Effect of pressure and solar cooking on phytic acid and polyphenol content of cowpeas

Mamta Pasrija and Darshan Punia

Introduction
Cowpea (Vigna unguiculata L. Walp) seeds have about 25 per cent protein, 67 per cent carbohydrates (Oyenuga, 1978), and are reported to contain certain antinutrients which can reduce their nutritional value (Ekpenyong, 1985). Like any other legumes, cowpea seeds are processed before consumption to make them soft and palatable, and to destroy antiphysiological substances. Common processing methods used involve soaking, dehulling or cooking.

Solar cooking of foods is rarely practised, even in the countries which receive plenty of sunshine during the summer season. In Northern India, May and June are the hottest summer months having temperatures of 46-48°C. Solar energy, which saves fuel and money, can be used to cook selected food items with the help of a solar cooker. The present investigation was carried out to study the effect of pressure cooking and solar cooking on the phytic acid and polyphenol content of cowpea cultivars.

Materials and methods

Materials
The seeds of four varieties of cowpea, namely, V-240 (brown), CAZC-B (black), CS-55 (grey) and FS-68 (white) were procured from the Forage Section, Department of Plant Breeding, CCS Haryana Agricultural University, Hisar, India. The seeds of cowpeas were cleaned, made free of dust, dirt, broken seeds and foreign materials and stored in air-tight plastic containers for further use. For pressure and solar cooking, the unsoaked, soaked/dehulled cowpea seeds were used.

Soaking
The seeds were soaked in distilled water for 12 hours at room temperature. A seed to water ratio of 1:4 (w/v) was used. The remaining water was discarded and the soaked seeds were washed twice using distilled water.

Dehulling
Soaked seeds (12 hours) were dehulled manually.

Pressure cooking
The unsoaked, soaked, and soaked/dehulled seeds were pressure-cooked at 1.05kg/cm²

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Dehulling
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Pressure cooking
The unsoaked, soaked, and soaked/dehulled seeds were pressure-cooked at 1.05kg/cm²
pressure. For this, a seed to water ratio of 1:4 (unsoaked), 1:2 (soaked) and 1:1 (soaked/dehulled) was used. The seeds were cooked until soft, as felt between the fingers. The cooked samples were dried at 70°C to a constant weight.

**Solar cooking**
Solar cooking of cowpea samples was carried out on bright, sunny days in the last week of the month of May. A seed to water ratio of 1:4 (unsoaked), 1:3 (soaked) and 1:1 (soaked-dehulled) was used. The direction of the solar cooker’s mirror was set in such a way that sun rays fell directly on it. After 30 minutes, one seed was withdrawn without interrupting cooking and the degree of cooking was tested by pressing the seeds between the fingers. If the seed felt uncooked, one seed was again tested after 15 minutes. This procedure continued until five seeds tested were found to be cooked. The unsoaked, soaked, and soaked/dehulled seeds were cooked for 150, 90 and 30 minutes, respectively.

All the soaked, dehulled and cooked samples were dried at 70°C to a constant weight. Dried samples were ground to a fine powder and stored in air-tight plastic containers for further chemical analysis.

**Chemical analysis**
Phytic acid was extracted in 0.5M nitric acid and determined colorimetrically by the method of Davies and Reid (1979). Total polyphenols were extracted by the method of Singh and Jambunathan (1981) and estimated as tannic acid equivalent according to the Folin-Denis procedure (Swain and Hills, 1959).

**Statistical analysis**
The data were processed for the analysis of variance according to standard methods of statistical analysis (Snedecor and Cochran, 1967).

**Results and discussion**

**Phytic acid**
Pressure cooking reduced the phytic acid content of cowpea seeds significantly. Pressure cooking of unsoaked seeds reduced the phytic acid by 20-22 per cent. A significantly greater reduction (28-30 per cent) was noticed in pressure cooking of soaked cowpeas compared to unsoaked seeds and this reduction increased (40-42 per cent) when the soaked/dehulled seeds were pressure cooked (Table I).

Solar cooking had a greater reducing effect on phytic acid than that of pressure cooking. Phytic acid was reduced by 34-35 per cent when soaked seeds were solar cooked whereas solar cooking of soaked-dehulled seeds reduced phytic acid by 45-47 per cent when compared with unprocessed cowpeas. Cooking of dehulled cowpeas, after soaking, showed a beneficial effect in the reduction of phytic acid. The decrease observed in phytic acid content of cowpeas due to cooking can be attributed to the formation of insoluble complexes between phytate and other components (Kumar et al., 1978). A reduction in phytate content after cooking of black gram (Kataria et al., 1988), moth beans (Khokhar and Chauhan, 1986) and rice beans (Kaur and Kapoor, 1990) has been reported earlier. Akinyele (1989), Shinde et al. (1991) and Umeron et al. (1997) observed a reduction in phytate content of cowpeas during cooking. Chifai et al. (1997) analysed Chinese indigenous legume seeds and reported that phytate content in different seeds was reduced by different amounts depending on the cooking times.

**Polyphenols**
Pressure cooking of unsoaked seeds resulted in a significant reduction of polyphenol content (32-38 per cent) in all the cowpea varieties. The reductions were higher for soaked seeds than for unsoaked seeds (Table II). About half the amount of polyphenols present in raw seeds was lost during pressure cooking of soaked seeds. The cumulative effect of soaking and dehulling followed by cooking was the removal of most of the polyphenols (86-90 per cent) of the cowpea seeds. This decrease in polyphenols may be due to removal of polyphenol-rich seed coat.

Solar cooking of seeds also had a significant reducing effect on polyphenolic compounds. Percentage losses in polyphenol contents were higher in solar-cooked seeds than pressure-cooked seeds; reduction to the extent of 88-94 per cent was noticed in solar cooking of soaked-dehulled seeds. Greater reduction in polyphenolic content during solar cooking may be due to longer exposure of seeds to heat treatment. A decreased amount of
polyphenols in cooked seeds could result from reduced extractability or change in chemical reactivity (Satwadhar et al., 1981). Pressure cooking and solar cooking involving moist heating may also destroy polyphenols. Laurena et al. (1987) suggested that the use of wet heat is the most effective method of polyphenol removal, while dry heat should be used with caution, considering its drastic effects on digestibility and the overall nutritional quality. A marked reduction in polyphenol content of cooked cowpea seeds has been reported earlier (Laurena et al., 1987; Shinde et al., 1991; Giami, 1993). Cooking for 60 minutes was found to be effective in reducing the tannin contents of Chinese indigenous legume seeds (Chifai et al., 1997). Cooking of soaked and dehulled seeds had the most pronounced lowering effect on the total phenolic contents of pigeonpea and climbing bean (Igbedioh et al., 1995). The smaller loss in cooking of unsoaked seeds may be due to the fact that soaking the seeds had already removed a significant amount of antinutrients and only a relatively small amount was left when the seeds were cooked.

The results of the present study reveal that solar cooking was more effective than pressure cooking in reducing the concentrations of phytic acid and polyphenolic compounds of cowpeas. Soaking and dehulling, followed by cooking, had a beneficial effect in the reduction of antinutrients in cowpeas. Such practices should be encouraged at the home level for the preparation of cowpea foods. Solar cooking of foods, in countries like India, where solar energy is available in abundance, should be popularized.

### Table I: Effect of pressure and solar cooking on phytic acid content (mg/100g) of cowpea (on dry matter basis)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cultivar</th>
<th>V-240</th>
<th>CZAC-B</th>
<th>CS-55</th>
<th>FS-68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unprocessed (control)</td>
<td></td>
<td>730.63 ± 0.74</td>
<td>992.13 ± 4.72</td>
<td>980.73 ± 3.46</td>
<td>849.36 ± 4.56</td>
</tr>
<tr>
<td>Pressure cooking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsoaked</td>
<td></td>
<td>569.83 ± 0.57 (22)</td>
<td>793.66 ± 3.76 (20)</td>
<td>784.56 ± 2.70 (20)</td>
<td>670.96 ± 3.62 (21)</td>
</tr>
<tr>
<td>Soaked</td>
<td></td>
<td>511.40 ± 0.53 (30)</td>
<td>714.30 ± 3.37 (28)</td>
<td>706.10 ± 2.51 (28)</td>
<td>603.00 ± 3.24 (29)</td>
</tr>
<tr>
<td>Soaked/dehulled</td>
<td></td>
<td>423.70 ± 0.45 (42)</td>
<td>595.23 ± 2.85 (40)</td>
<td>588.40 ± 2.06 (40)</td>
<td>492.60 ± 2.66 (42)</td>
</tr>
<tr>
<td>Solar cooking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsoaked</td>
<td></td>
<td>533.30 ± 0.53 (27)</td>
<td>744.06 ± 3.54 (25)</td>
<td>735.50 ± 2.59 (25)</td>
<td>628.50 ± 3.39 (26)</td>
</tr>
<tr>
<td>Soaked</td>
<td></td>
<td>474.86 ± 0.49 (35)</td>
<td>654.76 ± 3.11 (34)</td>
<td>647.23 ± 2.26 (34)</td>
<td>552.06 ± 2.97 (35)</td>
</tr>
<tr>
<td>Soaked/dehulled</td>
<td></td>
<td>387.16 ± 0.41 (47)</td>
<td>545.60 ± 2.59 (45)</td>
<td>539.36 ± 1.93 (46)</td>
<td>450.13 ± 2.42 (47)</td>
</tr>
</tbody>
</table>

Notes:
- Level of significance, p < 0.05; against cultivar, 1.60; against treatment, 2.77
- Values are means ± SD of three independent determinations
- Figures in parentheses indicate per cent decrease over control values

### Table II: Effect of pressure and solar cooking on polyphenol content (mg/100g) of cowpea (on dry matter basis)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cultivar</th>
<th>V-240</th>
<th>CZAC-B</th>
<th>CS-55</th>
<th>FS-68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unprocessed (control)</td>
<td></td>
<td>1,084.55 ± 10.07</td>
<td>962.02 ± 14.88</td>
<td>838.80 ± 22.65</td>
<td>520.35 ± 11.84</td>
</tr>
<tr>
<td>Pressure cooking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsoaked</td>
<td></td>
<td>780.82 ± 7.27 (28)</td>
<td>673.37 ± 10.45 (30)</td>
<td>578.72 ± 15.60 (31)</td>
<td>353.80 ± 8.04 (32)</td>
</tr>
<tr>
<td>Soaked</td>
<td></td>
<td>553.07 ± 5.16 (49)</td>
<td>490.60 ± 7.58 (49)</td>
<td>419.40 ± 11.32 (50)</td>
<td>260.15 ± 5.93 (50)</td>
</tr>
<tr>
<td>Soaked/dehulled</td>
<td></td>
<td>151.80 ± 1.42 (86)</td>
<td>115.40 ± 1.78 (88)</td>
<td>92.22 ± 2.47 (89)</td>
<td>51.97 ± 1.20 (90)</td>
</tr>
<tr>
<td>Solar cooking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsoaked</td>
<td></td>
<td>704.92 ± 6.57 (35)</td>
<td>620.45 ± 9.59 (35)</td>
<td>536.80 ± 14.48 (36)</td>
<td>327.77 ± 7.45 (37)</td>
</tr>
<tr>
<td>Soaked</td>
<td></td>
<td>531.40 ± 4.94 (51)</td>
<td>452.10 ± 6.99 (53)</td>
<td>377.42 ± 10.18 (55)</td>
<td>223.67 ± 5.08 (57)</td>
</tr>
<tr>
<td>Soaked/dehulled</td>
<td></td>
<td>130.10 ± 1.23 (88)</td>
<td>096.17 ± 1.49 (90)</td>
<td>67.07 ± 1.80 (92)</td>
<td>31.15 ± 0.72 (94)</td>
</tr>
</tbody>
</table>

Notes:
- Level of significance, p < 0.05; against cultivar, 3.97; against treatment, 6.88
- Values are means ± SD of three independent determinations
- Figures in parentheses indicate per cent decrease over control values
References


