, rain, exposure to sun light, high humidity, heat, etc. which are major factor that can cause reduction in iodine content, is in accordance with Diosadyet. (17) and (18). Improper storage, poor handling practices and buying non iodized salt are some of the cause for low iodine content in salt [19, 20, 21].

Iodized salt that is improperly packed and transported over long distance under humid conditions attracts moisture and becomes wet, reducing iodine content of the salts. At humidity lower than 76%, salt can release surface moisture and this also may result in some iodine loss. If the bag used in storing salt is porous, the iodine compound can escape so that little or no iodine is left in the salt by the time it reaches the consumer. To reduce this loss, iodized salt should be packed in air tight bags of either high density polyethylene (HDPE) or polypropylene (PP) laminated or non-laminated or low density polyethylene – lined jute bag (FAO/WHO,2001). Also, it is known that after salt is exposed to air for 4 weeks, the salt losses 100% of its iodine content (John D., 2012). This is evident in the amount of iodine present in unbranded salt (locally produced salt), which is extremely below the minimum level of 30 ppm recommended at retail sale.

Although the study carried out shows that the commonly consumed salts in Nigeria are below the NAFDAC Standard level, most of the salts contain iodine above the minimum level. However, the proportion of households with inadequate iodine content in salt is in line studies conducted in Nigeria 95% [28], Ghana 75.6% [12] India and Tajikistan(64%, 71% respectively) [29, 30].

The possible reason for this discrepancy may be the difference in technology and institutional factors to refine iodize salt, lack of enforcement in the legislation, and quality-controlled iodization technology at the production site, awareness of community, effective transport channels, correct labeling, packaging and storage The fact that many Nigerians are poor, few ones are still using the unbranded salt that is locally produced which are very low in iodine content.

V. Conclusion

This study demonstrated that some proportions of salt consumers were consuming inadequately iodized salt. Socio-demographic factors such as ethnicity, religion, sex, lower educational level of food caterers might have an influence on poor, household practices like exposure of salt to sunlight. Hence, information, education and communication on the importance of consuming iodized salt and its proper handling in the house is important and regular monitoring of the salt iodine level at consumer level is also essential for healthy living. It is recommended that consumers should be informed or enlightened on the basic reason for consuming iodized salts, especially branded salts.

Awareness campaigns and education should be intensified and sustained in order to ensure that the people are fully enlightened.

Further studies should also be carried out on different household keeping practices and also to identify the place of iodine loss from the salt; in manufacture industry, during transport, house or in the shop.

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