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# Determination of Iodine Content and Stability in Selected Commercial Iodized Salts

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***Abstract*** *- Iodine is an essential element for the synthesis of thyroid hormones required for thyroid-stimulating hormones. Iodine deficiency leads to goiter, mental retardation, cretinism, brain damage, and neurological problems. Iodine Deficiency Disorder (IDD) is a major public health problem in developing countries including India. The consumption of foods grown on iodine-deficient soils leads to the production of iodine-deficient foods. To overcome iodine deficiency, fortification technology was developed through the addition of iodine in the form of chemicals in edible common salts. The iodine availability is an important parameter to assess iodine content in the targeted population that depends on the iodine present in the iodized salts. The stability of iodine present in the salt depends on the moisture, metals, impurities, and type of technology used in the manufacture of iodized salt. Iodine content labeled on the iodized salt packets may vary from company to company in the form of production, distribution, batches, mixing, and storage at the consumer level. The present research study was focused on the assessment of iodine content and stability of iodine in selected iodized salts available in the local markets of Tumakuru, Karnataka state, India.* ***Materials****: Eight iodized salt samples were collected from local supermarkets of different brands. General information was collected on the salt packets such as iodine content, packing date, and batch number for the stability study.* ***Method****: 10g of iodized salt sample was taken, dissolve completely, and add sulphuric acid and potassium iodide. Samples were titrated against sodium thiosulphate and starch was used as an indicator. The burette value was converted to parts per million (ppm) of iodine by using a conversion table.* ***Results****: The investigation of the study results of A1, A2, A3, and A4 samples showed 33.9, 20.1, 25.4, 39.7, and 51.9 ppm respectively compared to 15 ppm iodine labeled on the packets. A5.A6, A7, and A8 samples showed 51.9, 5.3, 7.4, and 4.6 ppm respectively compared to 30 ppm iodine on the packets. The stability of iodine after six months in A1, A2, A3, A4, and A5 was 97 to 100 %, and after expiry 91 to 96 % compared to the initial values and three samples were shown below the labeled value.* ***Conclusion****: This information may be useful to the consumers to know the iodine content present in the iodized salt to meet recommended daily allowance for controlling iodine deficiency disorders.*

***Keywords*** *- Iodine, Stability, Iodine Deficiency Disorders*.

## I. INTRODUCTION

Now a day the maintenance of good health is very important depending on the type of food consumption, and meeting recommended dietary allowance (RDA) leads to the development of a healthy society and nation. The present challenge being faced worldwide is micronutrient malnutrition and commonly referred to as hidden hunger. Iodine Deficiency Disorder (IDD) is a major public health problem and a reported 2.2 billion people have been affected in developing countries. Iodine deficiency can cause goiter, hypothyroidism, cretinism, mental retardation, brain damage, cell growth, and neurological problems in the targeted population [1, 2]. Iodine is an essential dietary element required for the synthesis of triiodothyronine (T3) and thyroxine (T4) under the control of thyroid-stimulating hormone (TSH) and dietary iodine deficiency stimulates TSH secretion and leads to thyroid hypertrophy [3]. If the constant intake of iodine is lower than 50 µg/day results in goiter. A sufficient quantity of dietary iodine supplementation is not possible to meet RDA through staple foods due to poor iodine content present in the soil. To overcome iodine deficiency, iodized salt was developed through fortification technology, where the addition of potassium iodate to edible salts which were widely used as a food vehicle for the fortification technology[4]. Salt is an excellent iodine carrier by the independent of socioeconomic status of the targeted population within society. The actual availability of iodine from iodized salt at the consumer level can vary a wide range of the amount of iodine added during the iodization process, and uneven distribution of iodine in the salt within batches, and individual bags. Iodine is added to the salt in the form of potassium iodate due to better oxidation resistance. Potassium iodate may be reduced to elemental iodine by reducing agents present in the salts such as ferrous iron and magnesium chloride. The stability of added iodine present in the salts is important to maintain the required amount of iodine for a stipulated period and iodine stability is mainly influenced by moisture, humidity, packing, light, heat, alkalinity, or acidity, pH, temperature, and type of impurities. Scientific reports indicated that the iodine losses ranged from 5 to 66 % as potassium iodate without stabilizers after 12 months of iodine stability. The current supplementation level of iodine in salt (15 ppm, 10 g daily average salt consumption will provide 150 µg/day of iodine) [5]. It is important to note that there should minimize the cost of iodized salt and the required amount of iodine delivered to the consumers' level. In the survey conducted by the National Nutrition Monitoring Board (NNMB) in 2000-2001 in rural areas of Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, Orissa, and West Bengal, the overall prevalence of total goiter rate among 6-12 year children was about 4 % [6]. Most of the Indian states have introduced mandatory salt iodization through legislation [7] to the national planners and salt producers for implications of an effective program, and safety [8]. To know iodine content in the salts, iodine testing is an important indicator process for monitoring the process towards universal salt iodization under the national iodine



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deficiency disorders control program in India. Iodization of salt is the recommended strategy within the level of iodization fixed at a minimum of 15 ppm at the consumer level and 30 ppm at the production level. Therefore, the main of the present study was to evaluate the iodine content and stability of iodine in the iodized salts.

## II. Materials and Methods

### *Chemicals*

Sodium thiosulphate, Sulphuric acid, Potassium iodide, Starch, Sodium chloride, and all the chemicals used were of analytical grade unless otherwise specified.

### *Study Design*

Random iodized salt samples were collected from local supermarkets of different brands in the Tumakuru District of Karnataka State. General information was collected on the iodized salt packets such as iodine content, packing date, batch number, and other information requires for the study. All samples were stored under controlled conditions throughout the study. All collected samples were stored at room temperature.

*Method [9]:* 10 g of iodized salt sample was taken in a 250 ml Erlenmeyer flask with a stopper. 50 ml water was added and swirled to dissolve the salt completely. 1ml 2N $H_2SO_4$, & 5 ml 10% of KI were added. The solution turned yellow indicating the presence of iodine. The flasks containing different samples were kept in dark for 10 minutes and titration with 0.005 M sodium thiosulphate until the solution turned pale yellow. Then 2 ml starch indicator was added and the titration was continued until the solution became pink and finally colorless. The thiosulphate level in the burette was recorded and this volume was converted to parts per million (ppm) of iodine by using an equation or conversion table.

$$\text{Iodine (ppm)} = \frac{\text{Titration volume (ml) X 21.15 X Normality of Sodium thiosulphate X1000}}{\text{Weight of Salt (g)}}$$

*Conversion table*

| BR | PPM | BR | PPM | BR | PPM | BR | PPM | BR | PPM |
|---|---|---|---|---|---|---|---|---|---|
| 0.1 | 1.1 | 2.1 | 22.2 | 4.1 | 43.4 | 6.1 | 64.5 | 8.1 | 85.7 |
| 0.2 | 2.1 | 2.2 | 23.3 | 4.2 | 44.4 | 6.2 | 65.6 | 8.2 | 86.8 |
| 0.3 | 3.2 | 2.3 | 24.3 | 4.3 | 45.5 | 6.3 | 66.7 | 8.3 | 87.8 |
| 0.4 | 4.2 | 2.4 | 25.4 | 4.4 | 46.6 | 6.4 | 67.7 | 8.4 | 88.9 |
| 0.5 | 5.3 | 2.5 | 26.5 | 4.5 | 47.6 | 6.5 | 68.8 | 8.5 | 89.9 |
| 0.6 | 6.3 | 2.6 | 27.5 | 4.6 | 48.7 | 6.6 | 69.8 | 8.6 | 91.0 |
| 0.7 | 7.4 | 2.7 | 28.6 | 4.7 | 49.7 | 6.7 | 70.9 | 8.7 | 92.0 |
| 0.8 | 8.5 | 2.8 | 29.6 | 4.8 | 50.8 | 6.8 | 71.9 | 8.8 | 93.1 |
| 0.9 | 9.5 | 2.9 | 30.7 | 4.9 | 51.9 | 6.9 | 73.0 | 8.9 | 94.2 |
| 1.0 | 10.6 | 3.0 | 31.7 | 5.0 | 52.9 | 7.0 | 74.1 | 9.0 | 95.2 |
| 1.1 | 11.6 | 3.1 | 32.8 | 5.1 | 54.0 | 7.1 | 75.1 | 9.1 | 96.3 |
| 1.2 | 12.7 | 3.2 | 33.9 | 5.2 | 55.0 | 7.2 | 76.2 | 9.2 | 97.3 |
| 1.3 | 13.8 | 3.3 | 34.9 | 5.3 | 56.1 | 7.3 | 77.2 | 9.3 | 98.4 |
| 1.4 | 14.8 | 3.4 | 36.0 | 5.4 | 57.1 | 7.4 | 78.3 | 9.4 | 99.5 |
| 1.5 | 15.9 | 3.5 | 37.0 | 5.5 | 58.2 | 7.5 | 79.4 | 9.5 | 100.5 |
| 1.6 | 16.9 | 3.6 | 38.1 | 5.6 | 59.2 | 7.6 | 80.4 | 9.6 | 101.6 |
| 1.7 | 18.0 | 3.7 | 39.1 | 5.7 | 60.3 | 7.7 | 81.5 | 9.7 | 102.6 |
| 1.8 | 19.0 | 3.8 | 40.2 | 5.8 | 61.4 | 7.8 | 82.5 | 9.8 | 103.7 |
| 1.9 | 20.1 | 3.9 | 41.3 | 5.9 | 62.4 | 7.9 | 83.6 | 9.9 | 104.7 |
| 2.0 | 21.2 | 4.0 | 42.3 | 6.0 | 63.5 | 8.0 | 84.6 | 10.0 | |

### *Statistical Analysis*

The results were subjected to statistical analysis. Origin 8.1 software was used for the graphs and statistical analysis.

## III. Results

Iodized salts samples were collected in both crystal and fine powder forms. The investigation results of iodized samples were shown as A1, A2, A3, A4 (For the research study sample codes are being created instead of company name) 33.9, 20.1, 25.4. 39.7 and 51.9 ppm respectively compared to 15 ppm iodine labeled on the iodized salt packets. A5.A6, A7, and A8 samples showed 51.9, 5.3, 7.4, and 4.6 ppm respectively compared to the 30 ppm iodine mentioned on the packets. The stability of iodine after six months in A1, A2, A3, A4, and A5 was 97 to 100 %, and after expiry 91 to 96 % compared to the initial values and three samples were shown below the labeled value (Table 1 and Figure 1).

TABLE 1

| Iodine content in selected iodized salts and stability(ppm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Iodine** | **A1** | **A2** | **A3** | **A4** | **A5** | **A6** | **A7** | **A8** |
| Iodine (on packet) | 15 | 15 | 15 | 15 | 30 | 30 | 30 | 30 |
| Iodine (Initial) | 33.9 | 20.1 | 25.4 | 39.7 | 51.9 | 5.3 | 7.4 | 4.6 |
| Iodine (after 6 months) | 33.9 | 19.0 | 25.4 | 37.0 | 50.8 | 5.3 | 6.3 | 3.2 |
| Iodine (After Expiry date) | 32.8 | 16.9 | 24.3 | 32.4 | 47.6 | 4.2 | 5.3 | 3.2 |

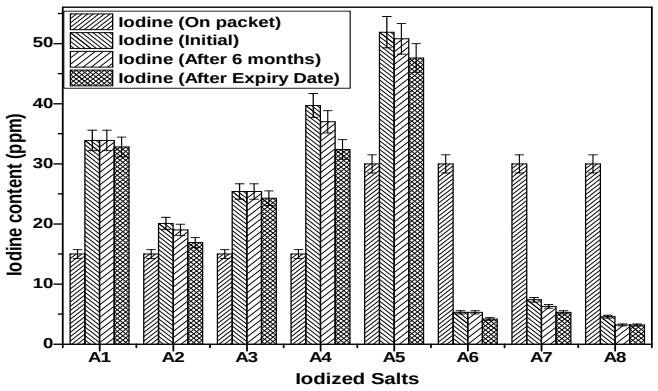


Fig. 1

## IV. Discussion

Iodine is a very essential element required for the thyroid hormone and is not available daily in the diet as the required quantity to meet recommended dietary allowance (RDA). Iodine is not present in the expected quantity in the natural sources due to soil conditions. To control IDD fortification technology has been developed to provide the required quantity of iodine through salt by the addition of the chemical potassium iodate. Research reports showed that 15 ppm of iodine per day is required to control iodine deficiency disorders. In many salt-producing companies indicated in their iodized salt packets, iodine content was different such as 15ppm or 30 ppm/kg. In this context, the present work was carried out by collecting different companies' iodized salt samples for analysis. Added iodine content was different from



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one company to a company of iodized salts. Collected samples are both crystal and fine powder forms of iodized salts. The investigation results showed A1, A2, A3, and A4 (For the research study sample codes are being created instead of company name) samples were shown 33.9, 20.1, 25.4. 39.7 and 51.9 ppm respectively compared to 15 ppm iodine labeled on the packets. A5.A6, A7, and A8 samples showed 51.9, 5.3, 7.4, and 4.6 ppm respectively compared to 30 ppm iodine on the packets. The stability of iodine after six months in A1, A2, A3, A4, and A5 was 97 to 100 %, and after expiry 91 to 96 % compared to the initial values and three samples were shown below the labeled value (Table 1). Branded salts contain iodine content range from 28-47 ppm and inadequate iodine < 5-15 ppm, adequate iodine 15 to > 30 ppm [10]. The results showed the stability of iodine content in commercial iodized salts depends on the addition of iodine and suitable technology used during the processing of salts.

## V. CONCLUSIONS

This information may be useful to the salt-producing companies and consumers to know the iodine content present in the iodized salt to meet recommended daily allowance for controlling iodine deficiency disorders.

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*Conflicts of Interest*: None

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