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## **An Assessment of Levels of Iodine in Iodised Salt Retailed in the Ghanaian Markets**

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### **Abstract**

The salt iodization law of Ghana prescribed that edible salt meant for animal and human consumption must be iodised with potassium iodate between 25-50ppm for retail and production respectively. Packaged (refined) and unpackaged (crude) salts samples randomly obtained from selected locations across the then ten (10) regions of Ghana in fourteen (14) months, were analysed for their iodine content using classical titrimetric method. For the refined, 465 samples made up of 2 types, imported (7) and local (3), whilst the crude were 126 samples. None of the samples was compliant with the 25µg/g iodine level prescribed for retail. For instance, sample F refined, with a relatively wider distribution in this study, had a mean iodine content of  $50.1 \pm 0.02 \mu\text{g/g}$ , whilst crude sample from Upper West region being the only iodised salt recorded an average of  $51.6 \pm 0.002 \mu\text{g/g}$  iodine. Questionnaire responses revealed that the choice of salt type depends on availability, affordability, and not iodine content.

**Keywords:** iodised salt; universal salt iodisation; edible salt; iodine deficiency disorder.

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## **1. Introduction**

Access to iodised salt has increased worldwide with the Americas and the Western Pacific having the highest access of 89.8 and 89.0 percent respectively whilst; Africa has 66.6 percent [1]. The World Health Organization (WHO) and United Nations International Children and Education Fund (UNICEF) have recommended universal salt iodisation (USI) as a safe, cost-effective, and sustainable strategy to fight iodine deficiency disorders (IDD). This uses common salt as the vehicle to eliminate IDD [2].

Studies conducted between 1992 and 1994 showed that 33.3 percent of the districts in Ghana showed serious IDD problems that require urgent attention. For example, the situation in Upper East was most severe. Consequently, salt iodisation, was recommended as national priority in stemming this problem [3].

Ghana implemented this programme in 1996 by passing the mandatory salt law. The initial mandatory level was revised from 100 to 25-50 ppm [4]. Violating the law attracts a fine, imprisonment, seizure, administrative charges, and supervision of re-iodisation at a fee [3].

The revised medium term health strategy for Ghana still maintained high levels of IDDs in the Northern parts and some parts of the Western Region [5], and in the Central belt of Ghana [6, 7].

The major problems confronting past salt iodization strategies in Ghana include absence of coordinating agency, lack of political and financial commitment to implement the strategy; inadequate iodisation of salt by producers; and penchant for uniodised salt in spite of the awareness of IDD and the benefits of consuming iodised salt [3].

The goal of the Ghana USI programme is to achieve 90 percent coverage of household with adequately iodised salt, i.e. 90 percent of household actually buying and consuming adequately iodised salt. The expected outcome is the elimination of IDD in Ghana [3].

USI III strategy an improvement of the strategy II programme will move the household coverage of adequately iodised salt (>15 ppm) from the current 29.3% towards 90 percent in Ghana. A survey has however, indicated that 58 percent of salt sold in the markets of Ghana was iodised below 20 ppm compared with mandatory level of 25-50 ppm [5, 3]. The aim of this study therefore is to investigate the compliance with the law of the statutory content of iodine in salt in the Ghanaian Markets.

## **2. Methods**

### ***2.1 Salt sampling***

Packaged and unpackaged salt samples obtained at random from selected areas across Ghana. The packaged salt refers to the type of salt that is refined, granulated and sold in low-density polyethylene (LDPE) sachets, and labelled according to the manufacturers' specifications. The number of samples were four hundred and twenty six (426).

The unpackaged salt however is the type that is crude, unrefined or unprocessed. It is widely sold in open trays, and largely crystalline salt. It has no label. The total number of samples was one hundred and twenty six (126).

Between October 2017 and November 2018, the study took place.

**2.2 Salt iodine content**

The determination of the salt iodine content was by titrimetric method [8].

**3. Results**

**3.1 Packaged salt**

Tables 1, 2 and Figure 1 show the result for the packaged salt with respect to mean concentration, distribution and legal limits of iodine.

Table 1 shows the mean iodine concentrations in the various brands.

**Table 1:** Mean Iodine Concentrations in Brands of Packaged Salt.

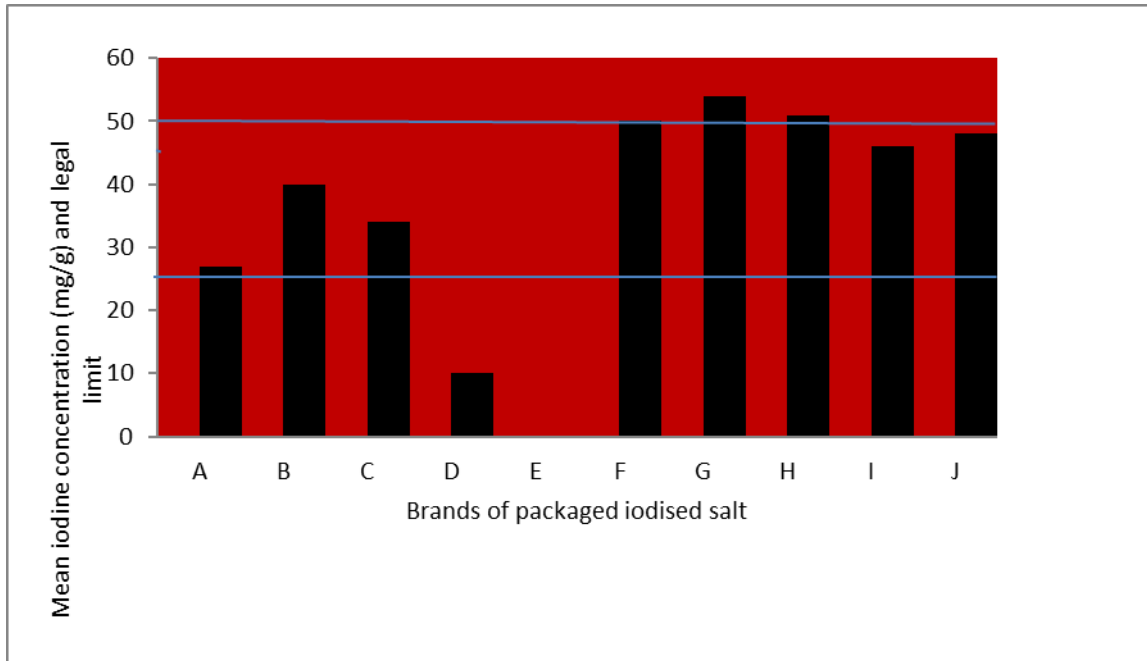
<b>Brand</b>	<b>Mean concentration, µg/g</b>
A	29.0 ± 0.03
B	40.2 ± 0.01
C	34.1 ± 0.01
D	10.1 ± 0.04
E	0.05 ± 0.01
F	50.1 ± 0.02
G	51.1 ± 0.04
H	51.1 ± 0.02
I	43.3 ± 0.01
J	47.2 ± 0.02

Source: Field work, Bartels, 2017

The extent of violation of the law about the statutory level of the salt at the retail is revealed in the concentrations as shown in Table 1. For instance, samples A, B, C, F,G, H, I and J constituting 80 percent have between 16 and 104 percent iodine concentration above the minimum limit of 25 ppm set for retail in the law; whilst 20 percent of the samples namely D and E contain between 60 and 100 percent iodine below the minimum level.

The producers might not have followed best practice in producing the salt, which could affect its integrity to fight IDD. There is therefore the need to intensify awareness about the tenets of the law.

Figure 1 shows the legal limits. Two separate horizontal lines represent these limits at the 25 and 50-ppm points. The 25-ppm is set for retail, and the 50-ppm for production as set by Ghana Standard Authority. Between these points, the salt is adequately iodised.



**Figure 1:** Mean iodine concentration (mg/g x 10<sup>3</sup>) of brands of salt and legal limits.

None of the samples has concentration of 25 ppm as shown in Figure 1. This is an indication that the salt is non-compliant with the law.

However, sixty (60) percent congregates within the 25-50 ppm bracket. These are samples A, B, C, F, I and J. These are rather supposed to be either at the production point, storage facility or in transit to distribution outlets, and not at the retail point where consumers can easily have access and consume. Obviously, such would deliver excess iodine to consumers with its resultant health implications.

**Table 2:** Distribution of the Brand of Packaged Salt across the Markets.

Brand of Salt	Percent distribution
A	48
B	3
C	13
D	3
E	3
F	100
G	39
H	74
I	6
J	3

Source: Bartels, statistical analysis, 2017

Sample F is the most widely distributed iodised salt in the markets of Ghana according to Table 2. As a result, it is available to a large number of consumers across Ghana compared to the other brands, and hence the leading brand to promote the USI programme.

### 3.2 Unpackaged salt

The results for the crude salt across the then ten regions of Ghana is shown in Table 3.

**Table 3:** Mean Iodine Concentration of Unpackaged Salt ( $\mu\text{g/g}$ ).

Regions	Mean Concentration of Iodine
Northern	$0.05 \pm 0.01$
Upper West	$51.6 \pm 0.02$
Upper East	$0.05 \pm 0.01$
Brong - Ahafo	$0.05 \pm 0.01$
Eastern	$0.05 \pm 0.01$
Ashanti	$0.05 \pm 0.01$
Central	$0.05 \pm 0.01$
Western	$0.05 \pm 0.01$
Greater Accra	$44.0 \pm 0.01$
Volta	$0.05 \pm 0.01$

Source: Statistics, Bartels, 2017

At the retail, the Upper West and Greater Accra constituting 20 percent of the regions produced salt with iodine content of 51.6 and 44.0  $\mu\text{g/g}$  respectively. The Upper West salt sample contains iodine that is 106 percent above the retail concentration of 25 ppm; whilst Greater Accra sample has 76 percent above it. This breach could be attributed to lack of monitoring during production and effective market surveillance.

### 3.3 Questionnaire responses

Tables 4-6 give information about the preference for type and manner of use of salt.

**Table 4:** Preference for Type of Salt.

Reasons	Respondents, %
Iodised	5
Availability	35
Affordability	60
<b>Total</b>	<b>100</b>

Source: Statistics, Bartels, 2017

The preference depends on availability (35%), affordability (60%), and not iodine content (5%) of the salt. The cost and the accessibility are the driving force and not the iodine, which is supposed to be priority. This could defeat the aim of the USI, and might not make its required impact.

**Table 5:** Manner of Use of Packaged Salt.

Manner of Use	Consumers, %
As table salt	9.8
As cooking salt	90.2
<b>Total</b>	<b>100</b>

Source: Statistics, Bartels, 2017

Most respondents (90.2%) use the salt for cooking. This manner of use does not yield maximum benefits of iodine to the consumer as it evaporates due to excessive heat. It should be used as table salt where evaporation of the iodine is negligible.

**Table 6:** Manner of Use of Unpackaged Salt.

Manner of Use	Consumers, %
As table salt	0.8
As cooking salt	99.2
<b>Total</b>	<b>100</b>

Source: Statistics, Bartels, 2017

Traditionally used for cooking at both high and low temperatures. This type is usually not used at the table because of the grain size and colour. The size is comparatively big and take long to dissolve in meals, whilst the colour is not appealing for the table.

Thus the 99.2 percent needs education about the proper use of the salt to achieve the objectives of the USI programme.

#### 4. Discussion

##### 4.1 Sampling of salt

Four hundred and twenty-six (426) samples of packaged salt, and 128 of unpackaged samples were sampled from the retail outlets, and analysed for their iodine content. The mandatory salt iodisation law of Ghana requires that all salt for both human and animal consumption must be iodised, and that salt meant for industrial use and which is not supposed to be iodised must be clearly marked as such [9].

During sampling, all the salt for sale sampled at the retail were for consumption, and none was marked for industrial use. Therefore, the samples were assumed iodised.

##### 4.2 Salt iodine content of packaged salt

They were seven (7) imported and three (3) local brands. The imported brands were samples A, B, C, D, I, J and E; whilst the local were samples G, H, and F as shown in Table 1.

The samples (426, 100%) A, B, C, D, E, F, G, H, I and J, having respective mean concentrations of  $29 \pm 0.03$ ,  $40 \pm 0.01$ ,  $34 \pm 0.01$ ,  $10 \pm 0.04$ ,  $0.05 \pm 0.01$ ,  $50.1 \pm 0.02$ ,  $51 \pm 0.04$ ,  $51 \pm 0.02$ ,  $43 \pm 0.02$ , and  $47 \pm 0.02$   $\mu\text{g/g}$ , did not comply with the GSA limit of 25 ppm for salt iodine at the retail outlet (markets) [9]. However, sample E though labelled as iodised did not contain iodine ( $0.05 \mu\text{g/g}$ ). This observation confirms the assertion that some of the salt in the markets are dishonestly, and wrongly labelled and do not comply with the provisions of

the law and inconsistent with production practices [3].

For example, sample F, a leading brand in Ghana was reported to contain less than 25 ppm iodine [5], and most widely distributed as shown in Table 2, rather contains  $50.1 \pm 0.02\text{g I/g}$  at the retail in the present study, an increase of about 50% over a period of five years. The producers are unable to comply with the 25 ppm legal limit as shown in Fig 1. Similarly, samples H and G with significant coverage of 74 and 37 percent respectively were also non-compliant as shown in Table1, Figure 1. This implies that households that consume these brands take in excess above the < 15 ppm recommended [3], and thus could derail the effort of the Government to implement an effective USI strategy. Likewise, expose consumers to iodine poisoning, and IDD.

On the other hand, samples G and H had concentrations that were above the maximum legal limit of 50 ppm, Figure 1. This implies that they contained iodine in excess of what is required to fight IDD, and that its consumption could lead to iodine poisoning. These salts constitute 20% of salt analysed. However, one percent (1%) of the salt did not meet the requirement, this was sample D with iodine concentration of 10 ppm, which was below the legal limit of 25 ppm did not contain adequate amount of iodine to fight IDD. These findings collaborated studies by Buxton & Baguuna, (2012) who found that in the Western Region of Ghana, 58% of iodised salts contained less than 20-ppm iodine compared with the mandatory iodisation level of 25-50 ppm. The consumption of such salt could result in hypothyroidism, hyperthyroidism, and malfunctioning of the body [10].

#### ***4.3 Salt iodine content of unpackaged salt***

The unpackaged salt is the type of edible salt that is crude, large crystals and sold in open containers. Usually served by measuring cups into polythene. One hundred and twenty-six (126) samples of such salts were analysed. The samples of such salt from Upper West and Greater Accra regions were the only samples that contained iodine as shown in Table 3 even though the levels are above the legal limit for retail.

As inferred from Tables 3 and 4, the relative availability and affordability of the crude salt could influence the decision of the 65.72% of the population [11] in the other regions to opt for crude salt, which is largely uniodised. Such practice has the potential of defeating the objectives of the USI programme in Ghana.

#### ***4.4 Questionnaire responses***

The questionnaire solicited information from participants about their reasons for preferring type of salt and manner of use. The responses shown in Table 4 expressed diverse opinion and practices about their preferences.

#### ***4.5 Preferred type of salt based on affordability***

As shown in Table 4, sixty percent (60%) of the respondents preferred salt that is, affordable. The preference is therefore about economic considerations. The cheaper the cost, the greater the patronage especially in Ghana where unemployment is a major socio-economic problem [12] and projected to increase by 5 % in 2023 [13]. Comparatively, the crude salt is cheaper than the packaged salt, 450g of the refined salt costs GC 5.00 whilst the

crude costs GC1.60 for the same quantity in 2023 [14, 15]. Such price difference of 68% has the tendency to attract respondents to salt that is cheaper, and in this case non-iodised salt as implied in Table 6. The purpose therefore for the USI programme, which in effect ensures that about 90 percent of households in Ghana have access to and consume adequately iodised salt to avoid IDD [16], which is premised on health could be defeated.

#### ***4.6 Preferred type of salt based on availability***

Again, equally fatalistic to the USI programme is the decision by 35 percent of the respondents to opt for salt, which is easily accessible (available), as shown in Table 4. In Ghana, crude salt is widely available in every market and in every corner where foodstuffs are sold as compared to refined salt. Again, cost of transportation and poor road network make it difficult for consumers who are hitherto not urban residents to ply urban areas to patronize refined salt.

#### ***4.7 Preferred type of salt based on iodine content***

The USI is instituted to help populations to fight against IDD. In Ghana, for the USI to be effective a law was promulgated to promote edible salt as the sole vehicle to provide dietary iodine for human and animal consumption. However, factors like affordability and accessibility affect the preference for iodised salt as depicted by the 5% of respondents as shown in Table 4. This suggests that consumers are not mindful of the benefits of iodised salt. To achieve a successful implementation of the USI programme in Ghana, affordability, availability and iodine content of salt must have the same priority.

#### ***4.8 Manner of use of salt***

Majority of respondents (90.2%), as shown in Table 5, use the packaged salt as cooking salt, though wrongly. Studies have revealed that cooking method and time of addition of salt during cooking result in loss of iodine between 6.58 to 51.08% [17], this could deprive the consumers of the full benefit of the iodine. In other words, it must be used as table salt, to reduce the loss of iodine in order to offer adequate iodine to the consumer. Producers do not provide information on the package about manner of use of content, as none of the packaging had such information, leaving the manner of use at the discretion of the respondents.

### **5. Conclusion**

Most of the packaged (refined) salt was adequately iodised. However, the concentrations at the retail was higher than expected. The unpackaged (crude) salt was largely not iodised. The few samples that were iodised had concentrations above the retail limit. Both types of salt did not satisfy the retail concentration of 25 ppm as required by law and specified by Ghana Standards Authority.

Questionnaire responses indicated that preference for type of salt depends on affordability, availability and not iodine content. Moreover, participants during cooking use the refined salt, which is supposed to be a table salt, as though it were cooking salt whilst the crude as table salt.



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## 6.Data Availability

Data is available on request

## 7.Conflicts of Interests

The authors do not declare any conflicts of interests

## 8. Funding Interest

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