IODINE PROFILE OF AKWANA LOCAL SALT AND SELECTED TRADE MARKED TABLE SALTS IN WUKARI MARKET, TARABA STATE, NIGERIA

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Abstract: The aim of this research is to assess and investigate the iodine content of Akwana local salt collected from Akwana area of Taraba State, Nigeria and trademarked salt in the market and to determine the effect of heat on the salts. This study revealed that Akwana mineral salt obtained from the mining pond (sample A) popular called "Akwana salt" naturally contained 116.10±0.08 mg/kg of iodine concentration as compared with the trademarked salts purchased from Wukari market, sample F (Uncle palm) and sample E (Mr Chef) which have 116.30±0.13 mg/kg and 116.10±0.08 mg/kg, respectively. Sample C (Akwana mineral salt raw filtrate obtained from the local factory in Akwana town) has 71.90±0.08 mg/kg iodine concentration while the least concentrations of iodine are found in sample B (Akwana mineral salt raw sample obtained from the local factory) and D (finished fused Akwana salt sample obtain from the local factory in Akwana town) contained 57.00±0.08 mg/kg and 13.60±0.13 mg/kg, respectively. The re-engineered particle size of Akwana salt had 11.8713 gm, 12.6449 and 13.9519 gm of iodine with comparable texture and particles as fine as the trademarked salt purchased from the market.

Keywords: Akwana salt, trademarked salt, iodine, re-engineered salt particle size

Introduction

Universally, table salts are fortified with iodine for human consumption. This is done to prevent iodine deficiency disorders (IDD) in humans (Pieter, 2003). IDD is a major public health problem in several areas of the world, especially in the developing countries. It has been reported that 2.2 billion people (about 38% of the world's population) live in areas with iodine deficiency and risk its complications (Wisnu, 2008). These complications include mental retardation (Consumer Voice, 2017), enlarged thyroid gland (goitre), growth retardation, reproductive failure, increased childhood mortality, thyroid storm, thyroid cancer and damage to the brain among others (Stephen, 2015).

The World Health Organization (WHO), UNICEF recommended iodine levels in salt and guidelines for monitoring their adequacy and effectiveness WHO/NUT/96.13 Geneva, 1996 (Table 1).

Table 1: Daily iodine requirement

Age Group	Daily Iodine Requirement (µg)
0-11 months	50
12-59 months	90
6-12 years	120
>12 years	150
Pregnant and lactating women	200

Iodine is a trace element that is essential for the synthesis of thyroid hormones by the thyroid gland. These hormones are involved in optimal mental and physical development and control of metabolic processes in the body (WHO, 2014). Adequate intake of iodine plays a key role in regulating human growth, development and metabolic functions (Rohneret *al.*, 2014; Zimmermann and Boelaert, 2015). Iodine functions in the body to correct iodine deficiency disorders such as, retarded mental and physical development, hypothyroidism, endemic goiter, reproductive failure and child mortality (Pieter, 2003). Iodized salt has been an important sources of dietary iodine, a trace element important for regulating human growth, development, and metabolic functions (Maalouf *et al.*, 2015).

The iodine content of foods depends on iodine content in the soil (WHO, 2014). The World Health Organization (WHO) maintains that on a worldwide basis, iodine deficiency is the most common cause of cretinism and is the most easily preventable. Hence, iodizing salts is a global public health strategy for addressing iodine deficiency (WHO, 2014). Nigeria supports the fight against IDD consequently; iodized salt is the accepted form of edible salt in Nigeria (NIS, 2004).

Akwana salt before now has not been known to contain iodine endowed by nature. Discovering that it contains Iodine during our preliminary investigation of the composition of Akwana salt gave us the impetus to investigate its iodine profile. The dearth of the knowledge of its iodine potency affected its patronage by consumers and the economy of the local producers. This has also been further worsened by its large grain size. Hence this work was embarked upon to study the content of iodine in the raw Akwana mineral salt, from sampling to the brine production and crystallization of the salt. And the second intent, to re-engineer the particle size to an acceptable size comparable to trademarked salts found in the markets. These will enhance its acceptance by consumers and improve its economic value to the local producers and other interested investors.

Materials and Methods

Study area

The study area covered three salt mining ponds and one local factory in Akwana district of Wukari Local Government area of Taraba State, Nigeria. Akwana lie between latitudes 7° 51' 0" North and longitudes 9° 14' 0" East and is 72 km away from Wukari which lie between longitudes 7° 51' 0" North and 9° 47' 0" East.

Sampling and sample technique

Samples used in this study include, Akwana mineral salt, raw mineral salt from mining site (Sample A), Akwana mineral salt raw sample obtained from the local factory (Sample B) and filtrate sample from the local factory (Sample C), Fused finished Akwana salt (Sample D), Branded salt samples, Uncle Palm (Sample E) and Mr. Chef (Sample F) purchased from Wukari market.

Random sampling was employed in the collection of all the samples from the mining site and local factory at Akwana district. 1 kg was taken for each sample in a plastic container. They were labelled and preserved for analysis.

Sample preparation

Samples A to D were filtered using different filtration beds packed with fine and coarse sand to obtain the brine and the brine (filtrates) were then used for qualitative and quantitative determination of iodine at ambient temperature and at 90, 100, 110^{0}Cduring crystallization.

Qualitative and quantitative determination of iodate content

Qualitative determination of iodine was carried out as follows: Sample (10 g) was weighed into a 250 ml Erlenmeyer flask with a stopper and 30 ml distilled water was added and swirled to dissolve the salt sample and made up to 50 ml. Then, 1 ml 1MH_2SO_4 solution was added to the solution followed by addition of 5 ml 10% KI and kept in the dark place for ten minutes for colour development. After ten minutes, the set up was observed for colour change. The presence of iodine was indicated by yellow colour. The same procedure was repeated for each of the samples. The quantitative determination was carried out on the above qualitative solution using this procedure.

A 50 mL burette was filled with 0.005M $Na_2S_2O_3$. The qualitative solution was titrated with the 0.005M $Na_2S_2O_3$ solution until the solution turn pale yellow. Then approximately 2 ml starch indicator solution was added, the solution turned dark blue. This was titrated further to a colorless solution. The volume of $Na_2S_2O_3$ consumed was recorded and converted to ppm directly. The procedure was repeated for all the samples.

Volatility of iodine at different temperatures

This was determined for various samples by weighing 10 g of each sample and placed in a drying oven at a temperature of 70, 80, 90, 100 and 110℃, respectively. Qualitative and quantitative determination of iodine was carried out for each sample to ascertain its iodine contents with respect to its volatility (Salami & Ojo, 2007).

Akwana salt particle size re-engineering

A 200 ml of each filtrate was measured into a 250 ml evaporating dish and was evaporated on a hotplate between 30 – 45 min at 100℃ for crystals to form. The yield for each sample was then determined by weighing the salt formed.

Results and Discussion

Table 2 shows the results of iodine content of Akwana mineral salt and trademarked salts. Sample A and F showed the highest concentration of iodine, 116.30±0.13 mg/kg and 116.10±0.08 mg/kg, respectively, also sample E has 113.70±0.13 mg/kg and sample C had 71.90±0.08 mg/kg. Samples B and D had the least concentration as 57.00±0.08 mg/kg and 13.60±0.13 mg/kg, respectively. The result showed that the concentration of iodine in sample A was slightly greater than that of B and C sold in the market.

Table 2: Concentration of iodine content of Akwana mineral salts and the trademarked salts

Sample	Conc. of iodine (mg/kg)
A	116.30 ± 0.13^a
B	13.60 ± 0.13^c
C	71.80 ± 0.08^b
D	57.00 ± 0.08^b
E	113.70 ± 0.13^a
F	116.10 ± 0.08^a

A: Akwana mineral salt, raw soil (AMS RAWs); B: Akwana local salt (from local factory, F1); C: Akwana local salt (from re-filtered factory soil, F2); D: Akwana local salt (Fused form); E: Mr. Chef (Trademarked salt); F: Uncle Palm (Trademarked salt).

The volatility of iodine with respect to temperature during crystallization is shown in Fig. 1 below. Exposure of Akwana salt samples to heat during processing and crystallization resulted to decrease in iodine content. Iodine content of sample A decreased from 116.30 to 105.70 mg/kg. A gradual decrease was observed in the following order 99.20, 89.50, 80.90, 78.60 and 67.20 mg/kg at the following corresponding temperatures 70, 80, 90, 100, 105 and 110^{o}C, respectively. The decrease in the concentration of iodine could be attributed to its ability to sublime when it absorbs heat.

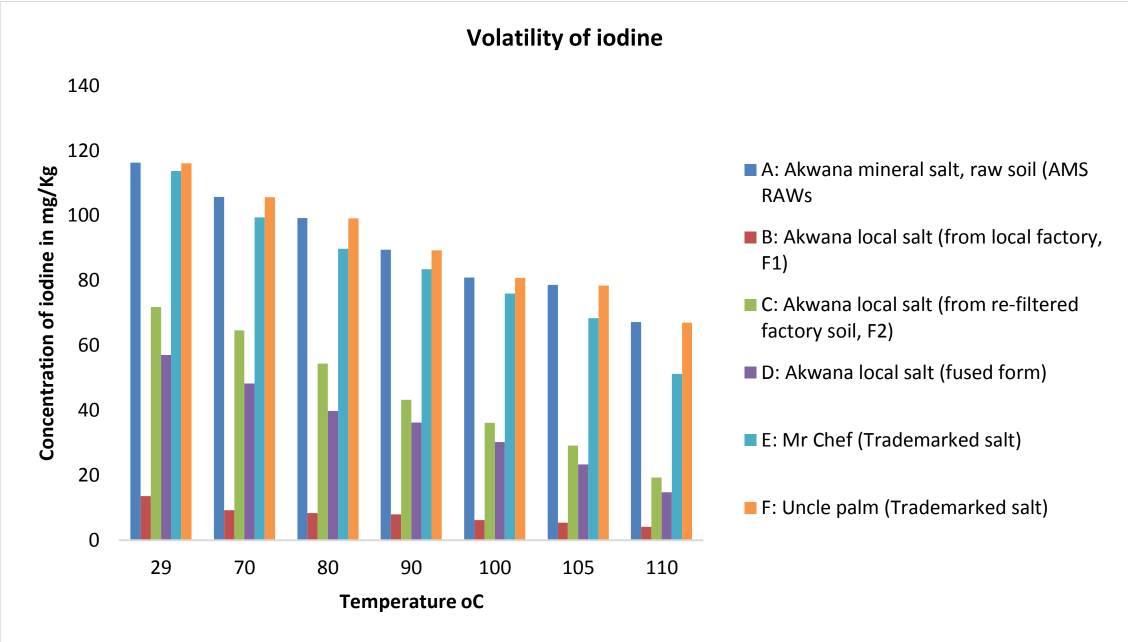

Fig. 1: Volatility of iodine with temperature change

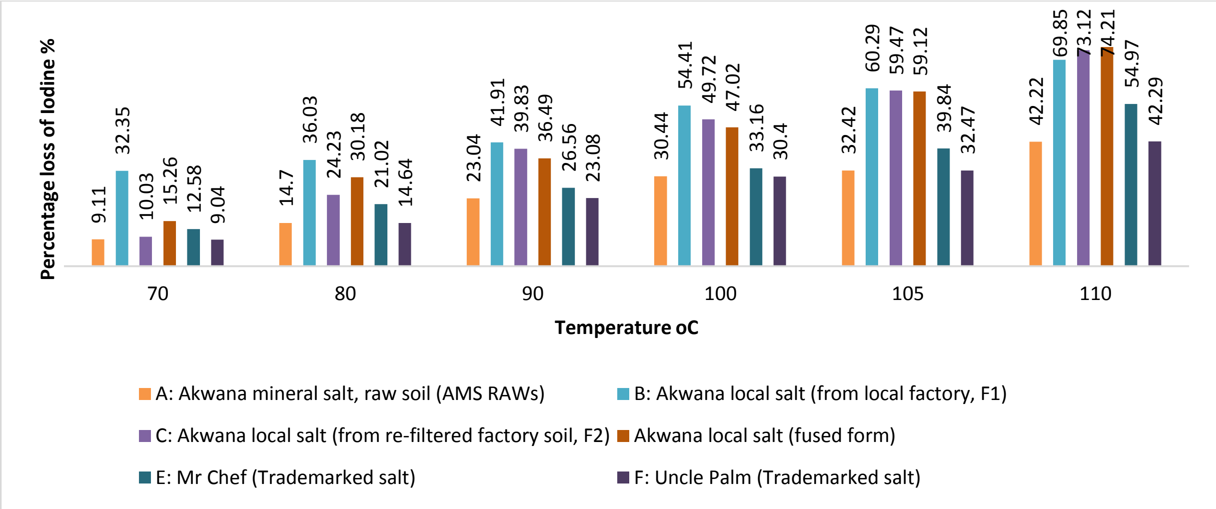

Fig. 2: Percentage loss of iodine with temperature change

Figure 2 shows percentage loss of iodine with temperature change. On exposure of the samples to heat at varying temperatures, the iodine content of sample A decreased from 116.30 to 105.70 mg/kg. This decreases further to 99.20, 89.50, 80.90, 78.60 and 67.20 mg/kg at 70, 80, 90, 100, 105 and 110ºC, respectively with the corresponding percentage loss as, 9.11, 14.70, 23.04, 30.44, 32.42, and 42.22%. In the case of sample B, the observed decreased was from 13.60 to the values 9.20, 8.30, 07.90, 06.20, 05.40 and 04.10 mg/kg for the corresponding temperatures of 70, 80, 90, 100, 105 and 110^{0}C, respectively. This represents percentage loss of 32.35, 36.03, 41.91, 54.41, 60.29, 69.85%, respectively. For sample C, D, E and F similar trend were observed as in the case of sample A and B but varying extent of iodine loss. The samples (B, C, D) experienced more than 50% loss in iodine content.

Table 3 shows fine re-engineered crystal particle size for Akwana table salt and the corresponding quantity of salt obtained via dilution. Sample A2 has the highest yield of 11.87, 12.64 and 13.95 gm, respectively. Sample A1, A3 and A5 gave fine crystals but low yield. The re-engineered particle size of Akwana salt looks more attractive when compared with the finished Akwana salt from the local factory and the one obtained in the laboratory. It has comparable texture with the trademarked salts (Mr Chef and Uncle Palm) purchased from Wukari market.

Table 3: Re–engineered particle size of Akwana salt (gm)

Samples	Dilution (50:250 ml)	Dilution (50:300 ml)	Dilution (50:350 ml)
A1	2.3221±0.002	2.6925±0.002	3.2228±0.001
A2	11.8713±0.001	12.6449±0.003	13.9519±0.002
A3	0.5039±0.002	0.7877±0.002	1.3024±0.002
A5	3.6000±0.01	4.0808±0.001	4.7020±0.001

A1: Filtrate from soil using salt water from the pond; A2: Filtrate from soil using distilled water; A3: Re-filtered local filtrate; A5: Filtrate from local factory

Conclusion

This study revealed that Akwana mineral salt from which the local Akwana salt is processed contain sufficient amount of iodine naturally added and would not need fortification with iodine to make it fit for consumption as table salt. Akwana salt if processed with modifications in the local factory it may meet the acceptable standard for table salt. Also, if is properly packaged it may compete favorably with other trademarked salts in the market.

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