Chapter 3
(Part – II)

Effects of Processing on the Nutritional and Antinutritional Substances of Premature Pods of *Parkia timoriana*(DC.) Merr

3.1b Introduction

*Parkia timoriana* entire pods have been substantially and favouritely consumed as legume vegetables at maturation from stages young to premature. The percent weights of pod portion in edible parts of young and premature entire pods were 77.88% and 58.01% respectively. Hence, the pod constituted a major portion of edible part of green entire pods. The green entire pods have been consumed by preparing into dishes such as “Iromba” (a chutney like preparation), fried items, cooked ones of various recipes and also in raw by mixing with fermented fish, chilly and salt. Giri (2000) displayed the nutritional value of staging entire pod and its parts. In a previous contribution (Priya, 2012) effects of boiling + draining, pressure cooking + draining, steaming and frying on nutritional, antinutritional substances and antioxidants of premature seed have been envisaged. Since the pod have been consumed along with seeds, it is an attempt to carry out a similar study on pod.

3.2b Materials and Methods

Premature entire pods of about same size and maturity belonging to *P. timoriana* plant growing in Heinoupok, Imphal west were procured. The green skin and unedible parts of the entire pods were removed and then they were separated into seed and pod portions. About 1000g of the
pods were manually cut into small pieces and they were divided into five portions of 200g each. The following treatments were then performed.

**Boiling**

200ml of distilled water was added to a portion of pod and boiled inside a beaker for 20 min. The liquid was then drained off.

**Pressure Cooking**

To a portion of the pod 150 ml of distilled water was added and pressure cooked upto third blowing. This was followed by draining of liquid.

**Steaming**

Into a beaker a portion of the pod was transferred and steamed for 20 minutes with the help of water bath.

**Frying**

Over a thick iron pan a portion of the pod was fried with occasional sprinkling of distilled water in a manner so that pod do not get charred. The process was continued for 10 minutes.

**Unprocessed Pod**

The remaining portion of the pod was left unprocessed and treated as control. A portion of the samples were immediately analysed for the contents of ascorbic acid (Jayaraman, 1985), folic acid (Ranganna, 1986) free amino acid (Moore and Stein, 1948) and moisture (Ranganna, 1986).
The remaining mass of the processed and unprocessed portions of the pods were cut into small pieces and then left for sun drying. The sun dried mass was ground into 60 mesh size and stored inside dessicators to dry up completely and storage continued until biochemical analyses were accomplished.

The analysis of the contents of crude protein, crude fibre (Sadasivam and Manickam, 1997), crude fat and ash (Ranganna, 1986) of the samples were carried out. Total crude carbohydrate content was calculated from the formula given by Janardhanan and Lakshmanan (1985). Energy content was determined adopting the method of Osborne and Voogt (1978). In furtherance, the determinations of total soluble sugars (Dubois et al., 1956), reducing sugars and methionine (Sadasivam and Manickam, 1997) of the samples were carried out. Difference of total soluble sugars and reducing sugars was produced as content of non-reducing sugars. The determinations of total phenols, tannins and phytate were carried out following standard methods (Sadasivam and Manickam, 1997). Method of Chang et al. (2002) was adopted for the determination of flavonoids.

Each estimation was done in three independent determinations and the data were statistically analysed following the method of SPSS package version 13.00. For difference between two means of treatments Bonferroni of Post Hoc tests of ANOVA were advocated respectively. Significant differences were determined at 0.05 level of significance.
3.3b Results and Discussion

Table 3.3 displays that moisture content increased in all the processings except frying. In the latter case, the loss might be due to the application of high temperature which resulted in vapourization of water from pods. Ajala (2009) observed that moisture content increased after cooking Solanecio biofrae and Solanum nigrum which could as a result of water absorption by the fibres and other natural chemical component of the vegetables. Pressure cooking + draining caused reduction in crude protein and ash content relative to their values. Magdi and Osman (2007) reported that protein content decreased after cooking Dolichos lablab beans (Lablab purpuresus L. sweet) which might be attributed to the leaching of soluble proteins. Baines et al. (2011) reported that ash content decreased after boiling and pressure cooking of cowpea due to leaching out of the mineral component into the boiling water. During all processing treatments the value of crude fat was found to be reduced insignificantly. Magdi and Osman (2007) observed a drastic reduction in fat after boiling Dolichos lablab beans which break down the triglyceride to simple fatty acids. Boiling + draining, pressure cooking + draining and steaming caused significant reduction of crude fibre value while an increase in the value was found due to frying. Ikenebomeh (1986) reported that boiling the African locust bean seed reduced its crude fibre content. Total crude carbohydrate increased in all the processings except frying. Table 3.3 is evidential that only frying caused reduction of energy while boiling + draining and pressure cooking + draining caused increase. While pressure cooking + draining, steaming and frying effected significant decrease of total soluble sugars, reducing sugars also seemed to be significantly affected due to these treatments while for non reducing sugars only frying exhibited such change.
Table 3.3: Changes of proximate composition, energy and other constituents of premature pod following different processing treatments.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Unprocessed</th>
<th>Boiled +drained</th>
<th>Pressure cooked+drained</th>
<th>Steamed</th>
<th>Fried</th>
<th>R/I %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture %</td>
<td>77.20±0.82</td>
<td>87.60±0.67</td>
<td>+13.50 84.80±0.91</td>
<td>+9.89</td>
<td>85.60±0.58</td>
<td>+10.90</td>
</tr>
<tr>
<td>Crude Protein %</td>
<td>8.58±0.38</td>
<td>7.63±0.52</td>
<td>-11.07 7.17±0.31</td>
<td>-16.36</td>
<td>8.06±0.39</td>
<td>-6.06</td>
</tr>
<tr>
<td>Crude fat %</td>
<td>3.03±0.12</td>
<td>2.80±0.42</td>
<td>-7.59 2.60±0.46</td>
<td>-14.19</td>
<td>2.00±0.33</td>
<td>-33.49</td>
</tr>
<tr>
<td>Crude fibre %</td>
<td>27.00±0.49</td>
<td>23.70±0.43</td>
<td>-12.20 24.20±0.39</td>
<td>-10.40</td>
<td>25.60±0.49</td>
<td>-5.19</td>
</tr>
<tr>
<td>Ash %</td>
<td>4.40±0.47</td>
<td>3.40±0.50</td>
<td>-22.73 3.00±0.49</td>
<td>-31.82</td>
<td>3.20±0.20</td>
<td>-27.27</td>
</tr>
<tr>
<td>Total crude carbohydrate %</td>
<td>56.98±0.37</td>
<td>62.43±0.50</td>
<td>+9.63 63.02±0.68</td>
<td>+10.60</td>
<td>61.14±0.78</td>
<td>+7.30</td>
</tr>
<tr>
<td>Energy value (K cal/100g)</td>
<td>289.56±3.42</td>
<td>305.60±1.88</td>
<td>+5.54 304.20±4.60</td>
<td>+5.06</td>
<td>294.80±1.92</td>
<td>+1.81</td>
</tr>
<tr>
<td>Total soluble sugars (mg/100g)</td>
<td>7000.00±100.06</td>
<td>6750.00±110.30</td>
<td>-3.57 5520.00±100.25</td>
<td>-21.14</td>
<td>4882.50±232.75</td>
<td>-17.52</td>
</tr>
<tr>
<td>Reducing sugars (mg/100g)</td>
<td>5320.00±227.76</td>
<td>5000.00±110.30</td>
<td>-6.01 4340.00±505.43</td>
<td>-18.42</td>
<td>4200.00±135.56</td>
<td>-21.05</td>
</tr>
<tr>
<td>Non-reducing sugars (mg/100g)</td>
<td>1680.00±191.10</td>
<td>1750.00±475.28</td>
<td>-8.17 1180.00±598.51</td>
<td>-29.76</td>
<td>682.50±98.72</td>
<td>-59.38</td>
</tr>
<tr>
<td>&quot;Total free amino acid (mg/100g)</td>
<td>310.00±17.50</td>
<td>230.00±58.52</td>
<td>-25.80 195.66±9.60</td>
<td>-36.90</td>
<td>180.00±12.80</td>
<td>-41.90</td>
</tr>
<tr>
<td>Methionine (mg/100g)</td>
<td>121.00±19.40</td>
<td>74.67±3.83</td>
<td>-38.29 44.00±0.84</td>
<td>-63.64</td>
<td>97.78±10.84</td>
<td>-19.19</td>
</tr>
<tr>
<td>&quot;Folic acid (μg/100g)</td>
<td>56.06±2.78</td>
<td>42.12±2.16</td>
<td>-24.90 24.22±0.82</td>
<td>-56.80</td>
<td>23.86±2.52</td>
<td>-57.40</td>
</tr>
<tr>
<td>&quot;Ascorbic acid (mg/100g)</td>
<td>180.32±10.58</td>
<td>121.78±13.47</td>
<td>-32.46 94.17±5.79</td>
<td>-47.78</td>
<td>84.13±5.56</td>
<td>-53.34</td>
</tr>
</tbody>
</table>

* Fresh mass values; Others are values of dry matters
R= Reduction(-); I= Increase (+)
Values with the same superscript in the same row do not differ significantly (P>0.05)
Values are means of three replications ± SD
Mubarak (2005) reported that reducing and non-reducing sugars are significantly reduced after boiling of mung bean seeds due to diffusion into the cooking water. Boiling + draining and frying affected folic acid less extensively than did by pressure cooking + draining and steaming. Contrary to our finding, DeSouza and Eiten (1986) reported that steam blanching of green vegetables resulted in greater retention of folic acid compared to water blanching due to leaching. It was also recorded that pressure cooking + draining, steaming and frying affected ascorbic acid severly while boiling + draining affected the vitamin lessly. On the other hand Godavari et al. (1974) observed that maximum ascorbic acid retention was in steaming and less in boiling of drumstick, french beans and cluster beans. Yadav and Sehgal (1995) revealed that loss of ascorbic acid from vegetables during processings such as boiling, frying, blanching and pressure cooking could range from 36% to 83% due to its instability at high temperature and its water soluble nature that caused it to leach into cooking water which is generally discarded after cooking. Tarvinder and Kochar (2005) reported that in contrast to pressure cooking, frying of green leaves of carrot, turnip and cauliflower resulted to reduction of appreciable amount of vitamin C. But, in the present case pressure cooking + draining was found to affect ascorbic acid in parity to did by frying. Data of table 3.3 show that only pressure cooking + draining and steaming reduce total free amino acid significantly whereas except steaming other treatments reduced methionine significantly, but at greater extent by pressure cooking + draining (63.64%). Khalil and Mansour (1995) observed that cooking reduces sulphur containing amino acids and tryptophan in faba bean. Loss of available lysine during heat treatment in
chickpea and peanut had also been reported by Rama Rao (1974) and of faba bean as well by Rani and Hira (1993). El-Adawy (2002) observed that cooking of chickpea decreased the concentration of lysine, tryptophan, total aromatic and sulphur containing amino acids. Total phenols mean the phenolic compounds nowadays known to have antioxidant property. Regarding their fate during processings it was observed that pressure cooking + draining and frying affected total phenols severely while boiling + draining affected them slightly. Unexpectedly, steaming caused 38.90% increase of total phenols. The flavonoids component of total phenol was found to be very low; but they were drastically affected at undiscriminated extents due to all processings. Xu and Chang (2008) reported that among soaking, boiling and steaming of black beans steam processing exhibited several advantages in appearance and texture of the cooked product, shortening processing time being associated with greater retention of TPC and antioxidant activities. Contrary to our finding, Chukwumah et al. (2007) observed that boiling had a significant effect on the phytocomposition of peanuts compared to oil and dry roasting as boiled peanuts had the highest total flavonoid and polyphenols contents. Boiling green leafy vegetables resulted in a drastic loss of potential antioxidants (Padma and Anitha, 2005). Piorrock et al. (1984) observed that food processing method such as boiling reduces the amount of the phytochemicals in fresh water green and blue green algae.

Regarding antinutritional substances, all the processing methods decreased tannin content and maximum reduction was found in pressure cooking + draining (Table 3.4). Suttikomin (2002) found that due to heat exerted during conventional blanching, boiling or stir frying reduction of tannins content in leafy vegetables (collard and ivy gourd) and fruit producing plants (egg plant and yard long bean) was evented.
Egbe and Akinyele (1990) investigated the effect of boiling on tannin content of lima bean and the level of tannin was found to be decreased during cooking. Rehman and Shah (2005) envisaged that tannins contents of black gram, red kidney bean and white kidney bean were significantly reduced after ordinary cooking and pressure cooking at 121°C for 20 minutes.

Statistically analysed data gave the clue that only steaming and frying affected significant decrease of phytate but at greater extent due to latter. Dry heating brought about a large reduction in the phytic acid content of fababean which may be due to insoluble phytins formed between phytic acid and some minerals (Crean and Haisman, 1963). Cooking has been reported to decrease phytate content in peas (Bishnoi et al., 1994).

In this study it was ascertained that frying reduced significantly the levels of tannins (11.50%) and phytate (20.59%). Obviously steaming reduced tannins by 16.02% whereas for phytate reduction change was only 10.72%. Boiling + draining and pressure cooking + draining caused the reduction of tannins by 11.18% and 23.10% respectively. The reduction of tannins and phytate would increase protein digestibility while the latter case would also increase absorption of minerals like iron, calcium, magnesium, zinc and copper. Data of tables 3.3 and 3.4 show that severe reduction was caused only on nutrients : ascorbic acid by steaming and frying; folic acid by former two; methionine by pressure cooking and non reducing sugars by frying; but substantial amounts of them are still available after the treatments. This finding, above mentioned extents of reduction of tannins and phytate, material of analyses (legume); desireous extensive removal of antinutritional substances are the attributes for suggesting frying as better one. Next to it steaming was adoptable.
Table 3.4: Changes of phenolic compounds and antinutritional substances of premature pod following different processing treatments

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Unprocessed</th>
<th>Boiled +drained</th>
<th>R/I %</th>
<th>Pressure cooked +drained</th>
<th>R/I %</th>
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<th>R/I %</th>
<th>Fried</th>
<th>R/I %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total phenol (mg/100g)</td>
<td>695.67 ±13.72</td>
<td>574.00 ±26.57</td>
<td>-17.49</td>
<td>436.00 ±12.11</td>
<td>-51.70</td>
<td>966.00 ±31.57</td>
<td>+38.90</td>
<td>320.65 ±7.60</td>
<td>-53.91</td>
</tr>
<tr>
<td>Flavonoids (mg/g)</td>
<td>1.82 ±0.42</td>
<td>0.30 ±0.15</td>
<td>-83.50</td>
<td>0.16 ±0.03</td>
<td>-91.20</td>
<td>0.18 ±0.04</td>
<td>-90.10</td>
<td>0.64 ±0.13</td>
<td>-64.00</td>
</tr>
<tr>
<td>Tannins (mg/100g)</td>
<td>780.25 ±23.37</td>
<td>693.00 ±16.15</td>
<td>-11.18</td>
<td>600.00 ±23.44</td>
<td>-23.10</td>
<td>655.28 ±31.46</td>
<td>-16.02</td>
<td>690.45 ±17.42</td>
<td>-11.50</td>
</tr>
<tr>
<td>Phytate (mg/100g)</td>
<td>197.54 ±7.13</td>
<td>186.13 ±3.82</td>
<td>-5.78</td>
<td>191.73 ±2.91</td>
<td>-2.94</td>
<td>176.37 ±5.21</td>
<td>-10.72</td>
<td>156.87 ±5.79</td>
<td>-20.59</td>
</tr>
</tbody>
</table>

All values are of dry matter.
Values with the same superscript in the same row do not differ significantly (P > 0.05)
R- Reduction(-); I- Increase (+). Values are means of three replications ± SD.

References


**Suttikomin, W. (2002).** Effect of blanching, boiling and stir frying on total iron, vitamin C, phytate and tannin contents in Thai vegetables. M.Sc. Thesis in Food and nutrition for development, Faculty of Graduate Studies, Mahidol University, Thailand.
