HWWQL Bulletin

"Improving Wheat Quality Through Testing, Innovation, & Technology"

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http://www.ars.usda.gov/Main/docs.htm?docid=14298

"Quality Matters"

What does it mean?

Brad Seabourn
HWWQL Director

Special thanks to Dr. Brett Carver, wheat breeder, Oklahoma State University, for the above byline. It has two meanings: the first is a simple statement of fact --- "wheat quality is important"; the second, as a title for this recurring segment in our bulletin where I hope to discuss wheat quality "issues" (matters) of importance to everyone.

Let's consider the first meaning for a moment: Is QUALITY --- in anything --- truly important? I suggest you go online and 'google' the word *quality*. Over 700 million 'hits', covering virtually every human endeavor imaginable. 'Quality' is obviously important to a lot of people.

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*This, and all previous issues, of the **HWWQL Bulletin** are available online at:*
http://www.ars.usda.gov/Main/docs.htm?docid=14298&pa

Inside This Issue

Wheat Ethanol Research

HWWQL Collaborates With Kansas State University Researcher

The Hard Winter Wheat Quality Laboratory (HWWQL), in collaboration with Dr. Scott Bean (research chemist, USDA/ARS/GMPRC) and Dr. Donghai Wang (Assoc. Director, KSU Bio Material & Technology Lab), are developing methodologies for rapid, small-scale ethanol fermentation of cereal grains. Samples of sorghum with known ethanol yields were obtained from KSU and scanned with a near-infrared (NIR) spectrometer by HWWQL staff. Resulting NIR calibrations for the prediction of ethanol yield from sorghum proved very successful. The potential for accomplishing the same for wheat looks promising. This would allow breeders to screen wheat for their ethanol yield potential and allow breeders to direct experimental lines (that might otherwise have been dropped from the breeding program for their lack of quality as a human food source) to the industrial production of ethanol for fuel.

But, "Why wheat?"

Of all the feedstocks used to make ethanol, corn makes up 95% of total U.S. production. The Corn Belt states have improved their agricultural economy by turning crops into fuel. However, states with less available corn are not as fortunate. As future ethanol producers in these states consider the cost of transporting corn to their plants, alternative feedstocks are being explored.

One alternative is wheat. In fact, it is not just an alternative, but a reality.

Corn prices and yields are at a record high, primarily due to the demand for fuel ethanol. As of 2006, in the U.S. there are over 100 ethanol plants operating with

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But, "Is WHEAT quality important?"

Ah, there's the rub.

For, in order to answer that question, we would need a definition of *wheat quality* --- something breeders, farmers, producers, millers, bakers, and many others, have been struggling with for ages.

Fifty years ago, wheat quality might have simply meant yield, or an accepted minimum for test weight and/or protein content. Not any more. I believe the "progressive' view today is that wheat quality is defined by the customer or "end-user," and is based upon the ability of a given lot of wheat to satisfy the stated (or implied) needs of the customer. In other words, "quality is in the eye of the beholder" … and thus a moving target.

So, how do we hit a moving target?

Years ago, when I was first learning to hunt pheasant and quail with my father near my childhood home in southwest Kansas, my initial untrained urge was to simply point and shoot when a bird jumped up. After a long day of seeing nothing but tail-feathers, my father bluntly pointed out the obvious: "You're never going to hit anything doing it that way." He said, "You have to MATCH the flight path and speed of the bird, LEAD it slightly, and then SHOOT. You have to be CONSISTENT --- always do it that way and you'll bring home something for supper every time."

In terms of wheat quality, and in order for the U.S. to be the customer's first choice as a supplier of wheat, we have to *know* our individual customers' needs and *match* them *consistently*; in fact, we have to *lead* those needs --- know where the customer is going and be one step ahead so we can provide what they want when they get there. Then shoot.

… in order for the U.S. to be the customer's first choice as a supplier of wheat, we have to know *our individual customers' needs and match them.*

As my Dad said, "Always do it that way and you'll bring home something for supper every time."

When we pull all of the feathers off of the 'wheat quality' bird, THAT'S what we're really talking about --- whether you're a wheat farmer, breeder, or a Wall Street stock broker --- you're talking about supper. ■ - *Brad*

Hard White Wheat Quality Targets

PNW Adopts Great Plains Region HRW QTs

At the annual meeting of the Pacific Northwest Wheat Quality Council held on Jan. 22-26, 2007, in Salt Lake City, UT, the membership agreed to adopt the Recommended Quality Targets for Hard Red Winter Wheat for the production of pan bread, which were created and adopted by the Hard Winter Wheat Quality Council in 2005. In similar fashion, the Hard Winter Wheat Quality Council, at its 2007 annual meeting, agreed to adopt the PNW's recommended quality targets for hard white wheat in the production of pan bread, Chinese 'hard-bite' noodles, Chinese 'northern-type' steam bread, Korean instant noodles, and hamburger/hotdog buns.

For more information, or to obtain a copy of the quality targets, please contact Dr. Brad Seabourn, brad.seabourn@ars.usda.gov, or 785-776-2751. ❖

NEW Cereal Research

"A Measurement of the Rheological Properties of Whole Grain Using the SKCS"

Researchers at BRI Australia Ltd., NSW, Australia, recently published data (2007. B.G. Osborn et al, J. Cer. Sci. 45(2):122-127) in which they used the single-kernel characterization system (SKCS) 4100 instrument to measure the rheological properties of whole grain wheat. The SKCS has previously been shown to provide *in situ* measurements of the rheological properties of the bran and endosperm layers of wheat, otherwise only possible following their isolation by dissection or machining. The current study confirmed that endosperm maximum stress endosperm strength (ES), as measured using the SKCS 4100, correlates highly with compressive strength measurements performed on specimens of endosperm tissues of known dimensions, isolated from different subsamples of the same bulk wheat samples. This provides a means of scaling the stress axis of the crush–response profile plots to the Instron scale (MPa) so that the SKCS endosperm stress/strain curves for hard wheat, soft wheat and durum can be compared with Instron results presented in the literature. In addition, a simple method for the measurement of ES and stiffness, using the SKCS 4100, has been developed. The method has been shown to rank wheat

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A Closer Look

The Glutomatic Test In-depth

In April 2003, the Grain Inspection, Packers and Stockyards Administration (GIPSA) hosted an ideation meeting in Kansas City, MO to assess needs for rapid field testing of wheat functional qualities and end-use characteristics. The group identified "dough strength" as a high priority functionality test. Review of a U.S. Wheat Associates' global test methods survey identified dough strength tests (aside from protein content) as the most commonly requested tests by wheat importing countries. 'Wet gluten content' ranked as the second most desired test. Wet gluten represents the fraction of the total wheat protein that agglomerates upon hydration and ultimately forms a dough system.

The Glutomatic System (developed by Perten Instrument Ab, Huddinge, Sweden) measures both the gluten quantity and quality in wheat. Gluten is the visco-elastic substance formed through the interaction between the wheat proteins glutenin and gliadin, wheat lipids and water under the influence of energy. Gluten is critical for the end-use quality of wheat and durum. The Glutomatic test can be performed on both wheat flour and wheat whole meal using either ICC Method 155 and 158, or AACC Approved Method 38-12.

Glutomatic System

Gluten Index (GI), which is a measure of gluten strength, is a value derived from the Glutomatic test method. The basic underlying principle of the test is that gluten from strong wheat will resist centrifugal force to a greater degree than that from weak wheat. Wet gluten is washed from a flour using the Glutomatic instrument. The (wet) gluten is weighed and then centrifuged through a fine mesh screen. Strong glutens are retained after centrifugation, and weaker glutens (partially) pass through the screen. GI values (worldwide) range from over 80% to <10%. U.S. wheats are generally quite strong, and typically have GI values above 90% according to HWWQL test results.

The Method

10.0 g ± 0.01 g of whole meal or flour is weighed and put into the Glutomatic wash chamber containing an 88 micron polyester sieve. When vital wheat gluten is measured, 1.5 ± 0.01 g is weighed. 4.8 ml of salt solution is added to the meal or flour samples. No salt solution is added to vital wheat gluten samples. Meal or flour and the salt solution are mixed to form a dough during a 20 second mixing cycle.

After termination of the mixing phase, the washing automatically starts and continues for 5 minutes. For wheat meal, the sample is transferred to a chamber equipped with a coarse 840 micron sieve which allows bran particles to be washed out. Exactly 30 seconds after completed washing, the undivided wet gluten piece is transferred to the special sieve cassette and centrifuged one minute at 6000 ± 5 rpm in the Glutomatic Centrifuge.

The gluten fraction that passed through the sieves is scraped off with a spatula and weighed. The fraction remaining on the inside of the sieve is collected and added to the balance. The Total Wet Gluten weight is obtained. The total wet gluten piece is then dried at 150°C for 4 minutes in the Glutork Dryer. After drying, the gluten is weighed again. The amount of gluten remaining on the centrifuge sieve in relation to total wet gluten weight is the Gluten Index.

GIPSA implemented a NIRT protein-based wet gluten calibration in May, 2006, for hard red (HRS and HRW) wheat. Their protein-based wet gluten NIR calibration is: NIRT Wet Gluten (14% mb) = 3.029 x NIRT Protein (12% mb) – 7.83. See http://archive.gipsa.usda.gov/programsfgis/inspwgh/wet_gluten.pdf for further information.

Keys to accuracy and precision:

1) accurate sample weights throughout the test procedure (± 0.01 g),
2) damp dry the wet gluten ball prior to weighing in order to remove excess moisture.

Inconsistencies: some samples simply refuse to form a cohesive dough mass during the initial stages of the test. The test can be repeated using 4.2 ml of 2%

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sodium chloride solution with a 10-minute "rest time" (extra hydration time) before the automated washing step. (The 10-minute rest time is a deviation from the standard AACCI procedure.) However, the HWWQL has found that this modification remedies the problem in only a few cases.

For more information, please contact Dr. Richard Chen, richard.chen@ars.usda.gov, or 785-776-2750. ❖

HWWQL Offers New Service

Breeder 'Check Sample' Program

Beginning Sept., 2007, the HWWQL will provide a free check sample service to breeders in the hard winter wheat growing region that maintain their own quality testing laboratories.

Accuracy and quality control in the laboratory are the underlying principles of any quality testing laboratory. For more than 70 years, the HWWQL has aided wheat breeders in improving U.S. wheat. The HWWQL Check Sample Service provides subscribing members an opportunity to evaluate method accuracy, precision and instrument performance on a scheduled, regular basis.

By comparing internal laboratory data to results from other laboratories in the Great Plains growing region, a critical assessment of the analytical data generated by subscriber labs can be made, and identification of areas for method improvement can be identified. The check sample program can be used as a means to ensure the accuracy of data generated from various wheat quality test methods. The HWWQL Check Sample Service is an excellent tool by which subscribers can build confidence in the analytical data generated by their quality labs.

Participating quality laboratories will ultimately rely on this service for a number of reasons, including: comparison of subscriber results with those of other quality laboratories; checking analysis proficiency of laboratory personnel within the same facility; monitoring of instrumentation and/or method performance; benchmarking of 'best practices'; evaluation of alternative analytical methodologies; and enhancement of process control capabilities by providing an independent means to assure test-method contributions to data variability.

For more information, please contact Dr. Richard Chen, richard.chen@ars.usda.gov, or 785-776-2750. ❖

Departures

Rhonda Lyne

Ms. Rhonda Lyne left the HWWQL in April, 2007 to work at GIPSA's Kansas City field office and Dr. Rangan Chinnaswamy. Her duties while employed in the HWWQL included proximate analysis of protein, moisture, and ash contents in wheat, as well as SDS sedimentation tests when requested. Ms. Lyne also contributed to our work in assessing tortilla quality, and helped to establish standard tests and measures for screening wheat flour for this popular product.

Ms. Lyne received a B.S. in Biology in 1994, and a M.S. in Grain Science in 2006, both from KSU. She had been with the HWWQL since 1995. *Contact: Rhonda.K.Lyne@usda.gov.*

Jeff Milligan

Mr. Jeff Milligan left the HWWQL in July, 2007 to work for The Lubrizol Corporation, Wickliffe, OH, as a chemist. Jeff previously worked for Dr. Brad Seabourn (HWWQL) as a lab technician in the vibrational spectroscopy laboratory, where his primary focus was on NIR calibration and the spectral evaluation of dough rheology using mid-infrared spectroscopy.

Jeff received his B.S. degree in chemistry at Iowa State University in 1999. After working at Iowa State University and Oklahoma State University, he joined the staff of the HWWQL as a technician in December 2004. *Contact: jmilliga300sdl@hotmail.com.* ❖

CEREAL RESEARCH - continued from page 2

samples according to their performance when processed on a pilot mill. The criterion against which the SKCS-derived rankings were compared was the Milling Quality Index, which uses both the percentage flour extraction and Branscan speck count measurements.

For further information or to obtain a copy of the above article, please contact the HWWQL. ❖

Classics in Cereal Chemistry

"Basic Rheology of Bread Dough and Glutenin-to-Gliadin Ratios"

In the Nov./Dec. 2000 issue of *Cereal Chemistry* (vol 77(6):744-749), Dr. Uthayakumaran of the Quality Wheat Cooperative Research Centre Ltd., North Ryde, NSW, Australia, and co-authors, published a paper on the uniaxial elongational and shear rheology of doughs varying in either the protein content or glutenin-to-gliadin ratio.

The authors found that increasing the protein content at constant glutenin-to-gliadin ratio increased the strain-hardening properties of the dough, as shown by increasing elongational rupture viscosity and rupture stress. Glutenin and gliadin had a more complex effect on the elongational properties of the dough. Increased levels of glutenin increased the rupture viscosity but lowered the rupture strain, while elevated gliadin levels lowered the rupture viscosity but increased the rupture strain.

These observations provided rheological support for the widely inferred role of gliadin and glutenin in shaping bread dough rheology, namely that gliadin contributes the flow properties, and glutenin contributes the elastic or strength properties.

They found that the shear and elongational properties of the doughs were quite different. Increasing protein content lowered the maximum shear viscosity, while increasing the glutenin-to-gliadin ratio increased maximum shear viscosity. Strong correlations between the results of basic and empirical rheology were found, highlighting the potential of basic rheology for bread and wheat research.

For further information or how to obtain a copy of the above article, please contact the HWWQL. ❖

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annual capacity of 4.5B U.S. gallons, and an additional 77 ethanol plants are expected to come on line by 2009. This will only drive the demand for corn up.

However, wheat ethanol production isn't much different from corn ethanol production. Only minor operational adjustments are needed, and some design changes are suggested, to convert any corn ethanol plant to a wheat feedstock.

With regard to nutritional value, wheat has slightly lower starch content than corn, but higher protein content. Because of the lower starch content, wheat will produce less ethanol, but about 15% more distillers grains. Wheat also contains more fiber and pentosans, which are hemicelluloses that are high in viscosity and hard to break down into starch. These factors may increase the capital cost of a wheat ethanol facility as compared to a corn ethanol plant, but industry experts believe this can be offset by lower operating costs.

U.S. competitors are in the race to convert wheat to ethanol as well.

Western Australian wheat growers will soon be sending their produce to the country's first wheat-based ethanol plant. BP Australia and Primary Energy recently announced plans to build a plant next to BP's Kwinana Refinery. It is expected to produce 80 million liters of biofuel each year, using 200,000 tons of wheat. The plant could be helping to fuel cars in Western Australia by 2008. The plant is a 'win' for wheat farmers.

To the north, Husky Energy Inc., headquartered in Calgary, Alberta, is one of Canada's largest energy and energy-related companies. The Company has almost $18 billion in assets and employs approximately 4,000 employees. Husky produces a clean burning fuel made of 10% ethanol and 90% gasoline. An alcohol-based product, Husky's ethanol is made primarily from feed wheat. Wheat starch is converted to ethanol in a fermentation and distillation process similar to making beer.

Husky plans to be Western Canada's largest producer of ethanol. To meet the growing demand for clean-burning fuels, Husky has built a new plant at Lloydminster, Saskatchewan and is building an expanded second plant at Minnedosa, Manitoba for completion in the third quarter of 2007. Each plant is

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capable of producing 130 million liters of ethanol per year.

When Husky's new ethanol plant in Minnedosa starts production, both it and the Lloydminster ethanol plant will consume in excess of 700,000 tons of feed grain annually, making Husky the largest purchaser of feed wheat in Western Canada. The ethanol plants will give local wheat producers a valuable new market in which to sell their harvest.

Ethanol producers look for classes and varieties that have lower protein content and thus higher starch content. The wheat classes that are of most interest are Canadian Prairie Spring (Red and White), Canadian Western Red Winter and Canadian Western Soft White.

For more information, please contact Dr. Scott Bean, scott.bean@ars.usda.gov, or 785-776-2725. ❖

In Future Issues of the Bulletin:

- *"Interpretation of dough functionality from the Mixograph and Farinograph"*
- *"Milling wheat on the Quadrumat Sr. Experimental mill"*

Questions, Comments, Suggestions?

Please email (brad.seabourn@ars.usd.gov), call (785-776-2751), or write the Hard Winter Wheat Quality Laboratory, USDA/ARS/GMPRC, 1515 College Ave., Manhattan, KS 66502-2736.

The monthly issue of GMPRC's ***Research Kernels*** *is now available at our website: http://www.ars.usda.gov/Research/docs.htm?docid=12839.*

2006 Regional Performance Nursery (RPN) Data

Data for the 2006 RPN crop has been updated weekly online at the Hard Winter Wheat Quality Laboratory webpage, and is now fully complete:

http://www.ars.usda.gov/Main/docs.htm?docid=14298.

Data may be viewed directly online, by downloading a PDF file, or in raw form (Excel). The RPN Relational Database, containing quality data for the crop years 1996-2006, is also available. You may receive a copy of the database by contacting Dr. Richard Chen, richard.chen@ars.usda.gov, or 785-776-2750. ❖

Calendar of Events

Special Event

2007 AACC International Annual Meeting
Place: San Antonio, TX
Date: Oct. 7-10, 2007
http://meeting.aaccnet.org/Special Event

Special Event

2007 ASA-CSSA-SSSA International Annual Meeting
Place: New Orleans, LA
Date: Nov. 4-8, 2007
https://www.acsmeetings.org/

Special Event

Wheat Quality Council Annual Meeting
Place: Kansas City, MO
Date: Feb. 19-21, 2008
www.wheatqualitycouncil.org

Special Event

HWW Breeders Field Day
Place: Texas
Date: April, 2008
http://www.ars.usda.gov/Research/docs.htm?docid=11932

HARD WINTER WHEAT QUALITY LABORATORY

*The Hard Winter Wheat Quality Laboratory is committed to **EXCELLENCE** in everything that we do. If it is worth doing, then we believe it is worth doing well. Our commitment to excellence is our commitment to the U.S. taxpayer and the individual collaborators, customers, and stakeholders that we work with and serve.*

It is our commitment to YOU!

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