# Topographical Variations in Iodine Content of Soil, Water and Major Foodstuffs of Bangladesh

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## Introduction

Iodine, an element sparsely distributed over the surface of the earth, is an essential component of the hormones elaborated by the thyroid gland. When the supply of iodine falls below a certain minimum, regulatory forces are called on which cause the thyroid to increase in size i.e. to become a goitre. Recent evidences indicate a wide spectrum of disorders resulting from severe iodine deficiency which puts at risk more than 800 million people in Asia, Africa, and South America[1].

In Bangladesh, alarming situation of goitre was first mentioned in the Nutrition Survey of 1962-64 of the then East Pakistan[2]. In 1981-82, average national prevalence rate of goitre was documented to be 10.51 per cent.[3] In order to understand the etiology of goitre in Bangladesh and also to formulate a successful intervention programme, we consider that the information on the iodine content of soil, water and foodstuffs of this country are urgently needed. This study is the first attempt to compare the iodine content in the foodstuffs, soil and water from topographically two different areas, sea side area and plain land. Investigation on the foodstuffs from sea side area, where iodine is abundant in the nature, will facilitate the identification of iodine rich foods.

## Materials and Methods

Teknaf is a peninsula, situatied to the south eastern tip of Bangladesh was selected as the sea side area. Marine fishes were purchased in fresh condition from Teknaf local market and were brought to the Institute of Nutrition and Food Science, Dhaka University on the same day in a cold carrier. Other food items were also procured in fresh condition from local households and market of Teknaf. Soil and water samples of sea side area were also collected from Teknaf. All the samples were kept in-$20^0$c till laboratory analysis. Plain land foods were purchased from different local markets of Dhaka city. Soil and water samples of plain land were collected from Dholaikhal area of Dhaka city. Small amounts of tolune was added to every water sample to form a thin layer, which protected the samples from the formation of microorganisms. In all cases, the samples were analyzed in the laboratory as early as possible after collection.

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Iodine in soil and foodstuffs were determined following the procedure described by Henry[4]. Iodine estimation in water was done following the method described by Karmarkar et al[5].

## Results

Table 1 shows that iodine content of the soil of sea side area was 99.4 µg per 100g, which is more than 3 times of the value obtained for soil sample of plain land. Results shown in the same table demonstrate that the amount of iodine in drinking water of sea side area was about 4 times higher than that of plain land area (average value 7.3 µg/litre). Coconut water of the sea side area was also found as a very good source of iodine (42.6 µg/litre).

**Table 1** : Iodine content of soil and water of sea side area and plain land.

| Name of the samples | Location of collection of samples | |
|---|---|---|
| | Sea side | Plain land |
| Soil (µg of iodine/100g) | 99.40 | 31.82 |
| Tube-well water (µg of iodine/litre) | 29.43 | 6.09 |
| Well water (µg of iodine/litre) | 28.81 | --- |
| Pond water (µg of iodine/litre) | --- | 7.81 |
| Supply water (µg of iodine/litre) | --- | 8.10 |
| Coconut water (µg of iodine/litre) | 42.57 | --- |

Dash indicates not determined. Each value represents the average of 2-3 determinations.

Table 2 shows the iodine content of a variety of foodstuffs which usually constitute diet of the common people of Bangladesh.

The most important finding is that all the foodstuffs of sea side area contain higher amount of iodine in comparison to the same category of food items of plain land. On average, rice of sea side area contained 3.8 µg of iodine per 100g. which was only 2.5 µg in the case of rice of plain land. Vegetables of sea side area were also found to contain a moderate amount of iodine in the range of 9.7 to 17.2 µg of iodine per 100g. A tuber from sea side area, colocasia contained 34.0 µg of iodine per 100g. A very interesting finding among the plain land foodstuffs is that the scarlet runner, whose seed is commonly advocated as a good source of protein for the poor population of Bangladesh, contained 17.0 µg of iodine per 100g. Spinach and amaranth leaves of plain land were also found to contain almost similar of iodine (Spinach, 15.0 µg; amaranth leaves, 14.0 µg per 100g). Betel leaves from sea side area was found to be a fair source of iodine (24.4 µg per 100g), which is about 7 times higher than that of plain land (3.4 µg per 100g). From the results presented in Table 2, the range of iodine (µg per 100g) content can be compiled for the following category of food items of Bangladesh, irrespective of their origin, cereal: 2.5-4.3, vegetables: 0.7-17.2, fruits: 0.1-10.0.

**Table 2 :** Iodine content of some foodstuffs of sea side area and plain land

| Name of the foodstuffs | Scientific Name | Sea side area | | Plain land | |
|---|---|---|---|---|---|
| | | Moisture (%) | Iodine (µg/ 100g) | Moisture (%) | Iodine (µg/ 100g) |
| Rice (IRRI) | *Oryza sativa* | 13.2 | 4.3 | - | - |
| Rice (Paigam) | *Oryza sativa* | 12.7 | 3.2 | 12.9 | 2.5 |
| Lentil | *Lens esculenta* | - | - | 16.6 | 3.4 |
| Potato | *Solanum tuberosum* | - | - | 74.7 | *1.8* |
| Colocasia | *Colocasia antiquorum* | 70.5 | 34.0 | - | - |
| Turnip | *Brassica rapa* | - | - | 92.6 | 0-7 |
| Carrot | *Daucus carota* | - | - | 88.5 | 2.4 |
| Ridge gourd | *Luffa acutangula* | 92.8 | 9.7 | - | - |
| Ladies finger | *Abelmoschus esculentus* | 91.7 | 17.2 | 90.1 | 13.0 |
| Kheksa | *Momordica cochinchinensis* | 78.2 | 15.6 | - | - |
| Giant chillies | *Capsicum annum var. grossa* | 75.2 | 16.0 | - | - |
| Chillies (green) | *Capsicum annum* | - | - | 73.1 | 2.7 |
| Scarlet runner | *Phaseolus coccineus* | - | - | 89.8 | 17.0 |
| Brinjal | *Solanum melongena* | - | - | 92.3 | 3.9 |
| Cabbage | *Brassica oleracea var. capitata* | - | - | 92.5 | 1.2 |
| Cauliflower | *Brassica oleracea var. botrytis* | - | - | 90.8 | 1.2 |
| Spinach | *Spinacia oleracea* | - | - | 92.2 | 15.0 |
| Amaranth leaves | *Amaranthus gangeticus* | - | - | 88.6 | 14.0 |
| Tomato | *Lycopersicon esculentum* | - | - | 95.1 | 0.7 |
| Ambada | *Spondias mangifera* | 82.1 | 6.6 | - | - |
| Paniyala | *Flacourtia cataphracta* | 83.5 | 10.0 | - | - |
| Guava | *Psidium guajava* | - | - | 78.5 | 1.1 |
| Papaya (green) | *Carica papaya* | - | - | 87.3 | 0.9 |
| Betel leaves * | *Piper betle* | 84.3 | 24.4 | 84.9 | 3.4 |
| Areca nut. * | *Areca catechu* | 30.3 | 4.0 | 30.1 | 1.6 |

Dash indicates not determined. Each value represents the average of 2-3 determinations.* Used as customary food in Bangladesh.

**Table 3 :** Iodine content of marine and freshwater fishes

| Name of fishes | Scientific Name | Fresh Fish | |
|---|---|---|---|
| | | Moisture (%) | Iodine (µg/100) |
| **Marine Fishes** | | | |
| Echuyri | *Trichiurus haumela* | 80.1 | 145.6 |
| Rupchanda (white) | *Stromatcur sinensis* | 59.6 | 67.0 |
| Olua | *Coila dussumieri* | 79.2 | 66.5 |
| Chingri | *Penaeus indicus* | 79.4 | 124.3 |
| Chapila | *Gadusia chapra* | 78.0 | 55.4 |
| Bata (with bone) | *Cirrhina reha (Hamilton)* | 77.9 | 168.0 |
| **Freshwater Fishes** | | | |
| Tatkini | *Crossochcilus latius* | 74.3 | 13.3 |
| Chingri | *Penacus indicus* | 79.6 | 13.8 |
| Tengra | *Mystus vittatus* | 72.2 | 12.0 |
| Mola | *Amblypharyn godonmola* | 77.1 | 3.1 |
| Rohu | *Labeo rohita* | 78.5 | 1.7 |
| Koi | *Anabas testudineus* | 71.3 | 5.0 |
| Pabda | *Callichorus pabo* | 73.2 | 17.9 |
| Hilsa | *Hilsa ilisa* | 56.1 | 22.4 |

The values represent the average from 2-3 determinations.

Table 3 demonstrates the iodine content of both marine and fresh water fishes. The iodine content of six species of fresh fishes of marine water ranged between 55.4-168.0 µg per 100g, with a mean value of 104.5 µg per 100g. The maximum amount of iodine was observed in bata fish and the minimum in chapila. On the other hand, range of iodine content of eight species of fresh water fishes was only 1.7-22.4 µg per 100g, with a mean value of 11.15 µg per 100g. The average amount of iodine observed in fresh fishes of marine water was 9.4 times higher than that of fresh water fishes.

## Discussion

Man obtains iodine primarily from foodstuffs and secondarily from drinking water[6]. The iodine content in food and water depends critically on the content in the soil[7]. The later iodine comes mainly from atmospheric precipitation. The oceans and seas are the world's chief iodine store and are fed by rivers flowing over iodine rich soils. The sea's iodine is continually redistributed in the atmosphere in the form of dust, or through oxidation of iodide to molecular iodine at the surface of the sea and returns to the land by precipitation

with rain[8]. Thus soil becomes gradually richer in iodine. So, it can be assumed that lands nearer to sea may contain higher amount of iodine, as was found in the present study. It is shown in Table 1 that iodine content of soil from a sea side area is 3 times higher than that of a plain land, far away from sea. Iodine content of water samples from the plain land is only one fourth of that of drinking water of sea side area.

Results of the investigation also clearly demonstrated a substantively higher amount of iodine in most of the foodstuffs from sea side area. Most significantly, the marine fresh fishes was evaluated as the best source of iodine (Table 3). The range of iodine content of marine and fresh water fishes observed in the present study are in agreement with the data presented by Fisher and Carr[9]. Irrespectivfe of origin, the amount of iodine observed in Bangladeshi food items like cereals, vegetables and fruits are also in good agreement with the average iodine content data reported by Stanbury and Hetzel[10].

The present results also showed that vegetables, specially scarlet runner, spinach and amaranthus gangeticus from plain lands contain moderate amount of iodine. The foregoing findings will be important additions to our knowledge on iodine rich foodstuffs of our country, which will in turn help to control iodine deficiency disordors in this land.

## Summary

Results of the present study indicated that iodine content of soil and drinking water of a sea side area are respectively 99.4 µg per 100g and 29.1 µg per litre. In the case of soil and water samples from plain lands, the iodine contents are one third to one fourth than that of sea side area samples. In the sea side area almost all category of foodstuffs were found to contain higher amount of iodine than that of plain lands. Irrespective of their origin the range of iodine content in Bangladeshi foodstuffs were, cereal: 2.5-4.3, vegetables: 0.7-17.2; fruits: 0.1-10.0 µg. / 100 gm. Fresh marine fishes were found to contain iodine in the range of 55.4-168.0 µg/100 gm (mean 104.5 µg/100 gm). On the other hand, range of iodine content of fresh water fishes was only 1.7-22.4 µg/100gm (mean 11.2µg/100gm).

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