Whole Grain Forum  
Beijing, China  
3rd International Nutrition & Health Industry Expo  

The Ingredient ‘Wheat Aleurone’ and Nutritional Benefits  

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Senior Food Technologist  
Cargill Bakery Technology
Who we are….

• Provider of food, agricultural and risk management products and services
• Global organization: 160,000 employees in 67 Countries
• Our purpose is to be the global leader in nourishing people
• Our mission is to create distinctive value for our customers
• The Bakery Category works across our ingredient businesses to identify key consumer trends and customer needs to develop innovative new products
Outline

> Role of whole grain components in US marketplace
> Nutritional comparisons
> Aleurone definition
> Applications
> Challenges and Opportunities
Endosperm

- 90-95% of wheat flour in the US
- Major portion of the wheat kernel
- Typically enriched with B vitamins and iron
- Processing benefits
- Acceptability
- Versatile applications
Wheat Germ

- The “heart” of the wheat kernel
- Vitamin E, Folic Acid, Phosphorus, Thiamin, Zinc, Magnesium
- Nutty sweet flavor
- Versatile applications
Bran

- Nutrient dense
- Public awareness of nutritional benefits
- Phenolic compounds
- Cereals, baked goods, snacks
- Affects processability in some applications at high levels
Wheat Bran Fractionation

- Consists of the aleurone layer, starch, and pericarp
- Contains 45-55TDF
- Concentrated source of essential vitamins, including B6, niacin and E
- Concentrated source of important minerals such as potassium, magnesium, calcium, iron and zinc
- Includes most major antioxidants, and many phytochemicals
## Wheat Aleurone and Bran Macronutrients

<table>
<thead>
<tr>
<th>Concentrated Aleurone vs. Wheat Nutritional Comparison</th>
<th>Concentrated Aleurone</th>
<th>Source Wheat Bran</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proximates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture %</td>
<td>8.14</td>
<td>12.76</td>
</tr>
<tr>
<td>Ash %</td>
<td>7.34</td>
<td>5.38</td>
</tr>
<tr>
<td>Protein %</td>
<td>17.46</td>
<td>16.31</td>
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<tr>
<td>Starch %</td>
<td>12.75</td>
<td>17.34</td>
</tr>
<tr>
<td>Total Dietary Fiber %</td>
<td>43.36</td>
<td>40.67</td>
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<tr>
<td>Insoluble %</td>
<td>40.15</td>
<td>38.50</td>
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<tr>
<td>Soluble %</td>
<td>3.07</td>
<td>2.48</td>
</tr>
<tr>
<td>Total Fat %</td>
<td>6.33</td>
<td>5.40</td>
</tr>
</tbody>
</table>

Source: USDA Nutrient Database
Cargill Incorporated
Data/GrainWise

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## Wheat Aleurone and Bran Micronutrients

<table>
<thead>
<tr>
<th>Nutritional Comparison</th>
<th>Concentrated Aleurone</th>
<th>USDA Wheat Bran</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minerals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe-Iron</td>
<td>13.93 mg/100g</td>
<td>10.57</td>
</tr>
<tr>
<td>Mg-Magnesium</td>
<td>770.00 mg/100g</td>
<td>611</td>
</tr>
<tr>
<td>P-Phosphorus</td>
<td>1857.00 mg/100g</td>
<td>1013</td>
</tr>
<tr>
<td>K-Potassium</td>
<td>1780.00 mg/100g</td>
<td>1182</td>
</tr>
<tr>
<td>Zn-Zinc</td>
<td>12.05 mg/100g</td>
<td>7.27</td>
</tr>
<tr>
<td>Cu-Copper</td>
<td>1.35 mg/100g</td>
<td>0.998</td>
</tr>
<tr>
<td>Mn-Manganese</td>
<td>12.70 mg/100g</td>
<td>11.5</td>
</tr>
<tr>
<td><strong>Vitamins</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiamin (B1)</td>
<td>1.26 mg/100g</td>
<td>0.523</td>
</tr>
<tr>
<td>Riboflavin (B2)</td>
<td>0.32 mg/100g</td>
<td>0.577</td>
</tr>
<tr>
<td>Niacin</td>
<td>22.87 mg/100g</td>
<td>13.58</td>
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<tr>
<td>Pantothenic acid</td>
<td>1.87 mg/100g</td>
<td>2.18</td>
</tr>
<tr>
<td>B6</td>
<td>2.52 mg/100g</td>
<td>1.3</td>
</tr>
<tr>
<td>Folate</td>
<td>220.33 mcg/100g</td>
<td>79</td>
</tr>
</tbody>
</table>

Source: USDA Nutrient Database Cargill Incorporated Data/GrainWise
Prebiotic Study
Concentrated Aleurone vs. Bran

• Aleurone shown to be better prebiotic than wheat bran
• Dietary fiber in aleurone is preferentially degraded


“Cereal aleurone tissue comprises the outermost layer(s) of the endosperm in cereal grains, and surrounds the starchy endosperm and part of the embryo. Cereal aleurone tissue is separated from the germ and starchy endosperm by standard milling practices, starting with the grain kernel or starting with the bran, followed by further extraction processes. Microscopic evaluation reveals that aleurone cells are morphologically distinct from other grain tissues because they contain a high concentration of niacin bodies. Each aleurone cell is enclosed within a fibrous cell wall that is thicker than endosperm cell walls and that is composed mainly of arabinoxylans and beta glucans in various ratios. Isolated aleurone tissue should contain low levels of starch and pericarp, and represents a major portion of the grain’s physiologically beneficial substances for human nutrition.”
The Aleurone Layer

> White paper written to support nutritional benefits of aleurone
  - Joanne Slavin and Gary Fulcher
  
  • “In wheat, the majority of desirable “whole grain” components are concentrated in the aleurone layer, the primary component of bran which is source of antioxidants, minerals, lysine-rich proteins, soluble and insoluble fiber, water- and fat-soluble vitamins, sterols and lignans, among others…The aleurone layer is not only unique – it is the primary source of bioactive effects conferred by whole wheat products; indeed it is the core of whole wheat benefits.”
FOOD APPLICATION EXAMPLES
Bread

- 20% Concentrated Aleurone: 80% Enriched White Flour = Whole Wheat nutrition
- Processability, texture, flavor, similar to a white bread

<table>
<thead>
<tr>
<th>Nutritional Comparison</th>
<th>Enriched White flour</th>
<th>*Whole Wheat flour</th>
<th>20% Aleurone flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein %</td>
<td>12.20</td>
<td>14.20</td>
<td>13.40</td>
</tr>
<tr>
<td>Fiber %</td>
<td>2.00</td>
<td>9.70</td>
<td>11.30</td>
</tr>
<tr>
<td>Insoluble %</td>
<td>1.40</td>
<td>8.70</td>
<td>10.00</td>
</tr>
<tr>
<td>Soluble %</td>
<td>0.60</td>
<td>1.00</td>
<td>1.30</td>
</tr>
<tr>
<td>Vitamins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B6 mg/100g</td>
<td>0.10</td>
<td>0.64</td>
<td>0.47</td>
</tr>
<tr>
<td>Niacin mg/100g</td>
<td>3.92</td>
<td>2.19</td>
<td>9.21</td>
</tr>
<tr>
<td>Minerals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ca mg/100g</td>
<td>16.30</td>
<td>30.60</td>
<td>37.20</td>
</tr>
<tr>
<td>Mg mg/100g</td>
<td>29.40</td>
<td>138.00</td>
<td>156.00</td>
</tr>
<tr>
<td>Zn mg/100g</td>
<td>0.71</td>
<td>2.65</td>
<td>2.24</td>
</tr>
<tr>
<td>K mg/100g</td>
<td>109.00</td>
<td>333.00</td>
<td>405.00</td>
</tr>
<tr>
<td>Ash %</td>
<td>0.48</td>
<td>1.50</td>
<td>1.83</td>
</tr>
<tr>
<td>Total Carbohydrates %</td>
<td>72.10</td>
<td>62.10</td>
<td>61.50</td>
</tr>
<tr>
<td>Fat %</td>
<td>1.63</td>
<td>2.52</td>
<td>2.66</td>
</tr>
<tr>
<td>Moisture %</td>
<td>12.20</td>
<td>11.00</td>
<td>10.60</td>
</tr>
<tr>
<td>Whiteness (L.A.B.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-Value</td>
<td>97.55</td>
<td>80.26</td>
<td>90.95</td>
</tr>
</tbody>
</table>

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Cereal

Flakes

- 35% Concentrated aleurone
  - Whole wheat flour, barley flour, and white flour
- Excellent source of:
  - Fiber
  - Two essential antioxidants (manganese and selenium)
  - Phosphorus
  - Magnesium
- Good source of:
  - Iron
  - Thiamin
  - Niacin
  - Vitamin B6
  - Copper
  - Natural Enrichment
  - Nutty flavor
  - Earthy appearance
  - Firm snap
Cereal

> Clusters
  – Blended with corn sweetener for binding syrup
  – Tender bite
  – Not sticky
> Granola
> Rice cakes
Snacks

➤ Extruded Snacks
  – 35% Concentrated aleurone
    • Whole grain corn flour, water
  – Excellent source of:
  – Fiber
  – Phosphorus
  – Magnesium
  – Good source of:
  – Niacin
  – Vitamin B6
  – Copper
  – Bland flavor
  – Good crunch
Protein Bar

High Protein Bar
- 20% Concentrated aleurone
  - Soy protein, whey protein, peanut flour
- Excellent source of:
  - Vitamin E
  - Copper
- Good source of:
  - Fiber
  - Protein
  - Niacin
  - Phosphorus
  - Magnesium
  - Soft texture
  - Good cohesiveness
  - Nutty flavor
Miscellaneous Applications

> Aleurone Dusted raisins
  - Raisins typically coated in sugar and wax
  - Dust with cinnamon/aleurone mixture
  - Retain moisture

> Meat extender
  - Helps to retain fat
  - Assists in carmelization
  - Retains moisture

> Nut butters
  - Disperses well in fat/oil

> Seasonings/rubs
> Salad toppers
> Ice cream
> Meal replacement beverages
> Powder addition to smoothie
CHALLENGES IN THE US MARKET
Promotion/Marketing

Whole grains ranks high on awareness as well as interest across the globe.

- **Aware of whole grains**: 74%
- **Extremely/somewhat interested in whole grains**: 67%

**Graphic 1**: Awareness of whole grains across regions

- Americas: 64%
- Europe: 73%
- Asia: 71%
- U.S.: 86%

**Graphic 2**: Interest in health benefits of whole grains

- 2003: 36%
- 2008: 48%
- 2010: 50%

**Source**: 2010 HFI International Trend Survey, 18 countries included
Labeling

> ‘Aleurone’ and wheat bran fraction
> Education to consumers
> Consumers want to see more ‘Whole Grain options in food

82% **read labels** on food products carefully to find out about ingredients, fat content and/or calories ¹

83% sometimes **change their purchase decision** after reading the nutrition label ¹

Sources: 1. GfK Roper Reports US, 2. NMI’s 2010 Health & Wellness Trends Report
Health Claims and Research Opportunities

> Clinical trials on human subjects to meet FDA’s requirements for health claims in food
> Claims of interest include prebiotic and cardiovascular
> Explore potential claims for supplement use

Whole Grain Health Claim
*Food must contain 51% or more whole grain ingredients by weight per reference amount customarily consumed
"Diets rich in whole grain foods and other plant foods and low in total fat, saturated fat, and cholesterol, may help reduce the risk of heart disease and certain cancers."

*Reference http://www.fda.gov/Food/LabelingNutrition/LabelClaims/FDAModernizationActFDAMAClaims/ucm073639.htm
Opportunities for Chinese Market