Estimation of Antioxidant and Antinutritional Factors of Green Broccoli Florets and their Effects on Boiling
Soumi Pal Choudhury, Dr. Kazi Layla Khaled
Department Of Home Science
Nutrition Laboratory
University of Calcutta
Kolkata -700027
INDIA

Abstract: Broccoli, scientifically known as Brassica oleracea contains high levels of vitamins, antioxidant and anticarcinogenic compounds like glucosinolates, sulforaphane, phytochemicals, vitamin K, vitamin C and possess some antinutritional factors like oxalic acid, phytic acid, protease inhibitor etc. Here the study was performed with raw as well as cooked broccoli florets. Antioxidant activity was measured by estimating total phenol content of broccoli and phytate, total alkaloid, trypsin inhibitor were estimated as antinutritional factors. Results showed quite difference between the cooked and the raw broccoli. It was found that after boiling there was 81.91%, 36.67%, 90%, 8.36% reduction of total phenol, phytate, total alkaloid and trypsin inhibitor respectively.

Keywords: Broccoli, Total phenol, Phytate, Alkaloid, Trypsin inhibitor, Antioxidant, Antinutritional, factors

I. Introduction
Broccoli is a plant in the cabbage family whose large flower head is used as vegetables. It belongs to the Brassicaceae family. It has been referred to as the CROWN JEWEL of nutrition since it possesses health-promoting compounds like vitamins, minerals, and fibres, proclaiming its exceptional health benefits[1]. Chronic non-communicable diseases are increasing among the adult population in both developed and developing countries. Cardiovascular diseases and cancer are at present the leading causes of death in developed countries (e.g. Europe and North America) accounting for 70-75 percent of total deaths [2]. The prevalence of chronic disease is showing an upward trend in the most countries. Numerous epidemiological studies indicate that Brassicas, in general, and broccoli in particular, protect humans against cancer since they are rich sources of glucosinolates, as well as possessing a high content of flavonoids, vitamins, minerals (bioactive compounds). Results clearly point towards a positive correlation between cancer prevention and consumption of cruciferous vegetable[3]. Sulforaphane, an isothiocyanate from broccoli, is one of the most potent food-derived anticarcinogens. Consumption of broccoli sprouts has been shown to be potentially effective at inhibiting Helicobacter pylori growth with sulforaphane [4].

The present study suggests that broccoli has excellent antioxidative potential. The hydroxycinnamic acid esters from broccoli, 1.2 -dinitapolygentiobiene and 1-sinapoyl-2-feruloylgentiobiene, are considered as the active components with antioxidant effect[5]. Broccoli also has antidiabetic effect. Investigation was performed by experts to see the effect of broccoli sprouts on the induction of various biochemical oxidative stress markers. Ascorbigen, an indole containing derivative of L-ascorbic acid was found in Brassica. Some of these ascorbigen analogs are immunomodulators[6].

Previous study also gives evidence of some antinutritional factors of broccoli like protease inhibitor, phytic acid, oxalic acid etc. These antinutritional factors interfere with the assimilation of nutrients and also interfere with the utilization of other nutrients like protein, iron, zinc, calcium, iodine etc. Most of the vegetables are commonly cooked before being consumed. It is known that cooking induces significant changes in chemical composition, affecting the bioavailability and content of chemopreventive compounds in vegetables. Cooking methods were shown to affect the contents of nutrient and health-promoting compounds such as vitamin C, carotenoids, polyphenols, glucosinolates in broccoli. The present study was performed with the cooking method (i.e. boiling at 100 °C for 30 minutes) to see the effect of heat on antinutritional and antioxidant factors of broccoli florets.

II. Materials and Methods
Fresh raw green broccoli florets and boiled broccoli florets have been selected for experimentation.
A. Preparation of Raw broccoli (Brassica oleracea) florets:
Broccoli was purchased from the local market. After cleaning, broccoli florets were cut into pieces with minimum stalks.

B. Preparation of Boiled broccoli florets:
Broccoli florets were cut into pieces with minimum stalks. Then these florets were placed into boiling water at 100°C for 30 minutes (100 ml distilled water was used for boiling).

With this raw & boiled sample the following parameters were observed in broccoli florets:
1. Estimation of Total Phenol content (Barman, K.2004 method) [7],
2. Estimation of Phytate content (Wheeler et al, 1974 method) [8],
3. Estimation of Total alkaloid content (Harbone JB, 1973) [9],
4. Estimation of Trypsin Inhibitor content (N. Raghuramulu et al., 2003) [10].

Statistical analysis:
Statistical analysis were done by student’s t test [11]

### III. Results

#### Table I: Result of Total phenol content of broccoli florets

<table>
<thead>
<tr>
<th>Broccoli florets</th>
<th>TOTAL PHENOL</th>
<th>p value</th>
<th>Percentage of reduction of total phenol after boiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td>19.51 ±0.10</td>
<td>&lt;0.001</td>
<td>81.91%</td>
</tr>
<tr>
<td>Boiled</td>
<td>3.53 ±0.03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Table II: Result of Phytate content of broccoli florets

<table>
<thead>
<tr>
<th>Broccoli florets</th>
<th>PHYTATE</th>
<th>p value</th>
<th>Percentage of reduction of phytate after boiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td>0.12 ±0.0005</td>
<td>&lt;0.001</td>
<td>36.67%</td>
</tr>
<tr>
<td>Boiled</td>
<td>0.076 ±0.00013</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Table III: Result of Total alkaloid content of broccoli florets

<table>
<thead>
<tr>
<th>Broccoli florets</th>
<th>TOTAL ALKALOID</th>
<th>p value</th>
<th>Percentage of reduction of total alkaloid after boiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td>12 ±0.163</td>
<td>&lt;0.001</td>
<td>90%</td>
</tr>
<tr>
<td>Boiled</td>
<td>1.2 ±0.163</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Table IV: Result of Trypsin inhibitor content of broccoli florets

<table>
<thead>
<tr>
<th>Broccoli florets</th>
<th>TRYSIN INHIBITOR</th>
<th>p value</th>
<th>Percentage of reduction of trypsin inhibitor after boiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw</td>
<td>48.53±0.27</td>
<td>&lt;0.01</td>
<td>8.36%</td>
</tr>
<tr>
<td>Boiled</td>
<td>44.47±0.24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
IV. Discussion

Broccoli is widely considered to possess high levels of total phenols. Study found that the total phenol of green broccoli florets was reduced by 81.91% after 30 minutes heat treatment (i.e. boiling at 100°C for 30 minutes). This observation support the suggestion that the decrease in total phenol content was due to boiling[12]. Heat may disrupt the hydroxyl group structure of total phenol which is mainly responsible for phenolic antioxidant properties. Increased surface area of tissues in contact with cooking water as well as high temperature was likely to have caused disruption of cell walls and breakdown of phenolic compounds. Stability of the phytate was affected by boiling which was reduced by 36.67%. This was due to thermal decomposition of phytic acid structure [13]. Total alkaloid content showed drastic reduction after boiling i.e. 90% reduction takes place. From this result it can be suggested that the experimental broccoli contained such alkaloids which were heat sensitive. Result showed that trypsin inhibitor content of broccoli was reduced by 8.36% after 30 minutes boiling. From this observation it can be said that trypsin inhibitor needs drastic heat treatment and long soaking time [14]. Soaking before cooking and discarding of this soaking water can reduce trypsin inhibitor content significantly.

From all these experiments it can be suggested that the consumption of cooked broccoli is better than the raw one, which we generally use in salad. Though heat treatment reduces the antioxidant content of broccoli but simultaneously heat can also reduce the antinutritional factors. Reductions of these antinutritional factors are necessary as these factors cause deleterious effects on health.

References

[6]. M.N.Preobrazhenskaya,V.M.Bukman,A.M.Korolev,S.A.Efimoos,”Ascorbigen And Other Indole-Derived Compounds From Brassica Vegetable And Their Analogs As Anticarcinogen And Immunomodulating Agents”,Pharmacology &Therapeutics,60(2),1993,301-313

Acknowledgments

I am extremely thankful to my senior Ms.Rukshana Irani, Assistant Professor ,Raidighi college,West Bengal, India, for active co-operation and encouragement in carrying out the research work in the laboratory.