Iodine and Potassium Iodide content of packet salts sold in major markets in Enugu State, Nigeria

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ABSTRACT

***Background:** : Potassium iodide is a chemical form of iodine used to supplement iodine intake in edible salts to prevent iodine deficiency disorders.*

***Objectives:** The aim of this study was to determine the iodine and potassium iodide content of different salt brands sold in major markets in Enugu state and compare these values with the national standard for retail-level salts.*

***Methods:** Six salt brands, including three local and three foreign brands, were randomly purchased from the market in Enugu state. The iodometric titration method was used in the analytical laboratory to determine the salt samples' iodine and potassium iodide content. One-sample student t-test was used to compare the results with the national standards for iodine and potassium iodide, while Analysis of Variance and Turkey HSD tests were used to compare the mean values of the different salt samples. Statistical significance was set at $p < 0.05$.*

***Results**: The iodine content of the salt samples ranged from 30.55 to 45.25 ppm, and the potassium iodide content ranged from 24.10 to 47.60 ppm. All the samples met the national standard requirement for iodine (>30 ppm), but all were below the standard for potassium iodide (>50 ppm).*

***Conclusion:** The iodine levels in major salts sold in major markets in Enugu state met the National standard, but the potassium iodide content fell short of the requirements set by food law in Nigeria.*

Keyword: *Iodine, Potassium Iodide, Salts, Standards*

Received: 27-04-23
Accepted: 27-06-23
doi: https://dx.doi.org/10.4314/njns.v44i2.14

INTRODUCTION

Iodine, a non-metallic trace mineral, is essential for human health, with fetal development and early childhood being critical stages of requirement (1,2). It plays a crucial role in the function of the thyroid gland, which produces thyroxine (T4) and triiodothyronine (T3) hormones that regulate various physiological processes, including cell division, metabolism, growth, immune function, and mental health (3,4). Inadequate iodine intake can lead to the insufficient synthesis of thyroid hormones, resulting in adverse effects on mental growth,

cognitive development, and physical growth in children, as well as impaired mental functioning and reduced energy and productivity in adults (5–7).

Iodine can be obtained from various food sources, including seaweed species such as kelp, nori, kombu, and wakame, seafoods, green vegetables, iodized salt, dairy products, grain products, and eggs (6,8). However, the iodine content in these foods can vary widely depending on factors such as soil iodine content, fertilizer use, and irrigation practices 0(Institute of Medicine, 2001). Plant-based foods can have iodine concentrations ranging from 10 mcg/kg to 1 mg/kg dry weight, which in turn affects the iodine content of meat and animal products due to their diet (10). Therefore, people living in coastal areas or near marine waters may have better access to seafood and sea salt as a source of iodine in their diets.

To combat iodine deficiency, various approaches have been proposed and implemented, including the iodization of tea, bread, water, oils, and salt (11). Salt has been recognized as an excellent carrier for iodine and other nutrients, as it is safe, widely consumed, and independent of economic status (12). In fact, the Universal Salt Iodization (USI) program launched by the Joint UNICEF/WHO Committee on Health Policy in 1993 recommended the iodization of all food-grade salt for human and animal consumption to reduce the prevalence of iodine deficiency disorders (IDD) (12–14), and this approach has shown positive results in reducing the prevalence of iodine deficiency (13).

In Nigeria, salt iodization is regulated by the Standard Organization of Nigeria (SON), which sets standards for iodized salts, and the National Agency for Food and Drug Administration and Control (NAFDAC), which enforces standards for adequately iodized salts with >30 ppm iodine and >50 ppm potassium iodate content at the retail level (12). Despite the implementation of USI for two decades, research findings indicate that about 48% of Nigerians still do not consume adequately iodized salts in their households due to lapses in the monitoring of salt production companies (15). Regular research monitoring of nutrition programs is crucial to ensure proper practices and detection of any anomalies in implementation. Therefore, this study aims to determine the iodine and potassium iodide content of packet salts sold in major markets in Enugu state, Nigeria.

MATERIALS AND METHOD

Study design:

The study utilized an experimental design.

Procurement of Samples

Samples were obtained from Ogige market and Shoprite mall in Nsukka and Enugu city, respectively. Two different locations were chosen for purchasing salt samples as there were fewer brands available at the market in Nsukka. Six types of sachet salts were randomly purchased from the market and coded as samples 1-6 for iodine and potassium iodide determination, respectively. The manufacturing companies were recorded, with three being the local salt brands and three being foreign (imported) salt brands.

Determination of iodine and Potassium iodide content of Samples

Iodometric titration method, as described by AOAC (16), was used to determine the iodine and potassium iodide content of the salt samples. The standard set by the National Agency for Food and Drug Administration and Control (NAFDAC), which requires >30 ppm iodine and >50 ppm potassium iodide content at the retail level, was used as the standard to assess the suitability of the salt samples.

Statistical Analysis

Data were analyzed using IBM SPSS statistics version 23. Means and standard deviations were computed. Analysis of variance and turkey HSD test was used to compare the means. One sample student t-test was used to compare the means with NAFDAC standard. Statistical significance was accepted at $p < 0.05$.

RESULTS

The results of iodine and potassium iodide content for six different salt brands, labeled as salt 1 to salt 6, are presented in Table 1. Salt 3 showed significantly higher levels of iodine (45.25 ppm) and potassium iodide (47.60 ppm) content compared to the other salts. Salt 2 and salt 4 had comparable levels of iodine (30.55 ppm and 33.30 ppm, respectively), while salt 4 had the lowest potassium iodide content (24.10 ppm). Salt 1 (45.15 ppm iodine and 45.75 ppm potassium iodide) and salt 6 (44.35 ppm iodine and 47.55 ppm potassium iodide) had similar levels of iodine and potassium iodide content, and both had higher levels compared to salt 2, 3, 4, and 5.

Table 2 presents the mean values, p-values, and t-values of the salt brands along with their iodine and potassium iodide content levels. All the salt samples had iodine content levels above the recommended threshold of >30 ppm. However, only salts 1, 3, 5, and 6 showed significantly higher iodine content ($p < 0.05$) compared to the recommended levels for retail salt. On the other hand, the potassium iodide content of all salt samples was lower than the recommended levels. Among them, only salts 1, 4, and 5 showed significant differences ($p < 0.05$) and were lower than the recommended standard of >50 ppm.

DISCUSSION

The study aimed to determine the iodine and potassium iodide content of packet salts sold in major markets in Enugu state, Nigeria. The findings revealed that none of the salt samples studied met the minimum recommended standard for potassium iodide (>50 ppm for salts at retail level). This is concerning as salt iodization is meant to reduce the incidence and prevalence of iodine deficiency disorders in Nigeria. However, inadequate iodization of salt may result in failure to achieve the goals of the universal salt iodization campaign.

A similar study conducted in Adamawa state on five salt brands reported that only two met the minimum recommended level for potassium iodide in iodized salt (12). This finding corroborates with our results, indicating that salts in the Enugu markets also do not meet the minimum recommended levels of potassium iodide. Therefore, periodic screening and evaluation of policies and programs by relevant government agencies to ensure adherence is crucial for promoting a healthy nation.

The low levels of potassium iodide found in packaged salt samples in the market raise significant concerns. It is well known that potassium iodide sublimes on exposure, which means that when consumers purchase salt and store it in the kitchen, no potassium iodide will be left in the salt, as salt is often stored in open containers in most homes. This exposes families to the risk of iodine deficiency disorders (IDD) (11).

Iodine deficiency disorders occur due to inadequate iodine intake in the body. Since the human body cannot produce iodine on its own, it relies on daily consumption for its supply. The importance of iodine in the health of an individual cannot be overstated, as it plays a crucial role in the cognitive development of the fetus and the intelligence quotient of children (5). While iodine is made available in salts through salt iodization, the degree of its absorption depends on the level of potassium iodide used for fortification, as potassium iodide aids in the better absorption of iodine in the thyroid gland.

A study conducted by Ekott and Ubong (17) on salt brands revealed that salts are often exposed to high temperatures and sunlight without proper covering at retail shops in open markets. This exposure to air and high temperatures facilitates the sublimation of iodine from salts, resulting in loss of iodine content. Many petty traders and retailers are unaware of proper storage practices for iodized salts and the health implications associated with them. To reduce this loss, steps were taken to use yellow polythene containers or packets in the packaging of salt brands (17). Manufacturers are advised to use proper packaging materials to limit the loss of iodine and potassium iodide from salts during production, distribution, and storage at household levels.

Table 1: Iodine and Potassium iodide content of six salt brands purchased in Enugu state.

Samples	Iodine (ppm)	Potassium iodide (ppm)
Salt 1	45.15 ± 1.63^{d}	45.75 ± 0.35^{c}
Salt 2	30.55 ± 2.05^{a}	33.30 ± 2.26^{b}
Salt 3	45.25 ± 0.78^{d}	47.60 ± 1.41^{c}
Salt 4	34.50 ± 2.40^{ab}	24.10 ± 0.99^{a}
Salt 5	38.65 ± 0.64^{bc}	32.75 ± 1.48^{b}
Salt 6	44.35 ± 0.99^{cd}	47.55 ± 1.48^{c}

Mean± standard deviation of the duplicate sample. $^{a-d}$Mean values with difference superscript (column) are significant at $p<0.05$.

Table 2: Mean iodine and potassium iodide content of the salts with NAFDAC standard recommendation using one-sample T-test

Samples		Iodine (>30 ppm)	Potassium iodide (>50 ppm)
Salt 1	**Mean**	45.15	45.75
	t-value	13.17	-17.0
	P-value	0.048*	0.037*
Salt 2	**Mean**	30.55	33.30
	t-value	0.38	-10.44
	P value	0.769	0.061
Salt 3	**Mean**	45.25	47.60
	t-value	27.73	-2.40
	P value	0.023*	0.251
Salt 4	**Mean**	34.50	24.90
	t-value	2.65	-35.86
	P-value	0.230	0.018*
Salt 5	**Mean**	38.65	32.75
	t-value	19.22	-16.43
	P-value	0.033*	0.039*
Salt 6	**Mean**	44.35	47.55
	t-value	22.08	-2.33
	P-value	0.029*	0.258

*Significantly different at $p<0.05$

CONCLUSION AND RECOMMENDATIONS

The results of the present study indicate that all analyzed salt brands meet the required standard for iodine (>30 ppm), but none meet the standard for potassium iodide (>50 ppm) as recommended by NAFDAC. This suggests that there is a gap in the monitoring process of manufacturing industries. Government regulatory bodies responsible for food products should take on the responsibility of effectively monitoring the iodization of salt brands sold at retail level to ensure compliance with recommended standards.

Government agencies such as SON and NAFDAC

are urged to implement the following measures for the effective monitoring of salt brands:

1. Conduct routine supervision of the production and fortification processes of all salt producing companies to ensure compliance with standards.
2. Perform analytical tests on iodized salts for iodine and potassium iodide content through simple random sampling on a quarterly basis, from various salt producing company brands to verify adherence to required standards.
3. Enforce laws that restrict the sale of non-iodized or poorly iodized salts in the market and at retail level.
4. The National Agency for Food and Drug Administration and Control, in collaboration with the Standard Organization of Nigeria, should enforce these laws and standards among salt-producing companies and at retail levels.

Conflict of Interest:

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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