Wheat Quality - Why it Matters to the World & MN Producers

Senay Simsek, PhD
Professor, Wheat Quality Specialist

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North Dakota State University
Department of Plant Sciences
Fargo, ND, USA
Responsibilities

• **Adjunct Professor**
  – Purdue University, WCCR, Department of Food Science
  – University of Puerto Rico, Food Science Program

• **Research**
  – Carbohydrate Research
  – Leadership in Wheat Quality Laboratory

• **Teaching**
  – Carbohydrate Chemistry (2 cr, 100%)
  – Advanced Food Chemistry II (4 cr, 33%)
  – Fundamentals of Flour Testing and Baking (3 cr, 100%)
  – Cereal Science: Flour Testing and Baking (7/lectures/year)

• **Service**

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NDSU
Team Members

Project Leader
Dr. Senay Simsek

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Brandon Olson MS
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Hi Kent Ho
Sophia Marushka
Sean McMonagle
Victoria Miller
Kaitlyn Peterson
Caitlin Barnard
Wheat Quality Laboratory

NDSU Wheat Quality Lab

Project Leader
Dr. Senay Simsek

Survey: Regional Quality Report

Export Cargo Survey

Nursery Samples: Breeding Programs

Research Projects

Including Field Plots

Established 1905!
Wheat Quality Factors

Milling Quality
- Flour yield
- Protein loss
- Ease of endosperm reduction
- Ease of flour separation

Flour Quality
- Moisture
- Ash
- Protein
- Color
- Wet gluten
- Starch damage

Bread Making Quality
- Absorption
- Mixing time
- Mixing tolerance
- Fermentation tolerance
- Loaf volume
- External/internal appearance

Dough Quality
- Water absorption
- Mixing characteristics
- Dough strength
- Visco/Elasticity

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Wheat Quality Evaluation

1. Screening Based on Protein Content
2. Early Generation Nursery samples
3. Field Plot Variety Trials
4. Wheat Yield Trials

Evaluation of Breeders Samples (HRS and HRW Wheat)

RESEARCH EXTENSION CENTER LOCATIONS

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Wheat Quality Evaluation

**HRS Nursery Samples**
=5,000 Samples:
Protein, Mill (Quad Jr.), Mixograph and Bake (25g)

**HRS Drill Strip Samples**
=375 for wheat evaluation
=200 for full analysis: Whole wheat, Mill (Buhler), flour, dough and bake (100g)

**HRW Nursery Samples**
=500 Samples:
Protein, Mill (Quad Jr.), Mixograph and Bake (25g)

**HRW Drill Strip Samples**
=250 for wheat evaluation
=100 for full analysis: Whole wheat, Mill (Buhler), flour, dough and bake (100g)
HRS Growing Region

Total: 15.2 MMT
Top Ten HRS Markets (5 year avg.)

Year to Year Comparison (through Nov. 14, 2019)

- Philippines
- Japan
- Taiwan
- China
- Korea
- Thailand
- Indonesia
- Italy
- Mexico
- Guatemala

Slide Source: Erica Olson, NDWC
Minnesota Wheat travels between 2500 and 9400 miles to reach its destination!
Bakery Products

Bakery products means products manufactured in a bakery; for example: bread, rolls, buns, cakes, cookies, crackers, doughnuts, pies, pastries, pretzels, and potato chips.
Baked Products – Wide Variety

Each type of bakery product has a unique formulation and requires flour with different functionality and different types of functional ingredients to optimize quality.
## Major Wheat Classes Exported: Range in Protein Content and Uses

<table>
<thead>
<tr>
<th>Class</th>
<th>Protein Range 12% MB</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Red Spring</td>
<td>12-16%</td>
<td>Bread, Blending Wheat, Specialty Products</td>
</tr>
<tr>
<td>Hard Red Winter</td>
<td>10-14%</td>
<td>Bread, Buns, Rolls</td>
</tr>
<tr>
<td>Soft Red Winter</td>
<td>8-11%</td>
<td>Cakes, Cookies, Pastries, Crackers, Flat Breads</td>
</tr>
<tr>
<td>Soft White Wheat</td>
<td>8-12%</td>
<td>Sponge Cakes, Cookies, Pastries, Flat Breads</td>
</tr>
<tr>
<td>Durum</td>
<td>11-15%</td>
<td>Pasta, Spaghetti, Noodles, Couscous</td>
</tr>
<tr>
<td>Hard White Wheat</td>
<td>10-16%</td>
<td>Developmental Stage (Bread and/or Noodles)</td>
</tr>
</tbody>
</table>
Why Hard Red Spring Wheat?

Blended with lower protein wheat

- Increases “gluten” protein content and strength
- Improves baking performance.
- Increases strength and “bite” of noodles

Advantages

- High protein content
- Excellent protein “gluten” quality
- Strong mixing strength
- Good extensibility
- Long stability to over-mixing
- Great for increased mechanization

Blended with durum for pasta

- Produces better quality pasta than other bread (common) wheat
Hard Red Spring Wheat Overview

Characterized by:

- High protein content
- Superior milling and baking performance
- Blended with other wheat classes to improve baking performance
- Production of premium non-blended flours for specialty bakery goods

End products:

- Hearth and pan breads, rolls, bagels, croissant, pizza crusts, hamburger buns, frozen dough and refrigerated dough
Protein – Quantity & Quality

• As protein content and quality increase
  – “Baking absorption” increases
  – Tolerance to over-mixing increases
  – Dough handling properties improve
  – Loaf volume increases
• High quality “gluten” is the baker’s main reason for choosing HRS wheat flour
Protein Measurement (Quantity)

- NIRT (Near Infrared Transmittance) – Official method for determination of protein content
- Combustion Nitrogen Analysis (Leco)
  - Replaced Kjeldahl as the official method for calibration of NIRT by Federal Grain Inspection Service
How to Measure Protein Quality?

• Wet Gluten

• Dough Rheology
  – Mixograph
  – Farinograph
  – Extensograph
  – Alveograph

• Baking: The Ultimate Test
Wet Gluten Content and Gluten Index
Effect of Wet Gluten Content

Note: All loaves had the same quantity of flour.

Photo from Perten.com
Farinograph
Farinogram

Arrival Time  Peak Time  Departure Time

Stability

MTI
Stability: 5.1 min

Stability: 20.2 min

Stability: 58.2 min
### Farinograph Blending Study

<table>
<thead>
<tr>
<th>Sample</th>
<th>Absorption (14%, mb)</th>
<th>Peak Time (Min)</th>
<th>Stability (Min)</th>
<th>MTI (BU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft Wheat</td>
<td>Hard Wheat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td>0%</td>
<td>52.6</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>75%</td>
<td>25%</td>
<td>54.1</td>
<td>1.4</td>
<td>3.2</td>
</tr>
<tr>
<td>50%</td>
<td>50%</td>
<td>56.4</td>
<td>6.1</td>
<td>10.1</td>
</tr>
<tr>
<td>25%</td>
<td>75%</td>
<td>60.2</td>
<td>6.4</td>
<td>11.1</td>
</tr>
<tr>
<td>0%</td>
<td>100%</td>
<td>62.7</td>
<td>8.0</td>
<td>16.0</td>
</tr>
</tbody>
</table>
Farinograph Blending Study

100% Soft

75% Soft

50% Soft

25% Soft

0% Soft
Blending Study
Ratio of Bread Flour (HRS) to Cake Flour (SW)

HRS Protein (14%) – 13.2  SW Protein (14%) – 8.4

% HRS:SW
0:100  25:75  50:50  75:25  100:0

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Impact of Protein Quality

Variety: Grandin

Experimental Variety (Not Released for Production)

Note: Protein contents similar for both wheat varieties
RESEARCH EXTENSION CENTER LOCATIONS
2019 Top HRS Varieties
Farinograph Stability (min)


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2019 Top HRS Varieties
Loaf Volume (cc)


- SY Ingrmar
- SY Valda
- Bolles
- SY SororElgin-ND
- Faller
- Barlow
- Glenn
- SY Rockford*
- WB 9479 ^
- Linkert
- Shelly


- Target Value
SPECIFIC ACTIVITIES
Activities

Trade teams

US Wheat—Visiting Mills and Special Seminars

Contracting for Wheat Value Workshop

Hosting visiting scientists

• Takahiro Ueno (Nippon)
• Jun Umezaki (Nippon)
• Yasuyuki Nishitsuji (Nisshin)

Research Projects

• Nisshin Cereal Science Symposium
• Japan Buyers Conference
Top Ten HRS Markets (5 year avg.)

Year to Year Comparison (through Nov. 14, 2019)

Slide Source: Erica Olson, NDWC
Objectives of US Wheat Associates Trips

To meet with millers and end-users of US Wheat (all the classes) to explain the Basics of Cereal Chemistry and unique applications of US Wheat in various products.

Particular topics include utilization and biochemistry of SRC, basics of cereal chemistry and science behind baking.

Give seminars to millers, end-users and buyers of various US Wheat classes to inform them about the quality characteristics of the crop.
Visit to Mills, AgriPasific Corporation
May, 2019
AsiaPacific Philippines, May 2019
Special Seminars!

May 9, 2019

CEREAL CHEMISTRY IN THE MILL

Thursday, May 9, 2019 • Grand Hyatt Manila, Bonifacio Global City

Guest Speakers

Peter Lloyd, Regional Technical Director, U.S. Wheat Associates Middle East & North Africa

Sengee Sinha, Professor, North Dakota State University

Michael Krueger, Senior Analyst and Contributor, World Perspectives Inc.

U.S. WHEAT ASSOCIATES

The wheat associations: 1909 Philippine Stock Exchange Tower

18th Street corner 9th Avenue

BGC Financial District, Taguig City, R.A. 6744

MANILA, PHILIPPINES

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Visit to San Miguel, September 2019
September 10, 2019

“Grain Chemistry, Milling, Quality Assurance and Food Safety Seminar” at the Mill Seminar
URC, Philippines, September 2019
URC, Philippines, September 2019
URC, Philippines, September 2019
GMC, Cebu 2019
GMC, Cebu, September 2019
Asian Grains, Cebu September 2019
Visit to Wilmar in Surabaya, Indonesia May 2019
Inter Flour, Malaysia, August 2019
Inter Flour, Malaysia, August 2019
MFM, Luput, Malaysia August, 2019
FFM September, 2019
MARDI, Malaysia September 2019
Nisshin Cereal Chemistry Symposium
January, 2019
2019 Crop Quality Seminars and Japan Buyers Conference
Japan, Breads November 2019
Tsukuba Research Center, Nisshin November 2019
Breads of Peru
Trade Teams 2019
Challenges with HRS Wheat Market

Just my personnel perspective!
Increasing Profits

- Yields (up)
- Price (up)
- Costs (down)
10 Year Average of HRS and #1 CWRS Protein Content

*No. 1 CWRS from Western Prairie region, 13.5% protein segregation
10 Year Average of HRS and #1 CWRS Farinograph Absorption

*No. 1 CWRS from Western Prairie region, 13.5% protein segregation*
10 Year Average of HRS and #1 CWRS Farinograph Stability

*No. 1 CWRS from Western Prairie region, 13.5% protein segregation
Why Care?

- **Hard Red Spring**
  - High protein
  - High gluten strength
  - High absorption

### Protein Content
- **European Union**
- **Argentina**
- **Russia**
- **Ukraine**
- **Australia (AS&WAPW)**
- **Kazakhstan**
- **Canada**

### Relative Exportable Surplus
- **Soft White**
- **Soft Red Winter**

### Countries
- Argentina
- Hard Red Spring
- Canada
- Australia (AH&APH)
- Kazakhstan
- Russia
- Ukraine
- EU
- Australia (AS&WAPW)

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[Image: U.S. Wheat Associates logo]
Domestic and overseas buyers pay top dollar for HRS because of its high quality and unique characteristics.
10 Year Average Farinograph Absorption

Absorption (%: 14% MB)


*MB = Moisture basis
10 Year Average Farinograph Stability

Stability (min)

Providing grains education and technical services in the Philippines could stimulate and support demand for Australian #wheat and #barley in that country, according to a new AEGIC report.

Report co-author Dr Peter White said while there were other more compelling prospects for Australian grain in South East Asia, strong population and consumption growth in the Philippines could represent opportunities for Australia. 
Take Home Message:

Working Together We Can Be Strong

US Wheat Customers

NDSU, MN Breeding & Quality Programs

MN Wheat Growers

US Wheat Customers

NDSU, MN Breeding & Quality Programs

MN Wheat Growers
Thank You!

E-mail: senay.simsek@ndsu.edu

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Instagram: @ndsu.wheat.carbohydrate

Facebook: NDSU Wheat Quality & Carbohydrate Lab

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