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Article

A study on consumption of iodine by an individual in selected area in Tangail, Bangladesh

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Abstract: The purpose of this study was to assess consumption of iodized salt by an individual (g/person/day) in a village of Tangail district and to compute the intake of iodine by an individual (µg/person/day) in a village in Tangail district. Vacuum evaporated salt was used for the study. The salt was analyzed for chemical composition and iodine content. Various physico-chemical characteristics of salt were analyzed to determine the moisture content, chloride content (as NaCl), water insoluble matter, pH, calcium content, magnesium content, and iodine content. Study was done among 68 families for a period of 35 days. Family member was divided into 4 groups according to their age - below 5 years, 5-9 years, 10-19 years and above 19 years. Male member among the family members was minimum 1 and maximum was 8. In case of female, minimum number was 1 and maximum number was 7. Among family members, 45.58% were male and 54.42% were female consumers. Percentage of salt consumers among Family members below 5 years was 11.81%, in 5-9 years it was 6.94%. Percentage of salt consumer in family members between 10-19 years was 24.54%, and salt consumers percentage in family members above 19 years was 56.71%. By statistical analysis among data, mean value of salt consumption g/ person /day was 12.49, standard deviation was 2.05 and minimum salt consumption among family members was 10.02 g/person/day and maximum value was 18.47 g/person/day. Among the family members, mean value of intake of iodine was 399.68 µg/person/day, maximum intake of iodine was 591.04 µg/person/day and minimum intake was 320.64 µg/person/day. Finding of this study was that, salt consumption rate are satisfactory and intake of iodine by individual in village Chamuria in Tangail district is adequate to avoid Iodine Deficiency Disorder in normal health condition.

Keywords: salt; iodine; calcium; magnesium; Bangladesh

1. Introduction

Iodine is an essential trace element present in nature. The bioavailability of iodide from iodized salt is only 10% of the estimated 0.75 mg iodide in iodized salt consumed per day (Edmundson *et al*., 1999; Abraham, 2006). Iodine is an essential micronutrient for normal growth and development. The human body contains about 15–20 mg of iodine, of which 70–80% is concentrated in the thyroid gland. Iodine is primarily obtained through the diet, but it is also a component of some medications (FAO and WHO, 2001). Dietary iodine is converted into the iodide ion in the gut lumen, and >90% is rapidly absorbed in the upper small intestine. However, absorption can be reduced by the presence of goitrogens in some foods and by deficiency of other micronutrients, such as selenium or iron. Fifteen percent of ingested iodine is taken up by the thyroid gland within 24 h of ingestion, and the excess is excreted by the kidneys in urine (EFSA, 2006). Iodine deficiency can be caused by consumption of iodine less salt or less iodine containing salt below the minimum requirement (Diosady *et al*., 1998). Iodine can be added to salt as potassium iodide, potassium iodide, or, less frequently, sodium iodide.

Salt is an excellent carrier for iodine, as it is consumed at relatively constant, well-definable levels by all people within a society, independently of socio-economic status. Salt is iodized by the addition of fixed amounts of potassium iodide or iodate, as either a dry solid or an aqueous solution. Iodine deficiency disorders (IDD) are one of the major nutritional problems in Bangladesh. Iodine deficiency affects at all stages of life. To eliminate the iodine deficiency, some countries use iodized capsule/oil or add iodine in drinking water. But the easiest way to control the problem is to use iodized salt, which is universally recognized as the most cost effective strategy in countries where iodine deficiency is wide spread (Bangladesh Gazette, 1989).

Iodine deficiency disorders (IDD) are recognized as a major global public health problem. According to the latest estimates, about 2.5 billion people worldwide (38% of the world's population) have insufficient iodine intake, of which 313 million are in the South-eastern Asian region that includes Bangladesh. Iodine deficiency is the single most preventable cause of neurological and intellectual impairment (cretinism) in the world. The law stipulates that all salt for human consumption must contain 45-50 parts per million (ppm) of iodine at the time of production and not less than 20 ppm iodine at the time of retail, to ensure a minimum of 15 ppm iodine at the household level (Harun, 2008). To prevent iodine deficiency disorders (IDD) in human, diet must be supplemented with iodine. During the past twenty years there has been a strong effort, lead by the United Nations, to iodize all salt for human consumption (Venkatesh Mannar, 1987). The iodine addition level is important, since too low levels in the diet will have no noticeable benefit, while excessive doses are wasteful, and may actually result in detrimental health effects. Considering these views in mind attempt was undertaken to analyze the physico-chemical properties of iodized salt, to determine the iodine content in a commercial iodized salt as well as to assess consumption of iodized salt by an individual (g/person/day) in a village in Tangail and to compute the intake of iodine by an individual (µg/person/day) in a village in Tangail.

2. Materials and Methods

2.1. Analysis of iodized salt

The chemical analysis of salt was carried out in the Ph.D. laboratory of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

2.2. Determination of moisture content of salt

AOAC (2005) method was used to determination of moisture content of salt.

2.3. Estimation of iodine in iodized salt

AOAC Official Methods of Analysis. 1984. Section 33, 147.

2.4. Determination of sodium choloride in iodized salt

AOAC (2005) method was used to determination of NaCI of salt.

2.5. Determination of calcium & magnesium (water soluble)

20g of salt sample was taken into a 1000ml volumetric flask. Distilled water was added to the volumetric flask to make the volume to 1000 ml. Hence the mother solution was prepared. For magnesium determination 10 ml of mother solution was taken into a 250 ml conical flask and 20-30 ml of distilled water was added. 10 ml buffer solution (pH 10) was added. Then 2-3 drops of Eriochrome Black T as indicator was added. Titrate with 0.01 N EDTA till the wine red color changes to pure blue or blackish blue (End point). The same procedure was followed with distilled water instead of sample for the blank titration. On the other hand for calcium determination 10 ml of mother solution was added into a 250 ml conical flask & 20-30 ml distilled water was added to it. 100 g of calcon mixed indicator was added and Titrate with 0.01 N EDTA till the green color changes to purple (End point). Same procedure was followed with distilled water instead of sample for the blank titration.

Calculation:

$$\% \text{ of } Mg^{++} = \frac{(V1\text{-}V2) \times F \times 243.1}{M}$$

Where,

M = mass in gm of dried sample
V1 = Volume of EDTA required for Magnesium, ml
V2 =Volume of EDTA required for Calcium, ml
F = Factor

Calculation:

$$\% \text{ of } Ca^{++} = \frac{V2 \times F \times 400}{M}$$

Where,

M = mass in gm of dried sample
V2 = Volume of EDTA required for Calcium, ml
F = Factor

2.6. Determination of pH of iodized salt

The pH of the selected samples was determined by the conventional procedure by a pH meter.

2.7. Determination of insoluble matter in salt

AOAC (2005) method was used to determination insoluble Matter in salt.

2.8. Estimation of potassium iodate solution used for iodized salt

AOAC (2005) method was used to determination of potassium iodate solution used for salt.

2.9. Salt intake survey

The study was conducted in the village chamuria, kalihati. Eighty questionnaires were distributed among the respondents and 68 complete questionnaires were received from them. Survey work are done by taking 68 families which was selected having at least one family members below 5 years, between 5-9 years, 10-19 years and above 19 years. Salt was distributed among family member in plastic pot with a spoon. Initially 2 kg of salt was supplied to each family in plastic pot. Weight of the salt was taken at an interval of 7 days and continued up to 35 days. Additional salt was supplied if required. During study period it was noted how many members took meals outside by family and how many guests were entertained. Quantitative and Qualitative data were converted into scoring wherever necessary. Data obtained from the respondents were first transferred to a master sheet, then compiled, coded, tabulated and analyzed in accordance with the objectives of the study. Such statistical measures as number and percentage distribution, range, mean and standard deviation were used in describing different variables. For clarity of understanding tables were used in presenting data. The data were entered into computer by using Microsoft Excel spread sheet and SPSS (Statistical Package for Social Sciences) package program.

3. Results

3.1. Physico-chemical analysis of iodized salt

3.1.1. Moisture content of iodized salt

Moisture content of iodized Salt was shown in Table1. In table showed that, by observation, amount of moisture content was found 0.18% in iodized salt, which is compared with BDS standard 6%, WFP standard 3%, China standard 0.1% and India standard 0.5%.

3.1.2. Water insoluble matter of iodized salt

Water insoluble matter of iodized Salt was shown in Table 1. In the table showed that, amount of Water insoluble matter percent by mass in iodized salt was 0.11% by observation, which is compared with BDS, WFP, China, and India standard o.1%, 0.2%, 0.1% and 0.1% respectively.

3.1.3. Chloride content (as Nacl) % in iodized salt

Chloride content (as Nacl) % of iodized salt was shown in Table 1. In the table showed that, by observation, amount of Chloride content (as Nacl)% in iodized salt was 99.55% which is compared with BDS, WFP, China, and India standard 97%, 97%, 99% and 98.50 % respectively.

3.1.4. pH of iodized salt

pH of the samples obtained by analysis was 7.26. In BDS standard it is ranges between 6.4-7.4, in WFP it varies from 6.5-7.5, in China Standard it is 6.5-7.4 and India standard it ranges between 6.6-7.2.

3.1.5. Iodine, Mg and Ca content of iodized salt

Iodine of the samples obtained by analysis was 32 mg/kg, In BDS standard it is ranges between 20.0-50.0 mg/kg, in WFP standard and Canada standard it is same to BDS and India it is 30 mg/kg.

Mg and Ca content of iodized Salt of the samples were obtained by analysis was 0.00% and 0.09% respectively. In different standard it is 0.1%.

3.2. Salt intake survey results

3.2.1. Distribution of respondent by gender

Distribution of respondent by gender is shown graphically in Figure1.

In this study, 68 family were selected which have total family numbers 432. In which male members were 198 and female members were 234 out of 432. The mean of male and female was 2.88 and 3.44 respectively. Male member in the family is minimum 1 and maximum 8. In case of female minimum number 1 and maximum number was 7. In percentages, 45.58% of male salt consumers and 54.42% were female consumers.

3.2.2. Distribution of respondent by age group

Distribution of respondent by age group is shown graphically in Figure2.

In this study, 68 family was selected which have total family numbers 432. Family members are divided into 4 categories according to their age. In case of category, Family members below 5 years was fall into category 1, in category 2 family members 5-9 yrs old were held, family members 10-19 years and family members above 19 years were held into category 3 and category 4 respectively. Sum of category 1, 2, 3, 4 are 51, 30, 106 and 245 respectively. Percentage of salt consumer in family members below 5 years was 11.81%, in family members 5-9 years, it was 6.94%, percentage of salt consumer in Family members 10-19 years was 24.54% and percentage of salt consumer in Family members above 19 years was 56.71%.

3.2.3. Salt consumption g/person/day

Salt consumption g/day/person is shown graphically in Figure3.

By statistical analysis among data, the mean value of salt consumption g/ person /day was 12.49, minimum salt consumption g/person/day among members was 10.02 and maximum consumption was 18.47 g/ person /day among the family members.

3.2.4. Intake of iodine µg/ person /day

Intake of iodine µg/person/day is shown graphically in Figure4.

By statistical analysis among data, the mean value of intake of iodine µg/person/day was 399.68, minimum intake of iodine µg/person/day was 320.68 and maximum intake of iodine µg/person/day was 591.04 among the family members.

Table 1. Parameters of Physico-chemical properties of iodized salt.

Parameters	Observed value	BDS (Bangladesh) standard value	WFP (World food program) standard	China standard	India standard
Moisture percent by mass	0.18	6.0	3.0	0.1	0.5
Water insoluble matter percent by mass	0.11	0.1	0.2	0.1	0.1
Chloride content (as NaCl)	99.55	97.0	97.0	99.0	98.50
pH Range	7.26	6.4-7.4	6.5 -7.2	6.5-7.4	6.6-7.2
Mg	0.00	0.1	0.1	0.1	0.1
Iodine content mg/kg	32	20.0 to 50.0	20.0 to 50.0	20.0 to 50.0	30
Ca	0.09	0.1	0.1	0.1	0.1

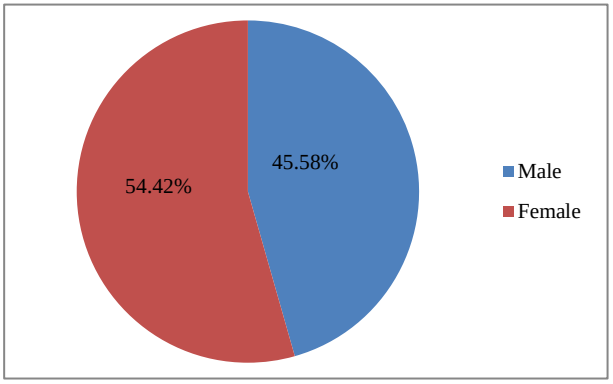

Figure 1. Graphical representation of distribution of respondent by gender.

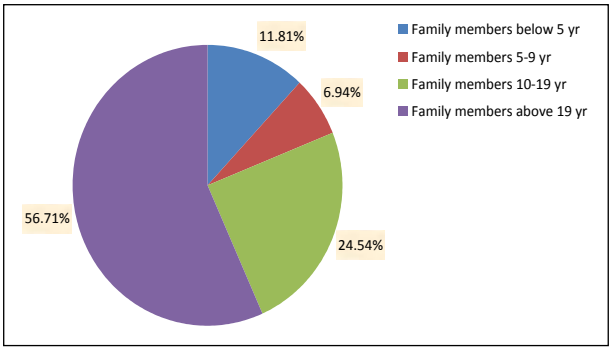

Figure 2. Graphical representation of distribution of respondent by age group.

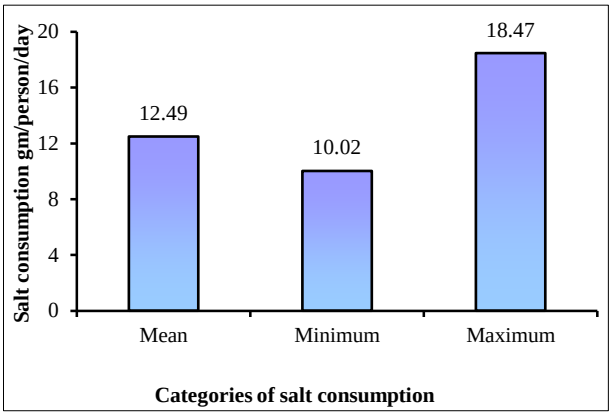

Figure 3. Graphical representations of Salt consumption g/person/day.

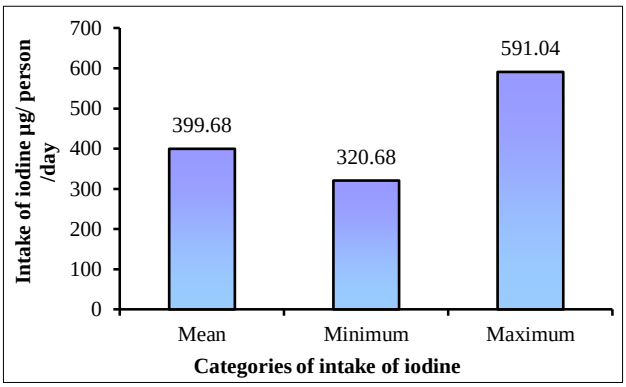

Figure 4. Graphical representation of Intake of iodine µg/person/day.

4. Discussion

4.1. Physico-chemical analysis of iodized salt

By observation, amount of moisture content was 0.18% in iodized salt, which is compared with BDS standard, WFP standard, China standard and India standard is 6%, 3%, 0.1% and 0.5% respectively. This is nearly to present study. High moisture content is important factor affecting the quality of product (Akubor, 1996). Product having high moisture content has minimum self-life (Ayub, 2005). In iodized salt, amount of Water insoluble matter percent by mass was found 0.11%, which is compared with BDS, WFP, China, and India standard is 0.1%, 0.2%, 0.1% and 0.1% respectively. Observation values are satisfactory according to standard reference value of BDS, WFP, China, and India. By observation, amount of Chloride content (as NaCl)% in iodized salt was found 99.55% which is compared with BDS, WFP, China, and India standard 97%, 97%, 99% and 98.50% respectively. Observation value supports the reference value. pH is one of the important characteristics which means the negative logarithm of hydrogen ion concentration in a solution. pH of the samples obtained by analysis with 7.26 ,in BDS standard it is ranges 6.4-7.4, in WFP it varies 6.5-7.2, in China and India it is ranges 6.5-7.4 and 6.6-7.2 respectively. pH of the samples obtained by analysis within the range set by BDS, WFP, China, and India. Iodine is one of the essential micronutrients required for the normal mental and physical well being of human beings. The healthy human adult body contains 15 – 20 mg of Iodine of which 50 – 80 percent is in the thyroid gland, which weighs only 15 – 25 gm. The tiny quantity of iodine is required everyday in the thyroid gland for adequate production of the hormone thyroxin. It requires four atoms of Iodine to make one molecule of thyroxin. Iodine content of the samples obtained by analysis was 32 mg / kg, in BDS, WFP, China standard it varies 20.0-50.0 mg / kg and India standard it is 30 mg / kg. Observation value is within the range set by BDS, WFP, China, and India. Mg and Ca content of iodized Salt samples were obtained by analysis was 0.00% and 0.1% respectively which is within the range set by BDS, WFP, China, and India.

4.2. Salt intake survey

In this study, among the family members 45.58% were male salt consumers and 54.42% were female consumers. Study was done among 68 families for a period of 35 days. Family member was divided into 4 groups according to their age - below 5 years, 5-9 years, 10-19 years and above 19 years. Family members below 5 yr was 11.81%, in family members 5-9 yrs it was 6.94%, Percentage of salt consumer in Family members 10-19 yrs was 24.54%, and salt consumer % in family members above 19 yrs was 56.71%. By statistical analysis among data , finding of study that, the mean value of Salt consumption g/person/day was 12.49, minimum Salt consumption g/person/day among members was 10.02 and maximum salt consumption was 18.47 g/ person/day among the family members. Intake of iodine, in case of family members, the mean value was 399.68 µg/ person/day, minimum intake of iodine was 320.68 µg/person/day and maximum intake of iodine was 591.04 µg/person/day among the family members. The daily Dietary Reference Intake recommended by the United States Institute of Medicine is between 110 and 130 µg for infants up to 12 months, 90 µg for children up to eight years, 130 µg for children up to 13 years, 150 µg for adults, 220 µg for pregnant women and 290 µg for lactating mothers, (Institute of Medicine, 2004). The Tolerable Upper Intake Level (UL) for adults is 1,100 µg/day (1.1 mg/day) (USNRC, 2000). As of 2000, the median intake of iodine from food in the United States was 240 to 300 µg/day for men and 190 to 210 µg/day for women (USNRC, 2000). Observed value support the reference value.

5. Conclusions

According to the results obtained from chemical analysis of salt samples, these may be recommended as safe for consumption. By iodine intake survey, finding of study is that, iodine intake by individual in village Chamuria in Tangail district is adequate to avoid IDD in normal health condition. Salt consumption among the villagers was minimum 10.02 g/person/day and maximum was 18.47 g/person/day. Intake of iodine among the villagers minimum was 320.68 µg/person/day and maximum was 591.04 µg/person/day. By iodine intake survey, finding of study is that, intake of iodine by individual in village chamuria in tangail district is adequate to avoid IDD in normal health condition. The study shows that, consumption rate is satisfactory to fulfill the daily requirement of iodine intake. If we enhance the regular intake of salt at an acceptable label, then it is possible to alleviate prevailing micronutrient deficiency problem from Bangladesh.

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Conflict of interest
None to declare.

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