Title: Influence of Milling Method on the Physical and Functional Properties of Yellow Pea Flour Used in Cookies

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Introduction
The addition of whole pea flour to wheat flour can greatly enhance the nutritional profile of wheat flour by increasing fibre, protein and mineral content of the blended flour. However, the presence of pea flour can also affect the functional properties of the blended flour which in turn can affect end-product quality. Both the physical and functional properties of pea flour can be affected by the method used to mill the peas into flour. Research is limited on how different milling methods influence flour quality and ultimately end-product quality. Understanding how milling method affects flour quality will enable processors to successfully formulate food products with whole yellow pea flour.

Objectives
- To determine the effects of milling method (hammer, stone, pin, roller) on the physical and functional properties of whole yellow pea flour.
- To examine the effects of milling method on the quality of cookies made from a blend of 30% whole yellow pea flour and 70% soft wheat flour.

Materials and Methods

Samples and Flour Analysis
- Whole yellow peas (WYP) (CDC Meadow var.) were commercially milled using four different milling technologies (hammer, stone, pin and roller). Fine and coarse pin milled flours were produced for a total of five WYP flours.
- Soft wheat flour was obtained from a commercial source and was used as the control and for blending with the WYP flours.
- Blends of 30/70% WYP/wheat flour were prepared and analyzed along with the wheat and WYP flours for:
  - Average Particle Size - Malvern Scirocco 2000 MasterSizer, with volume weighted mean reported.
  - Starch Damage - Chopin 9DMatic, expressed as a percentage of iodine absorbed (API).
  - Water Absorption Capacity - Beuchat (1977), expressed as g water/flour.

Cookie Production and Analysis
- Wire-cut cookies were made according to AACC standard method 10-53. Cookies were baked for 8 minutes at 375°F.
- Cookie colour was measured using a Minolta CR-310 Colorimeter using a D65 illuminant.

Results and Discussion

Flour Properties
- Particle size of the WYP and soft wheat flour blends was influenced by milling method (Tables 1 and 2).
- Greater levels of starch damage and water absorption capacity were found in WYP flours which had smaller particle sizes.
- Among the flour blends, only the blend with WYP milled flour had significantly higher starch damage compared to the control flour. All blends had significantly higher water absorption capacity values than the control flour, which was likely due to the presence of the hull fraction in the pea flour.
- Peak viscosities of the flour blends were significantly lower than the control flour. With the exception of the pin milled fine flour blend, the peak viscosities decreased as the particle size of the flour blend increased.

Cookie Dimensions
- Cookies made from stone, roller and pin milled fine flours were significantly different from the control in width, thickness and spread (Figures 1-3).
- Cookies made from the pin milled fine flour had the smallest width and the greatest thickness while cookies made with the stone milled flour had the greatest width and the smallest thickness.
- Cookies made from the roller milled and pin milled fine flours had the smallest spread whereas the cookies made from stone flour had the greatest spread.

Conclusions
- Milling method significantly affected the physical and functional characteristics of WYP flour as measured by flour particle size, starch damage and water absorption capacity.
- Interestingly, when the pea flours were blended with wheat flour, despite the differences in particle size, there were no significant differences in starch damage or water absorption capacity among the blended flours.

Table 1: Physical and Functional Properties of Wheat and Whole Yellow Pea (WYP) Flours

<table>
<thead>
<tr>
<th>Flour Treatment</th>
<th>Particle Size (μm)</th>
<th>Starch Damage (API%)</th>
<th>WAC (g/g)</th>
<th>Peak Viscosity (RVU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat Control</td>
<td>87.15</td>
<td>91.80 ± 0.12 a</td>
<td>0.60 ± 0.06 a</td>
<td>356.50 ± 7.78 a</td>
</tr>
<tr>
<td>WYP Fine Pin Milled</td>
<td>98.85</td>
<td>92.51 ± 0.04 ab</td>
<td>0.73 ± 0.01 b</td>
<td>271.50 ± 0.71 bc</td>
</tr>
<tr>
<td>WYP Roller Milled</td>
<td>123.36</td>
<td>92.90 ± 0.04 a</td>
<td>0.72 ± 0.00 bc</td>
<td>280.60 ± 2.83 b</td>
</tr>
<tr>
<td>WYP Coarse Pin Milled</td>
<td>156.00</td>
<td>91.76 ± 0.64 a</td>
<td>0.73 ± 0.01 b</td>
<td>280.50 ± 4.95 b</td>
</tr>
<tr>
<td>WYP Hammer Milled</td>
<td>212.23</td>
<td>91.86 ± 0.22 ab</td>
<td>0.75 ± 0.01 b</td>
<td>257.00 ± 1.41 cd</td>
</tr>
<tr>
<td>WYP Stone Milled</td>
<td>278.68</td>
<td>91.57 ± 0.05 a</td>
<td>0.75 ± 0.01 b</td>
<td>243.00 ± 5.66 d</td>
</tr>
</tbody>
</table>

1 WAC = Water Absorption Capacity
Values with the same letter within a column are not significantly different (p<0.05).

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References

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