ANNEXURE
Goitrogenic content of Indian cyanogenic plant foods & their *in vitro* anti-thyroidal activity

Amar K Chandra, Sanjukta Mukhopadhyay, Dishari Lahari & Smritiratan Tripathy

Endocrinology & Reproductive Physiology Laboratory, Department of Physiology, University College of Science & Technology, University of Calcutta, Kolkata, India

Received June 11, 2002

**Background & objectives:** Consumption of cyanogenic foods has been considered as one of the etiological factors in certain instances for the persistence of endemic goitre. The present study was undertaken to study the cyanogenic glucosides, glucosinolates and thiocyanate content in edible portion of certain selected plant foods of Indian origin. Further *in vitro* anti-thyroidal activity using raw, boiled and cooked extracts of these plants with and without excess iodide was also studied.

**Methods:** Cyanogenic plant foods generally vegetables were collected from different areas of West Bengal and Tripura. Cassava was obtained from Meghalaya and Kerala and their cyanogenic glucosides, glucosinolates and thiocyanate were estimated. Thyroid peroxidase activity (TPO) of human thyroid was assayed from microsomal fraction following I⁻ from iodide. The anti-TPO activities of the plants were assayed after adding raw, boiled and cooked extracts in the assay medium with and without extra iodide. Relative antithyroidal potency of the plant extracts was also evaluated in terms of the concentration (IC₅₀) necessary to produce 50 per cent inhibition of TPO activity. PTU equivalence of the plant foods was also determined.

**Results:** Cabbage and cauliflower were rich in glucosinolates, bamboo shoot and cassava were rich in cyanogenic glucosides, mustard, turnip and radish were relatively rich in thiocyanate however all the constituents were present in each plant. Boiled extracts showed maximum inhibition of TPO activity followed by cooked and raw extracts. Excess iodide was found relatively effective for raw extract but less effective for boiled and cooked extracts in reversing anti-TPO activity. Inhibition constant (IC₅₀) was found highest with bamboo shoot and least with cabbage.

**Interpretation & conclusion:** Raw, boiled and cooked extracts of the plants showed anti-thyroidal activity *in vitro*. Excess iodide reversed the anti-TPO activity to some extent but could not neutralise it.

**Key words** Cyanogenic glucosides - dietary goitrogen - glucosinolates - iodine - thiocyanate - thyroid peroxidase

Cyanogenic glucosides, glucosinolates (thioglucosides) and thiocyanate are the goitrogenic/antithyroid constituents of cyanogenic plants that are often used as food by men and animals. Large differences in glucosides content of plants belonging to the same family and the same taxonomy and grown within the same geographical area owing to their genetic backgrounds and ecological factors have been reported. Cyanogenic constituents affect hormone synthesis in thyroid gland either by inhibiting iodide uptake or interfering the activity of thyroid peroxidase (TPO), *i.e.* by inhibiting the organification of iodide (I⁻ leads to I₂), or iodination of tyrosine in thyroglobulin and coupling reaction. The goitrogenic or antithyroid potential of a plant not only depends on the relative concentrations of cyanogenic constituents found in fresh plant but also on its processing as food, so in the areas where these plant foods are consumed, the common measures to reduce the goitrogenic potency include soaking, washing, boiling, cooking *etc.* and to
supplement adequate iodide as it ameliorates the antithyroidal activity.

The information on goitrogenic content of cyanogenic plant foods of Indian origin and their antithyroidal activity is scanty. Therefore, the present work was undertaken to measure goitrogenic content viz., cyanogenic glucosides, glucosinolates and thiocyanate of certain cyanogenic plants used as foods and to evaluate their in vitro antithyroidal activity in raw, boiled and cooked extract with and without extra iodide.

Material & Methods

The study was conducted in the Endocrinology and Reproductive Physiology Research Laboratory of the Physiology Department, University of Calcutta, Kolkata during January 2001 to May 2003.

Selection of materials: Cyanogenic plant foods generally used as vegetable viz., cauliflower (Brassica oleracea var., botrytis), cabbage (Brassica oleracea var. capitata), mustard seeds (Brassica juncea), turnip (Brassica rapa), radish (Raphanus sativus), bamboo shoot (Bambusa arundinacea) and cassava (Manihot) were selected for the present study. Samples of these plants were collected at random from different areas of West Bengal and Tripura while cassava was collected from Meghalaya and Kerala states.

Measurement of cyanogenic glucosides: Cyanogenic glucosides were measured following the method of Lambert et al. Edible parts of fresh plants varying from 10mg to 1g were hydrolysed by the enzyme glucosidase (B-glucosidase, Sigma, USA) and the hydrocyanic acid thus liberated was trapped in sodium hydroxide. Cyanide content of trapped hydrocyanic acid was then determined quantitatively.

Measurement of glucosinolates: The enzyme myrosinase (thioglucosidase from Sigma, USA) to obtain thiocyanate. Thiocyanate was then estimated by the method of Aldridge as modified by Michajlovskij and Langer.

Measurement of thiocyanate: The plant foods were extracted with clean sand and water and refluxed subsequently. The extract containing thiocyanate was treated with trichloroacetic acid, followed by saturated bromine water and arsenous trioxide and allowed to react with pyridine-benzidine hydrochloride mixture. The intensity of colour thus formed was measured by using spectrophotometer (UV-1240 Shimadzu, Japan) following the method of Aldridge as modified by Michajlovskij and Langer.

Assay of thyroid peroxidase (TPO) activity: A 10 per cent homogenate was prepared using human thyroid tissues collected from the ENT Department, S.S.K.M. Hospital, Kolkata; in phosphate buffer (pH 7.2, 100mM) and sucrose solution (500 mM) at 4°C. Homogenization was carried out in a glass homogenizer (Potter-Elvehjem, Germany). The homogenate was centrifuged at 100,000 g for 10 min and this low speed supernatant was further centrifuged at 10,000 g for 10 min at 4°C to get the mitochondrial fraction. The microsomal fraction containing most of the peroxidase activity was obtained by centrifuging the post mitochondrial supernatant at 1,05,000 g for one h. Immediately after centrifugation the precipitate was solubilized in phosphate buffer.

Thyroid peroxidase activity was measured by the method of Alexander. The tissue protein level was determined by the method of Lowry et al using bovine serum albumin as standard. The results are expressed as change in optical density (AOD/min/mg protein).

Assay of anti-TPO activity of plant foods: Edible part of each fresh plant (raw, boiled and cooked) was homogenized in assay buffer (5 mg plant tissue in 5 ml phosphate buffer) and centrifuged at 700 g for 10 min. After centrifugation fixed amounts of aliquot of the supernatant of raw, boiled and cooked plant were added separately in a 1ml cuvette containing acetate buffer, potassium iodide, microsomal fraction of thyroid tissue and hydrogen peroxide was added to start the reaction. The TPO activity (AOD/min/mg protein) was measured following the procedure of Gaitan et al.

Anti-TPO activities of the plant extracts were also studied in presence of excess potassium iodide. For this
purpose in the cuvette maintaining the same concentration of assay buffer, plant extract (raw, boiled and cooked) and \( H_2O_2 \), the concentration of potassium iodide was increased (until highest activity obtained) and change in optical density (\( \Delta OD/min/mg \) protein) was recorded.

**Assay of IC\(_{50}\):** The activity of raw plant extracts was evaluated in terms of the concentration necessary to produce 50 per cent inhibition (IC\(_{50}\)) of TPO activity to evaluate their relative antithyroidal potency. The effect was also studied at different concentrations ranging from 10 to 150 \( \mu g \) fresh plant to determine the concentration required to produce IC\(_{50}\) of TPO activity. To compare the relative antithyroidal activity of the studied plants against a known antagonist, IC\(_{50}\) of 6-n-propyl-2-thiouracil (PTU from Sigma, USA) was determined.

### Results

**Goitrogen content:** The moisture content of the plants varied from 59 to 95 per cent except mustard seeds (8.5%). Based on relative concentrations of cyanogenic glucosides, glucosinolates and thiocyanate, the plants were grouped and the anti-TPO activities of raw, boiled and cooked extracts without (not adding extra iodide) and with extra iodide were determined.

**Anti-TPO activity of cabbage and cauliflower:** These two plants were rich in glucosinolates followed by thiocyanate and cyanogenic glucosides (Table I). The activity of the enzyme was reduced in presence of the raw cauliflower (74.75%) and cabbage (65% reduction) extract; further reduction observed after boiled extract (90.12 and 79.44%) and for cooked extract the values were almost same that of raw extract (75 and 66.05%). In presence of extra iodide recovery in TPO activity was maximum with raw extract (only 20.04 and 15% reduction), moderate for boiled extract and remain almost unchanged for cooked extract of the plants (Table II). TPO activity of control (with optimum potassium iodide) in absence of any plant extract was 1.62±0.054 (\( \Delta OD/min/mg \) protein).

**Anti-TPO activity of bamboo shoot and cassava:** Both these plants were rich in cyanogenic glucosides followed by thiocyanate and glucosinolates. However, concentrations of all three were almost double in bamboo shoots than cassava (Table I). Consistant with these raw, boiled and cooked extracts of these plants showed TPO inhibition and thus anti-TPO potency of bamboo shoot was almost twice to that of cassava (reduction in bamboo shoot raw 84.69%, boiled 85% and cooked 84.38%, cassava raw 69.88%, boiled 70.86% and cooked 70.25%). Extra iodide had reversed anti-TPO activity of cassava and bamboo shoot but it was more effective for raw and cooked extracts (Table II).

**Relative anti-TPO potency:** The relative anti-TPO potency of studied plants and PTU was determined by

<table>
<thead>
<tr>
<th>Plant foods</th>
<th>Cyanogenic glucosides</th>
<th>Glucosinolates</th>
<th>Thiocyanate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brassica family</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cauliflower</td>
<td>1.82±0.4</td>
<td>17.28±1.6</td>
<td>5.04±0.5</td>
</tr>
<tr>
<td>(Brassica oleracea var. botrytis)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>1.6±0.3</td>
<td>15.7±1.3</td>
<td>11.6±1.7</td>
</tr>
<tr>
<td>(Brassica oleracea var. capitata)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard</td>
<td>0.24±0.01</td>
<td>4.0±0.3</td>
<td>50.5±2.9</td>
</tr>
<tr>
<td>(Brassica juncea)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turnip</td>
<td>1.3±0.5</td>
<td>4.6±0.8</td>
<td>20.1±0.9</td>
</tr>
<tr>
<td>(Brassica rapa)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radish</td>
<td>1.28±0.4</td>
<td>2.64±0.2</td>
<td>13.28±0.9</td>
</tr>
<tr>
<td>(Raphanus sativus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Brassica family</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bamboo shoot</td>
<td>551.05±72</td>
<td>9.57±0.5</td>
<td>24.31±5.2</td>
</tr>
<tr>
<td>(Bambusa arundinacea)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cassava</td>
<td>304.31±41</td>
<td>4.32±0.8</td>
<td>12.95±2</td>
</tr>
<tr>
<td>(Manihot)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are mean±SD of 6 observations, expressed in terms of mg/kg wet weight.
Table II. In vitro TPO activity (ΔOD/min/mg protein) of raw, boiled and cooked plant extracts without and with extra iodide

<table>
<thead>
<tr>
<th>Plants</th>
<th>Raw extract</th>
<th>Boiled extract</th>
<th>Cooked extract</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without extra KI</td>
<td>With extra KI</td>
<td>Without extra KI</td>
</tr>
<tr>
<td>Control</td>
<td>1.62±0.054</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>0.409±0.014</td>
<td>1.295±0.024</td>
<td>0.160±0.007</td>
</tr>
<tr>
<td></td>
<td>(74.75)</td>
<td>(20.04)</td>
<td>(90.12)</td>
</tr>
<tr>
<td>Cabbage</td>
<td>0.362±0.016</td>
<td>1.368±0.012</td>
<td>0.333±0.024</td>
</tr>
<tr>
<td></td>
<td>(65)</td>
<td>(15)</td>
<td>(79.44)</td>
</tr>
<tr>
<td>Bamboo shoot</td>
<td>0.248±0.02</td>
<td>0.562±0.016</td>
<td>0.243±0.04</td>
</tr>
<tr>
<td></td>
<td>(84.69)</td>
<td>(65.31)</td>
<td>(85)</td>
</tr>
<tr>
<td>Cassava</td>
<td>0.488±0.009</td>
<td>1.063±0.01</td>
<td>0.472±0.04</td>
</tr>
<tr>
<td></td>
<td>(69.88)</td>
<td>(34.38)</td>
<td>(70.86)</td>
</tr>
<tr>
<td>Mustard</td>
<td>0.329±0.019</td>
<td>1.062±0.005</td>
<td>0.281±0.015</td>
</tr>
<tr>
<td></td>
<td>(79.69)</td>
<td>(34.44)</td>
<td>(88.65)</td>
</tr>
<tr>
<td>Turnip</td>
<td>0.470±0.033</td>
<td>1.362±0.005</td>
<td>0.294±0.014</td>
</tr>
<tr>
<td></td>
<td>(70.99)</td>
<td>(15.93)</td>
<td>(81.85)</td>
</tr>
<tr>
<td>Radish</td>
<td>0.655±0.02</td>
<td>1.458±0.008</td>
<td>0.328±0.018</td>
</tr>
<tr>
<td></td>
<td>(59.57)</td>
<td>(10)</td>
<td>(79.75)</td>
</tr>
</tbody>
</table>

KI, potassium iodide; TPO, thyroid peroxidase
With extra KI indicated addition of excess iodide in the incubation medium than control and others
Values are mean ± SD of 6 observations
Per cent inhibition of TPO activity against control is given in the parentheses

estimating the amount of plant food or PTU capable of producing 50 per cent inhibition (IC50) of TPO activity (Table III). The IC50 was highest in bamboo shoot, followed by cassava, mustard, cauliflower, radish, turnip and cabbage. This observation was confirmed by PTU equivalence of the studied plants.

Discussion

Many vegetables containing cyanogenic constituents are often consumed but the information on the systemic quantification of different goitrogenic/anti-thyroid components of these vegetables of Indian origin is scanty.

Thiocyanate content of cauliflower, cabbage, cassava (tapioca), mustard, radish and turnip was measured by earlier workers18,19 while cyanogenic glucosides were studied in bamboo shoot20 and cassava21. Marked variations were noted in the observations apparently for differences in genetic backgrounds and ecological factors and also for presentations of data. Cyanogenic glucosides, glucosinolates and thiocyanate are known as goitrogenic principles of cyanogenic plants. Goitrogenic/antithyroid potential of a plant food depends not only on the nature and the relative concentration for these goitrogenic principles present in it but also on how it is processed as food or the iodine nutritional status of the body.

Raw extract of all the plants reduced TPO activity from 60 to 85 per cent. Cyanogenic glucosides are readily
Table III. Concentration of fresh cyanogenic plant foods producing 50 per cent inhibition (IC$_{50}$) of thyroid peroxidase activity

<table>
<thead>
<tr>
<th>Plant foods</th>
<th>IC$_{50}$ (µg)</th>
<th>PTU equivalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTU</td>
<td>0.9±0.2</td>
<td>100</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>51.25±0.52</td>
<td>1.76</td>
</tr>
<tr>
<td>Cabbage</td>
<td>66.25±1.42</td>
<td>1.36</td>
</tr>
<tr>
<td>Bamboo shoot</td>
<td>27.5±0.77</td>
<td>3.27</td>
</tr>
<tr>
<td>Cassava</td>
<td>42.5±1.35</td>
<td>2.12</td>
</tr>
<tr>
<td>Mustard</td>
<td>45.00±0.67</td>
<td>2</td>
</tr>
<tr>
<td>Turnip</td>
<td>60.00±1.10</td>
<td>1.5</td>
</tr>
<tr>
<td>Radish</td>
<td>51.88±1.2</td>
<td>1.73</td>
</tr>
</tbody>
</table>

IC$_{50}$, inhibition constant
Values are mean±SD of 6 observations
PTU-6-n-propyl-2-thiouracil

converted into active goitrogenic agent thiocyanate by glucosidases and sulphur transferase enzymes present in the plant or in the animal tissues$^{22}$. Thiocyanate or thiocyanate like compounds primarily inhibit iodide-concentrating mechanism of the thyroid$^{15}$, at high concentration thiocyanate inhibits the incorporation of iodide into thyroglobulin by competing with iodide at the thyroid peroxidase level$^{23}$ and forming insoluble iodinated thyroglobulin in thyroid$^{24}$. High concentration of thiocyanate is also responsible for inhibition of TPO catalysed oxidation ($I^{-}$ leads to $I_{3}^{+}$) while glucosinolates undergo a rearrangement to form isothiocyanate derivatives$^{4}$. Isothiocyanate reacts spontaneously with amino groups to form thiourea that interferes in thyroid gland with organisation of iodide and formation of thyroid hormone and this action cannot be antagonised by the iodide$^{25}$. Thus, the in vitro inhibition of TPO activity of raw extract seen in the present study appeared to be mediated through thiocyanate or isothiocyanate like anti-thyroid derivatives.

In the present study boiled extract of most of the plants studied reduced the TPO activity further (from 70 to 90%). Cooked extracts of plants showed less anti-TPO activity than their boiled counterparts and nearly equal activity like their respective raw extracts. Anti-TPO activity of cooked extract of most of the plants was less than their boiled extract because of discarding the liquor containing the active anti-thyroid compounds that might have produced through hydrolysis during boiling of the plant. Therefore cooking had beneficial effects against anti-thyroidal activity of these plants as has been observed in in vivo studies with cooked brussel sprouts showing less harmful effect on thyroid functions$^{25}$.

The potent anti-thyroidal effect of cyanogenic foods is known to be enhanced by iodine deficiency$^{26}$. The goitrogenic action of thiocyanate or thiocyanate like compounds can be overcome by iodide administration$^{9,10,27}$. In our study addition of excess iodide showed different degrees of reversing effect against in vitro TPO inhibition. Reversing effect was encouraging for raw extracts of the plants except for bamboo shoot because of its higher concentration of goitrogenic constituents. Recovery was less for both boiled and cooked extracts because of conversion of cyanogenic constituents into thiocyanate completely or the cyanogenic glucosides and glucosinolates present in the plants were converted into more active anti-thyroid substances and their action was not antagonized by excess iodide. Feed containing high glucosinolates are shown to have goitrogenic effect, in swine and poultry$^{28}$; supplementation of iodide may reduce the anti-thyroid activity but cannot neutralise it.

Relative anti-thyroid potency of raw extract of bamboo shoot was found to be maximum followed by cassava, mustard, cauliflower, radish, turnip and cabbage as studied by their respective IC$_{50}$ and PTU equivalence. TPO-catalyzed organification of iodide depends on thiocyanate concentration or isothiocyanate like compounds in the medium$^{6,10,23}$. Anti-TPO activity of the plant extracts as observed in the present study was not consistent with goitrogenic content present in fresh plants. This may be because of differences in moisture contents of the plants or for the differences in conversion of inactive precursors to active constituents during mastication, boiling, cooking etc., from plant to plant.

In conclusion, the results showed that the cyanogenic plants had in vitro anti-thyroidal activity. Boiled extracts showed highest anti-TPO potency followed by cooked and raw extracts. Excess iodide though reversed the anti-TPO activity of the plant foods to a certain extent but could not neutralise it.

Acknowledgment

The financial assistance by the Department of Science and Technology, New Delhi, is gratefully acknowledged. The authors thank the Surgery Unit of ENT Department, S.S.K.M. Hospital, Kolkata for providing the thyroid tissue.
References


7. de Groot AP, Williams MI, de Vos RH. Effects of high levels of thiocyanate in domestic animals in goitrogen areas of southern Canada: International Development Research Centre (IDRC-207e); 1982 p.829-37.


23. Ermans AM, Bourdoux P. Antithyroid sulfurated compounds.


Reprint requests: Dr Amar K. Chandra, Reader, Department of Physiology, University College of Science & Technology University of Calcutta, 92 Acharya Prafulla Chandra Road, Kolkata 700009, India e-mail: amark_chandra@yahoo.co.in
Effect of bamboo shoot, *Bambusa arundinacea* (Retz.) Willd. on thyroid status under conditions of varying iodine intake in rats

Amar K Chandra, Dishari Ghosh, Sanjukta Mukhopadhyay & Smritiratan Tripathy
Endocrinology and Reproductive Physiology Laboratory, Department of Physiology, University of Calcutta, 92, Acharya Prafulla Chandra Road, Kolkata 700009, India

Received 7 January 2003; revised 21 May 2004

Young shoots or sprouts of common bamboos are used as food in third world countries. Evidences suggest the presence of cyanogenic glucoside like anti-thyroidal substance in bamboo shoots (BS) but effect of prolonged BS consumption on thyroid status under conditions of varying iodine nutriture remains unexplored. The study was undertaken to evaluate goitrogenic content, *in vitro* anti thyroid peroxidase (TPO) activity and *in vivo* anti thyroid potential of BS with and without extra iodide. Fresh BS contains high cyanogenic glucoside (551 mg/kg), followed by thiocyanate (24mg/kg) and glucosinolate (9.57mg/kg). *In vitro* inhibition in TPO activity was found with raw, raw boiled and cooked extracts. Inhibition constant (IC50) and PTU equivalence of fresh BS were 27.5±0.77 pg and 3.27 respectively. Extra iodide in the incubation media reduced TPO inhibition induced by BS but could not cancel it. Thyroid weight, TPO activity and total serum thyroid hormone levels of BS fed animals for 45 and 90 days respectively were determined and compared with controls. Significant increase in thyroid weight as well as higher excretion of thiocyanate and iodine along with marked decrease in thyroid peroxidase activity, T4 and T3 levels were observed in BS fed group. Chronic BS consumption gradually developed a state of hypothyroidism. Extra iodide had reduced the anti-thyroidal effect of BS to an extent but could not cancel it because of excessive cyanogenic glucoside, glucosinolate and thiocyanate present in it.

**Keywords:** Bamboo shoot, Cyanogenic glucosides, Glucosinolates, Thiocyanate, Iodide, Thyroid peroxidase, Thyroid hormones

**IPC Code:** Int. C17: A61K35

The young shoots or sprouts of common bamboos, *Bambusa arundinacea* (Retz.) Willd., family Graminaceae are used as staple food as well as pickle and chutney in third world countries including India. Varying amounts of cyanogenic glucosides have been reported from different species of bamboo shoots (BS)1. The cyanogenic glucoside present in BS is taxiphyllin [2-(b-D-glucopyranosyloxy)-2-(4-hydroxyphenyl) acetonitrile]2. Regular consumption of cyanogenic glucosides, glucosinolates and thiocyanate, the goitrogenic / anti-thyroid constituents of cyanogenic foods, affect thyroid physiology and may develop endemic goitre in long run3. These dietary goitrogens disrupt the biosynthesis of thyroid hormones in several ways that include inhibition of the iodide trapping mechanism, blockage of organic binding of iodine to thyroglobulin and coupling reaction of thyroglobulin149. The effect of regular consumption of BS on thyroid functions or information about its goitrogenic / anti-thyroid potential under conditions of varying iodide intake is scanty.

In the present study, the goitrogenic contents of fresh BS and *in vitro* thyroid peroxidase (TPO) activity of human thyroid tissue aiding raw, raw boiled and cooked extracts under different iodide concentrations were measured. The influence of BS feeding with and without iodide supplementation in rats for different durations on thyroid status have also been evaluated determining urinary iodine and thiocyanate concentrations, thyroid weight, *in vivo* TPO activity and thyroid hormone profiles.

**Materials and Methods**

*Collection of BS*—Fresh bamboo shoots were collected from the local markets for the measurement.
EVALUATION OF POSSIBLE GOITROGENIC AND ANTI-THYROIDAL ACTIVITY OF SOYABEAN (Glycine max) OF INDIAN ORIGIN

SANJUKTA MUKHOPADHYAY, DISHARI GHOSH, SRIRITIRATAN TRIPATHY, SIRSHENDU JANA & AMAR K CHANDRA*

Endocrinology and Reproductive Physiology Laboratory
Department of Physiology
University College of Science and Technology
University of Calcutta
92, Acharya Prafulla Chandra Road
Kolkata 700009

Both the vegetarian and non-vegetarian people throughout world extensively consume soyabean (Glycine max). The importance of soyabean is due to its high protein content. All the essential amino acids are present in soyabean except methionine and cystine. Besides protein it is also rich in vitamins, minerals and unsaturated fatty acids. In spite of all its qualities there are lot of controversies regarding its goitrogenic/antithyroid potentiality. Earlier reports showed that soyabean causes goitre in experimental animals under vitamin deficient condition. There are other studies, which indicate soyabean causes enlargement of thyroid glands and develops goitre in human. On the contrary, there are several reports, which indicate soyabean has no such goitrogenic/antithyroidal activities. The effect of soyabean of Indian origin on thyroid physiology is not available though it is extensively used in the country. In the present study attempt has been made to evaluate the antithyroid/goitrogenic potentiality of soyabean of Indian origin. Soyabean flour was fed to albino rats for a period of 60 days and the morphological status of thyroid gland, thyroid peroxidase (TPO) activity, serum T3 and T4 levels were measured. The protein and iodine nutritional status were monitored measuring serum protein and urinary iodine concentrations respectively. The results show that soyabean causes an enlargement of thyroid glands resembling a goitrous state, inhibits TPO activity both in vivo and in vitro but most strikingly elevates serum T4 level and T3 level to an extent. The study suggests goitrogenic/antithyroid effect of soyabean is expressed in a protein deficient state or in a state of iodine deficiency. Adequate supplies of dietary protein and iodine may prevent goitrogenic/antithyroid potential of soyabean.

The primary cause of goitre and hypothyroidism around the world is inadequate iodine intake (Hetzel et al., 1990). Thyroid abnormalities are also found due to consumption of different dietary goitrogens, such as cyanogenic glucosides in cruciferous vegetables, flavonoids in millets, aliphatic disulphides in onion and garlic etc. that interfere iodine utilisation or functioning of the thyroid gland (Ermans et al., 1983; Gaitan et al., 1989;* Corresponding author
IODINE CONTENT OF DRINKING WATER IN GANGETIC WEST BENGAL

AMAR, K. CHANDRA, SMRITIRATAN TRIPATHY, DISHARI LAHARI AND SANJUKTA MUKHOPADHYAY

(Endocrinology and Reproductive Physiology Laboratory, Department of Physiology, University College of Science and Technology, University of Calcutta, Kolkata - 700 009)

(Received 23rd June, 2003)

Introduction

Iodine in trace amount is essential for normal development and function of the brain and maintenance of body heat and energy. Man gets iodine through food and water. Iodine deficiency in a region is characterised by iodine poor soil, less iodine in foods (animal or vegetable origin) and in drinking water, resulting in iodine deprivation of living organism. The major consequences of iodine deficiency are goitre (enlargement of thyroid gland than normal), still birth and miscarriages, mental defect, deaf-mutism, weakness and paralysis of muscles as well as lesser degree of physical and mental function. Iodine deficiency is now recognised by World Health Organisation (WHO) as the most common preventable cause of brain damage in the world today. The northern part of the state of West Bengal is in the foot hills of the Himalayas and within the classical iodine deficient goitre endemic belt of India, while its major southern part is plain, the land is fertile and is drained by a number of rivers including the Ganga. Considering the consequences of iodine deficiency disorders the Government has introduced the use of iodised salt throughout the state since early nineties. However, we found the prevalence of goitre and associated disorders in a rural area of the Gangetic West Bengal during post-salt iodisation phase. Recently endemic goitre has also been observed in a number of districts of the Gangetic West Bengal during our IDD survey.

Reports on the bioavailability of iodine in this newly found goitre endemic region of the Gangetic West Bengal is not available. Therefore to understand the environmental iodine status in the region, from the goitre...
IODINE NUTRITIONAL STATUS OF SCHOOL CHILDREN IN A RURAL AREA OF HOWRAH DISTRICT IN THE GANGETIC WEST BENGAL

AMAR K. CHANDRA*, SMRITIRATAN TRIPATHY, DISHARI LAHARI AND SANJUKTA MUKHOPADHYAY

Endocrinology and Reproductive Physiology Laboratory, Department of Physiology, University College of Science and Technology, University of Calcutta
92, Acharya Prafulla Chandra Road, Kolkata – 700 009

(Received on June 23, 2003)

Abstract: The objective of the study was to assess the status of iodine nutrition in an area of Howrah district where iodine deficiency disorders (IDD) were reported despite the introduction of iodised salt for general use. A total of 969 school children in the age group 6–12 years of both sexes were clinically examined for goitre. On the spot 242 urine samples were collected from the children to study the iodine and thiocyanate excretion pattern and 108 edible salt samples were collected from the homes of the children to measure iodine level. Drinking water samples were collected to evaluate the bioavailability of iodine in the region. The total goitre prevalence was 37.6% (Grade 1: 32.6%; Grade 2: 4.9%). The median urinary iodine level was 36 pg/dL, 12.5% urine samples had iodine level below 10 pg/dL and no sample was found to contain iodine below 5 pg/dL. In 61.9% salt samples iodine level was below 16 ppm and the iodine level in the drinking water was about 82 pg/L. The people of the area consume foods from the vegetables of the Brassica family and mean thiocyanate level was 0.747 ± 0.21 mg/dL. The findings of the present study indicated that as per clinical criteria of WHO/UNICEF/ICCIDD, IDD is a severe public health problem though apparently there is no biochemical iodine deficiency. Overall results indicate that factors other than iodine deficiency may have a role in the persistence of endemic goitre in the post salt-iodisation in this region.

Key words: endemic goitre IDD school children urinary iodine urinary thiocyanate goitrogens

INTRODUCTION

Iodine deficiency disorders (IDD) are now considered as a major public health problem all over the world. Its major manifestations are goitre, mental defects, deaf mutism, stillbirth and miscarriages, weakness and paralysis of muscles as well

*Corresponding Author: E-mail address: amark_chandra@yahoo.co.in
STUDIES ON ENDEMIC GOITRE AND ASSOCIATED IODINE DEFICIENCY DISORDERS (IDD) IN A RURAL AREA OF THE GANGETIC WEST BENGAL

AMAR K. CHANDRA, SMRITI RATAN TRIPATHY, SANJUKTA MUKHOPADHYAY AND DISHARILAHARI

(Endocrinology and Reproductive Physiology Research Laboratory, Department of Physiology, University College of Science and Technology, University of Calcutta, 92, Acharya Prafulla Chandra Road, Kolkata-700 006)

(Received 27th November, 2002)

Introduction

Iodine is an important micronutrient for humans. Very small quantity of iodine is required by the thyroid gland daily for the production of thyroid hormones which are needed for the growth, development and normal physiological functions of the human body. Lack of iodine in the diet leads to visible and invisible spectrum of health consequences known as iodine deficiency disorders (IDD). The major consequences of iodine deficiency are goitre (enlargement of thyroid gland than normal), mental defect, deaf mutism, stillbirth and miscarriages, weakness and paralysis of muscles as well as lesser degree of physical and mental function. Iodine deficiency affects the socio-economic development of a community.

The northern part of West Bengal is mostly located in hilly sub-Himalayan classical conventional goitre endemic belt of India. Considering the consequences of IDD, supplementation of iodine through salt had been introduced in entire West Bengal since early nineties. However our preliminary studies indicate that the population of vast region of the Gangetic West Bengal are affected. Hence in the selected village, the entire population of both sexes covering the entire age group were clinically examined to evaluate thyroid enlargement or goitre and associated iodine deficiency disorders (IDD). To get the information about iodine intake, salt samples were collected from the households and iodine content of the salt was monitored.

Materials and Methods

Study area

Madhabnagar, a rural village, located in Pathar Pratima Developmental Block in Sundarban delta of South 24-Parganas district in the Gangetic West Bengal was selected for the study.

Study population

The entire population 4,272 of the village as per 1991 census were considered as target group of the study. The population of the village was surveyed for IDD during the period from January to June, 2002 by dividing...