Pea protein favored for starch based gluten-free bread: Study

By Kacey Culliney, 19-Feb-2013

Related tags: starch based, gluten-free, proteins, pea protein, soy protein, sensory, texture, volume, color, flavor, smell, structure, formulation

Related topics: Gluten-free & Allergens, R&D, Bread, Ingredients

Pea is the ‘most acceptable’ protein for starch based gluten-free bread, finds new research.

The study published in Food Hydrocolloids also tested other non-gluten proteins including albumin, collagen, lupin and soy.

Findings showed that all proteins increased the nutritional profile of the bread and could effectively prolong shelf-life but that bread with pea protein was preferred.
PULSE MILLING:
Processing Pulses into Functional Flours

Heather Maskus, MSc
Cigi Project Manager, Pulse Flour Milling and Food Applications
February 2013 Pulse Food Seminar
2012 Pulse Developments

Loblaw chief Galen Weston has a vision for keeping Canada competitive in the food industry. That vision includes a "food of the future" called pulses.

Manufacturers should use pulse flours to fill nutrient gaps in gluten-free products, says dietician

Study finds lentil flours require careful formulation in cakes

Lentil flours can be successfully incorporated into sponge cake formulations but flour particle size is crucial to the end quality of the product, finds a new study.
Outline

• Introduction: Cigi Pulse Flour Milling Project
• Milling Technology
• Flour Quality
  – Physical properties
  – Compositional properties
  – Functional properties
• Conclusions: Optimizing Pulse Flour Performance
Introduction:
Cigi Pulse Flour Milling Project

Phase 1:
Pulse Flour Milling & Characterization

Phase 2:
Product Development

Phase 3:
Scale-up & Technology Transfer
Phase 3

• Entering into final project year
• Work with commercial partners to target ideal flour specs
• Conduct onsite demonstrations to interested commercial partners
• Scale up products for product development
Milling Technology
Flour Mills

Hammer Mill (HM)
Pin Mill (PM)
Stone Mill (SM)
Roller Mill (RM)
Hammer Mill

- Hammers rotate at high speeds
- Impact forces at collision cause fracture and particle size reduction
- Sizing varies due to hammer tip speed, hammer configuration, screen design, perforation size and air assist
Pin Mill

- Pins mounted on disks rotate at high speed
- Impact forces cause particle size reduction
- Sizing varies due to the material feed rate, mill speed, rotation direction of plates
Stone Mill

- Round, grooved stones rotate against one another with material passing between them
- Shear forces cause particle size reduction
- Sizing varies due to pressure between the stones and the grinding speed
Roller Mill

- Material is passed through a series of rotating rolls
- Compression, shear and grinding forces can all cause particle size reduction
- Sizing is dependent on the roll speed differential, screen sizes, and roll surface corrugation
Milling Products

<table>
<thead>
<tr>
<th>Hammer Mill</th>
<th>Roller Mill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Flour (HM-W)</td>
<td>Unrefined Flour (RM-U)</td>
</tr>
<tr>
<td>Split Flour (HM-S)</td>
<td>Refined Flour (RM-R)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stone Mill</th>
<th>Pin Mill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Flour (SM-W)</td>
<td>Whole Coarse Flour (PM-WC)</td>
</tr>
<tr>
<td>Split Flour (SM-S)</td>
<td>Whole Fine Flour (PM-WF)</td>
</tr>
<tr>
<td>Split Coarse Flour (SM-SC)</td>
<td>Split Fine Flour (PM-SF)</td>
</tr>
<tr>
<td>Split Fine Flour (SM-SF)</td>
<td></td>
</tr>
</tbody>
</table>

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Pulses

Red Lentil (CDC Maxim)

Yellow Pea (CDC Meadow)
Flour Quality

Physical, Compositional and Functional Properties
Flour Quality Analysis

• **Physical**
  – Particle size distribution
  – Colour

• **Compositional**
  – Protein
  – Ash
  – Fiber

• **Functional**
  – Pasting profile
  – Starch damage
  – Water absorption capacity
  – Oil absorption capacity
  – Foaming
  – Emulsification
Physical Flour Properties

Particle Size and Colour
Physical Properties
PSD Whole Flours

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RM-U*</td>
<td>4.5-5.1%</td>
<td>2.9%</td>
</tr>
<tr>
<td>PM-WF</td>
<td>7.8-9%</td>
<td>6.5-7%</td>
</tr>
<tr>
<td>SM-W</td>
<td>10-11%</td>
<td></td>
</tr>
<tr>
<td>HM-W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM-WC*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Particle Size (µm)

Volume (%)
Pulse Flour Colour

Roller Mill Refined Flour
- $L^*= 75.6$
- $a^*= 1.48$
- $b^*= 38.6$

Hammer Mill Whole Flour
- $L^*= 72.5$
- $a^*= 0.52$
- $b^*= 33.5$

Pin Mill Split Coarse
- $L^*= 70.86$
- $a^*= 16.65$
- $b^*= 31.12$

Pin Mill Whole Coarse
- $L^*= 60.15$
- $a^*= 6.92$
- $b^*= 20.89$
Physical Properties -
Summary

- Flour particle size distributions and colour are altered with milling method and milling parameters.
- Presence of hull affects flour particle size distributions and flour colour.
Compositional Flour Properties
Compositional Properties
Yellow Pea

<table>
<thead>
<tr>
<th></th>
<th>Split Flour Range</th>
<th>Whole Flour Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (% dwb)</td>
<td>23.9-25.0</td>
<td>22.1-23.5</td>
</tr>
<tr>
<td>Ash (% dwb)</td>
<td>2.6-2.9</td>
<td>2.49-2.74</td>
</tr>
<tr>
<td>Total Starch (% dwb)</td>
<td>48.5-54.7</td>
<td>44.3-49.5</td>
</tr>
<tr>
<td>Total Dietary Fiber (% dwb)</td>
<td>7-14.6</td>
<td>16-21.8</td>
</tr>
<tr>
<td>Other (by difference)</td>
<td>2.8-18.1</td>
<td>2.5-15.1</td>
</tr>
</tbody>
</table>

Split Pea Flour

- Protein
- Ash
- Total Starch
- Total Fiber
- Other

Whole Pea Flour

- Protein
- Ash
- Total Starch
- Total Fiber
- Other
## Compositional Properties

### Red Lentil

<table>
<thead>
<tr>
<th></th>
<th>Split Lentil Flour</th>
<th>Whole Lentil Flour</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protein (% dwb)</strong></td>
<td>25.7-29.08</td>
<td>25.5-28.11</td>
</tr>
<tr>
<td><strong>Ash (% dwb)</strong></td>
<td>2.29-2.61</td>
<td>2.49-2.77</td>
</tr>
<tr>
<td><strong>Total Starch (% dwb)</strong></td>
<td>38.5-58.7</td>
<td>38.5-48.0</td>
</tr>
<tr>
<td><strong>Total Dietary Fiber (% dwb)</strong></td>
<td>4.8-11.1</td>
<td>12.1-13.4</td>
</tr>
<tr>
<td><strong>Other (by difference)</strong></td>
<td>0-28.7</td>
<td>7.72-21.41</td>
</tr>
</tbody>
</table>

**Graphs:**
- **Split Lentil Flour**
  - Protein
  - Ash
  - Total Starch
  - Total Fiber
  - Other
- **Whole Lentil Flour**
  - Protein
  - Ash
  - Total Starch
  - Total Fiber
  - Other

*Source: Cigi*
Compositional properties - Summary

Whole and split seeds greatest effect on composition

Important to consider for nutrition labeling
Functional Flour Properties
Pasting Profile-RVA

Split yellow pea flours

Whole yellow pea flours
Pasting Profile-RVA

Split red lentil flours

Whole red lentil flours
Functional Properties - Starch Damage

Hammer Mill  Pin Mill - Coarse  Pin Mill - Fine  Roller Mill  Stone Mill
Functional Properties - Water Absorption Capacity

- Whole Lentil Flour
- Whole Pea Flour
- Split Lentil Flour
- Split Pea Flour

Hammer Mill
Pin Mill - Coarse
Pin Mill - Fine
Roller Mill
Stone Mill

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Functional Properties - Oil Absorption Capacity

- Whole Lentil Flour
- Whole Pea Flour
- Split Lentil Flour
- Split Pea Flour

Hammer Mill, Pin Mill (Coarse), Pin Mill (Fine), Roller Mill, Stone Mill
Functional Properties - Foaming Capacity (%)

- Whole Lentil Flour
- Whole Pea Flour
- Split Lentil Flour
- Split Pea Flour

- Hammer Mill
- Pin Mill - Coarse
- Pin Mill - Fine
- Roller Mill
- Stone Mill
Functional Properties

- Emulsification Activity

<table>
<thead>
<tr>
<th></th>
<th>Whole Lentil Flour</th>
<th>Whole Pea Flour</th>
<th>Split Lentil Flour</th>
<th>Split Pea Flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammer Mill</td>
<td>Blue</td>
<td>Blue</td>
<td>Blue</td>
<td>Blue</td>
</tr>
<tr>
<td>Pin Mill- Coarse</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Pin Mill- Fine</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Roller Mill</td>
<td>Purple</td>
<td>Purple</td>
<td>Purple</td>
<td>Purple</td>
</tr>
<tr>
<td>Stone Mill</td>
<td>Cyan</td>
<td>Cyan</td>
<td>Cyan</td>
<td>Cyan</td>
</tr>
</tbody>
</table>

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Functional Properties - Emulsification Stability

![Bar chart showing emulsification stability for different types of flour and milling methods.]

- Whole Lentil Flour
- Whole Pea Flour
- Split Lentil Flour
- Split Pea Flour

Milling Methods:
- Hammer Mill
- Pin Mill - Coarse
- Pin Mill - Fine
- Roller Mill
- Stone Mill

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Functional Properties Summary

Functional properties correlated to physical and compositional properties

- Fibre, protein, starch
- Average particle size
- Particle size distribution
Quality Conclusions

Not all flours are the same.

What flour specifications should be targeted?
Conclusions

Study finds lentil flours require careful formulation in cakes

By Kacey Culliney, 22-Aug-2012, Contact the editor  Post a comment

Related topics: Formulation

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Acknowledgments

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