

## Estimation of iodine content of commercially available consumable salts in and around Madhuranthagam, Tamil Nadu, South India

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### Abstract

Iodine is an essential micronutrient in the thyroid hormone synthesis, hence inadequate or excess iodine may result in thyroid dysfunction. Hence the dietary iodine intake has to be monitored regularly for the recommended levels.

With other confounding factors in dietary source, salt fortification with iodine was implemented by World Health Organisation (WHO) and United Nations International Children's Emergency Fund (UNICEF) in 1993. In spite of Universal Salt Iodization (USI), Hypothyroidism is believed to be a common health issue in India and Worldwide.

Hence this study was done on a small scale primarily by estimating the salt iodine content of commercially available consumable salts. Salt packets were collected from the retail shops in and around Madhuranthagam. The iodine content in the salt samples was estimated and expressed in parts per million (p.p.m) based on the Titration method recommended by WHO. The results were analysed by the number of samples (in percentage) with adequate, less and excess iodine content as per the WHO recommendation.

**Keywords:** Consumable salt iodine, Iodine status, Thyroid dysfunction, Hypothyroidism, Universal salt iodization (USI).

### Introduction

Iodine is a micronutrient essentially required for thyroid hormone synthesis.<sup>1</sup> Thyroid hormones play a vital role in regulating basal metabolic rate, general growth and development and mainly in the development of nervous tissue. Hence, features of Iodine Deficiency Disorders (IDD) include endemic goitre, cretinism, retarded physical development, brain damage with irreversible mental retardation, abortions, still births and infertility.<sup>2</sup> Iodine deficiency is a common ecological problem where consumable commodities are grown in iodine - poor soil like remote inland areas, mountainous regions and where no marine foods are available. Hence based on the geographical need and to prevent Iodine deficiency, in 1991, World Health Assembly was adopted to eliminate iodine deficiency. In 1993, WHO, UNICEF AND ICCIDD recommended universal salt iodization as the safe and cost effective measure to eliminate IDD. Accordingly the daily intake of iodine was recommended as given in the Table 1.<sup>2</sup>

According to WHO, UNICEF AND ICCIDD, the salt has to be fortified with 20 – 40 mg of iodine per kilogram of salt (20 – 40 ppm) at the production site and at the household level it should have 15-40 ppm of iodine.<sup>2</sup>

This has to be done for the 20% loss of iodine in salt from production site to household and another 20% loss during cooking before consumption for an average salt intake of 10 gm per person per day.<sup>2</sup>

A survey on 2006 covering 91.1% of world population (since no data from 8.9% of world population i.e., 63 countries) showed out of 130 countries, 47 countries had IDD as a health problem, compared to 54 countries in 2004 and 126 in 1993. From remaining 83 countries, 76 countries

showed above the recommended levels of iodine intake and excessive in 7 countries. By 2013, 111 countries showed sufficient iodine intake, 33 are iodine deficient, 9 moderately deficient, 21 are mildly deficient and 10 countries with excessive iodine intake.<sup>3</sup>

IDD was first documented in India in the Himalayan region by McCarrison in 1908. Since 1950s, IDD is a public health problem in all States and union territories in India. Of the 325 districts surveyed in India, 263 districts are IDD-endemic, i.e. the prevalence of IDD is above 10 per cent in the population. In India as per the Coverage Evaluation Survey 2009, nearly 91 per cent of households in the country have access to iodized salt with 71 per cent consuming adequately iodized salt.<sup>4</sup> There are wide rural and urban variations in household coverage of adequately iodized salt (83.2% in urban areas vs. 66.1% in rural areas).<sup>5</sup>

Though the world organizations are trying to control iodine deficiency disorders by many means especially by salt iodization, still it seems to be a common health issue. Hence this study was carried out to screen whether iodine in fortified salts at the consumer level is adequate to the recommended levels.

### Aim

To estimate the iodine content in commercially available consumable salts.

### Materials and Methods

#### Sample Collection

Consumable salt packets were collected from 21 retail shops from 13 villages near our college, in Madhuranthagam. Samples were collected from all available retail shops in

each village. Totally 52 salt packets were bought. Out of which, 40 salt packets (Fine – 21 and Coarse- 19) were included for the study, excluding some salt packets of same brand. The salt packets were checked for proper sealing and quality of packing before buying, as there are chances of iodine loss by oxidation in open air.

**Materials**

Sodium chloride (Emparta; AR), Sodium thiosulphate (Nice; LR), Sulphuric acid (Nice; LR), Potassium Iodide (Rankem, Hi-pure, LR) and Starch (Chemspure; LR) were used for the estimation of iodine content in the salt samples.

**Method**

As Iodate is much more stable, it is recommended as fortificant in preference to Iodide. Hence, the iodate content of the salt samples was estimated by Iodometric Titration method.<sup>2</sup>

**Iodometric Titration Method**

**Sampling of Salt**

Before the salt analysis, salt was thoroughly mixed in a zip – lock bag to ensure homogenous iodine distribution in the salt. Fifty gram of iodated salt was mixed in 250 ml of double distilled water (to attain a ratio of 10gm of salt in 50ml of distilled water) from which aliquot of 50ml was used for titration. Salt packets after sample collection were properly sealed and stored air-tight for future reference.

**Titration Method**

Sulphuric acid (2N H2SO4) (1-2 ml) and 10% Potassium iodide (5ml) was added to the salt solution (50 ml), which in the presence of iodine will turn yellow. The reaction mixture was kept in a dark place (with no exposure of light) (as iodide ions will be oxidized to iodine) for 10 minutes for optimal reaction. Later, it was titrated with Sodium thiosulphate (0.005 N) using starch (2ml) as an indirect indicator. The concentration of iodine in salt is calculated based on the titration volume (burette reading) of sodium thiosulphate and based on the formula mentioned below.<sup>2</sup>

**Calculation**

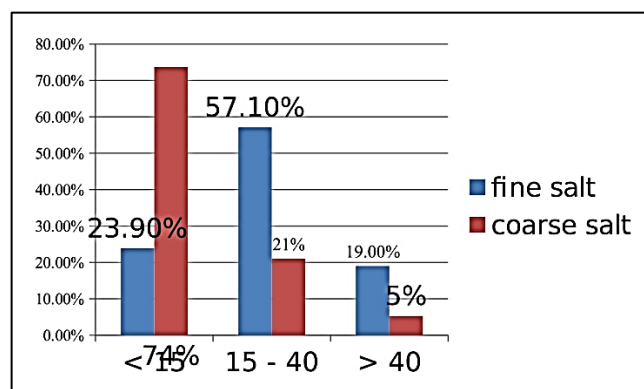
$$\text{Iodine content } \left( \frac{\text{mg}}{\text{Kg}} \right) (\text{ppm}) \text{ iodine} = \frac{\text{Titration volume (ml)} \times 21,15 \times \text{Normality of Sodium thiosuphate} \times 1000}{\text{Salt sample weight (gm)}}$$

**Result**

From our study, out of 40 salt samples, 19 samples (Fine – 5 and Coarse – 14) found to have <15ppm of iodine; 16 samples had adequate of 15-40ppm iodine (Fine – 12 and Coarse – 4) and 5 samples had > 40ppm of iodine (Fine –4 and Coarse –1) as given in table 2.

From the chart in Fig. 1, a relative comparison of required iodine content in fine and coarse salt can be done. It shows that the more than half of the fine salt samples have adequate iodine whereas majority of coarse salt samples have less than the required iodine content. This is further justified with the mean and standard deviation of iodine content of the salt samples. The fine salt samples showed a mean value of 26.63 ± 14.88 ppm of iodine with a median

of 28.55 ppm and the coarse salt samples showed a mean value of 11.40 ± 14.65 ppm of iodine with a median of 4.23 ppm as given in Table 3.



**Fig. 1:** Relative comparison of required iodine content in fine and coarse salt

**Table 1:** Recommended Iodine Intake by WHO, UNICEF and ICCIDD

Population group	Recommended daily iodine intake
Preschool children (0 – 59 months)	90 µg
School children (6 – 12 years)	120 µg
Adolescents (Above 12 years)	150 µg
Pregnant and Lactating women	250 µg

**Table 2:** Relative distribution of iodine content as per requirement in fine and coarse salt N = 40

Nature of salt	N	< 15 ppm		15– 40 ppm		> 40 ppm	
		n	%	n	%	n	%
Fine	21	5	23.80	12	57.14	4	19.04
Coarse	19	14	73.68	4	21.05	1	5.26
Total	40	19		16		5	

**Table 3:** Sample sizes, mean, standard deviation and median of iodine content in Fine and Coarse salts N=40

Nature of salt	Mean	Standard deviation	Median
Fine	26.63	14.88	28.55
Coarse	11.40	14.65	4.23

**Discussion**

The household coverage of adequately iodized salt in India has many ups and downs in the history of iodization programme. Nevertheless the efforts of USI has led to an improvement in the iodine status nationwide but with a discrepancy of 20% of households using inadequate iodized salt and 9% using non- iodized salt.<sup>6</sup>

According to Kapil et al, of the total coarse salt samples, 95.3% had less than 15 ppm of iodine and out of

powdered salt, 61.4% had less than 15 ppm of iodine, showing a higher percentage of salt samples having less iodine than the required levels.<sup>6</sup> Similar results have been documented from Haryana and Rajasthan.<sup>6</sup> Another study in Tamilnadu shows, only 16.2% of the population consumes required iodine of 15 ppm and more whereas by NFHS II survey, 21.5% of the population consumed required iodine.<sup>7</sup> According to Mohanty et al, in the household salt samples of Pondicherry, the mean iodine content in coarse iodised salt was  $36.7 \pm 9.4$  ppm which was comparatively higher than fine iodized salt of  $26.8 \pm 6.9$  ppm whereas fine iodized salt from retail shops had  $35.6 \pm 10.7$  ppm of iodine which almost coincides with our result.<sup>8</sup> Also, assessment of iodine concentration in table salt in South Africa at the production site revealed that fine salt had significantly higher mean iodine concentration than coarse salt showing similar results with our study.<sup>9</sup>

The commercial iodized salt products in Sri Lanka contained iodine in excess of recommended level of 15–30 mg/Kg.<sup>10</sup> Most of the people are tolerable to excess of iodine intake through food, water or other sources like drugs. Only susceptible individuals are at risk, influenced by age, gender, genetic predisposition, environmental factors, personal history of thyroid diseases and some medications. Tolerable upper level of iodine is 1100 µg/day.

The adverse effects of excess iodine intake above the tolerable level include thyroid dysfunction, thyroiditis, goiter, hyperthyroidism, sensitivity reactions and thyroid papillary cancers.<sup>10</sup>

## Conclusion

Most of the fine salts had adequate iodine content at consumer level. But few samples had lesser or more iodine content, hence should be further evaluated with increase in sample size along with thyroid function tests to rule out the cause for iodine related thyroid disorders.

Also, to overcome the difference in iodine content of salt, a social knowledge of salt iodization with internal quality control on the producer's side is mandatory. The Government's external monitoring and ensurance of adequacy of salt iodine content will yield improvement in the control of hypothyroidism.

**Conflict of Interest:** None

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