A Research Note

Essential Elements in Dry and Canned Chick Peas
(Cicer arietinum L.)

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ABSTRACT

Ten essential elements were determined in dry and canned chick peas (Cicer arietinum L.) by atomic absorption spectrophotometry. Samples were taken at different stages during the canning process to determine where changes in element content occurred. The content of each sample was compared statistically to other samples taken within the process. Element retention, excluding chloride and sodium, ranged from 12 to 127% on a dry weight basis and 4 to 45% on wet weight basis.

Previous work on the mineral element content of chick peas has included mostly macro-elements such as calcium, iron, phosphorus, potassium and sodium (1,3,6). No data have been found in the literature on the effects of unit operations in canning on retention of essential mineral elements in chick peas.

The objective of this research was to determine and compare the concentration of 10 nutritionally essential elements in dry chick peas as received at the plant, in chick peas at different stages of the canning process, and in canned chick peas. The data provide an evaluation of the effect of the canning process upon the retention of 10 essential mineral elements.

MATERIALS AND METHODS

Sampling

Samples of dry, soaked, blanched and canned chick peas (Cicer arietinum L.) were obtained at the canning plant of Hanover Brands, Inc., Hanover, PA. The chick peas (Surtato variety) were harvested in California in 1984 and commercially canned in April 1985. Following is the description of the commercial canning process used. Dry chick peas (dry sample taken) were conveyed to a water tank where they were allowed to soak at 10°C for 12 h (soaked sample taken). The soaked chick peas were washed before being blanched in a steam injection water blancher for 5 min at 77°C. After blanching, the chick peas were cooled by washing and inspected for debris and substandard peas (blanched sample taken). Approximately 1.5 kg (54.5 oz) of chick peas were added to each 3-kg (106 oz, 603 x 700) C-enamel can. Then approximately 1.7 kg (60 oz) of filling medium (2% NaCl and 0.02% Na₂EDTA in water) at 66°C was added before sealing. The minimum initial temperature (IT) was 21°C. The cans were then placed in still retorts, processed for 30 min at 121°C, and cooled in water (canned sample taken) before storing. The F₀ value of the thermal process was 8.4. Five samples were taken at each step of the canning process throughout the day. Sampling from the line was coordinated so that dry, in-process and canned samples were of the same batch. Five samples of soak water and filling medium and one sample of plant water and blanch water were taken during the period.

Dry, soaked, and blanched samples weighed 0.6 - 1.0 kg each. Three cans of chick peas were taken for each of the five canned chick pea and processed drained liquid samples. The canned samples were stored at 21°C for 16 weeks before being opened, drained and mixed. Preliminary analyses were performed on canned chick peas samples to determine the number of samples needed to give 15% variation for a paired "t" test, according to Sokal and Rohlf (5). As a result, five samples were chosen to keep the variation about 15%. To compare the element content of the samples, data were analyzed using analyses of variance at the 1 and 5% levels, and Duncan's multiple range tests (5).

Soaked, blanched and canned samples were prepared for analyses by mixing and pureeing with a Cuisinart food processor (Cuisinarts, Inc., Greenwich, CT), freezing at -8°C, and freeze-drying on a Virtis freeze dryer for 72 h. The freeze-dried and dry samples were ground in a Waring Blendor and stored in a freezer. Before weighing samples to be wet ashed, the frozen portions were dried in a forced air oven for 19 h at 80°C and stored in a desiccator. At no time were samples in contact with any metals except stainless steel. Duplicate 2.00 + 0.21 g dried samples were weighed into 250-ml Erlenmeyer flasks and boiled with 25 ml of 5 N nitric acid until dissolved. After the wet-ashed samples were filtered and made up to 50 ml, the solutions were ready for analysis by atomic absorption spectrophotometry (AAS). Samples of soak water, plant water, blanch water, filling medium and processed drained liquid were diluted 1:1 and contained 4% concentrated HNO₃.

Canned chick pea samples were prepared for chloride determination following AOAC Methods of Analysis 3.071 (2). Du-
plicate 1.00 ± 0.17 g freeze-dried samples were moistened with 20 ml 5% (wt/vol) Na₂CO₃ solution, dried at 90°C for 3 h and ignited at 450°C overnight. After washing and filtering the ash with hot water, the filter papers were ashed at 450°C for 2.5 h. Duplicate portions of the wet-ashed solutions were used for the indirect determination of phosphorus. Portions of all chick pea samples, plus soak water, plant water, blanch water, filling medium, and processed drained liquid samples were analyzed for phosphorus following AOAC Methods of Analysis 3.066 (2).

Chloride was also determined indirectly (4). Except for the canned chick peas, duplicate 1.00 ± 0.12 g samples of dried chick peas were analyzed. Five ml of the canned chick pea solutions prepared by the AOAC (2) method were analyzed by the chloride procedure as were portions of the soak water, plant water, blanch water, filling medium and processed drained liquid samples.

Analyses were done on four replications of 0.60 ± 0.08 g National Bureau of Standards (NBS) Citrus Leaves (Standard Reference Material #1572). These replicates were analyzed following the same analytical procedures used in this work. Data on the 10 elements analyzed for which NBS standards data were available showed variations of 10% or less for the nine elements for which values have been certified, and 32% variation between the NBS non-certified value for chloride and the results obtained by the indirect procedure used in this work. When standard deviations were considered, there were differences of less than 5% between the NBS certified values and the values obtained in this report, except for chloride which was determined indirectly.

### RESULTS AND DISCUSSION

All data are presented on dry and on wet weight bases. Moisture content of the chick pea samples was determined in duplicate by freeze-drying each of the five samples. The mean moisture content of dry chick peas was 8.88% with a standard deviation of ±0.12; soaked chick pea moisture was 54.46% with a standard deviation of ±0.54; for blanched chick peas, it was 56.25% with a standard deviation of ±1.21; and for canned chick peas it was 68.06% with a standard deviation of ±0.24.

The concentration, statistical analyses and percentage retention of 10 essential elements in canned chick peas on dry weight basis are given in Table 1. The concentration and percentage retention of 10 essential elements in canned chick peas on wet weight basis are given in Table 2.

Canned chick peas contained significantly lower concentrations of calcium, copper, magnesium, manganese, potassium and zinc than dry chick peas on a dry weight basis. These decreases were probably caused by the elements being extracted out during soaking, blanching, or thermal processing. There was no significant difference in iron and phosphorus content between the dry and canned products. Chloride and sodium content in canned chick peas increased due to the sodium chloride content of the canned chick peas.
TABLE 2. Concentration and percentage retention of elements in canned chick peas (wet weight basis).

<table>
<thead>
<tr>
<th>Element</th>
<th>Dry (mg/100 g)</th>
<th>Soaked (mg/100 g)</th>
<th>Blanch (mg/100 g)</th>
<th>Canned (mg/100 g)</th>
<th>Retention (%)&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>116 ± 5</td>
<td>59.9 ± 2.7</td>
<td>53.4 ± 3.4</td>
<td>33.0 ± 2.8</td>
<td>28</td>
</tr>
<tr>
<td>Chloride</td>
<td>25.2 ± 7.8</td>
<td>6.96 ± 1.53</td>
<td>7.42 ± 2.22</td>
<td>602 ± 19</td>
<td>N.A,&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Copper</td>
<td>3.82 ± 2.00</td>
<td>0.89 ± 1.01</td>
<td>0.42 ± 0.37</td>
<td>0.16 ± 0.05</td>
<td>4</td>
</tr>
<tr>
<td>Iron</td>
<td>2.60 ± 0.96</td>
<td>2.45 ± 0.52</td>
<td>2.55 ± 0.19</td>
<td>1.16 ± 0.10</td>
<td>45</td>
</tr>
<tr>
<td>Magnesium</td>
<td>118 ± 5</td>
<td>62.1 ± 1.6</td>
<td>56.8 ± 3.4</td>
<td>26.5 ± 1.1</td>
<td>22</td>
</tr>
<tr>
<td>Manganese</td>
<td>2.24 ± 0.05</td>
<td>1.12 ± 0.06</td>
<td>0.99 ± 0.05</td>
<td>0.55 ± 0.02</td>
<td>25</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>140 ± 15</td>
<td>73.5 ± 8.0</td>
<td>75.9 ± 6.1</td>
<td>45.4 ± 5.4</td>
<td>32</td>
</tr>
<tr>
<td>Potassium</td>
<td>1,100 ± 21</td>
<td>515 ± 10</td>
<td>438 ± 6</td>
<td>188 ± 4</td>
<td>17</td>
</tr>
<tr>
<td>Sodium</td>
<td>19.7 ± 1.8</td>
<td>11.9 ± 1.2</td>
<td>10.2 ± 1.1</td>
<td>361 ± 10</td>
<td>N.A,&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Zinc</td>
<td>5.44 ± 1.25</td>
<td>2.06 ± 0.59</td>
<td>1.67 ± 0.18</td>
<td>0.79 ± 0.04</td>
<td>15</td>
</tr>
</tbody>
</table>

<sup>a</sup>Retention of elements in canned chick peas, on the basis of element concentration in dry chick peas being 100%. Retention = canned/dry x 100.

<sup>b</sup>NaCl was added during canning process.

filling medium, and their concentrations varied depending on the concentration of the medium used.

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REFERENCES


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