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A rapid, small-scale method to evaluate dough viscoelastic properties

F. Xie and B.W. Seabourn

The viscoelastic properties of dough (i.e., extensibility and resistance to extension) influence each step of the baking process, as well as the quality of the final product, and thus are important quality factors to consider in the selection of suitable lines for advancement in wheat-breeding programs. The objective of this study was to develop a rapid small-scale method to evaluate dough extensibility and resistance to extension properties. A total of 20 HRWW flour samples varying in protein content and rheological properties were studied. The standard extensigraph method and a small-scale texture analyzer (TA) method utilizing a Kieffer rig were compared and used as reference methods for a new near infrared spectroscopy (NIRS) method. Spearman rank correlation coefficient (r) between extensibility measured by Extensigraph and by TA was 0.85, whereas that of resistance to extension was 0.71. The coefficient of determination (R^2) between resistance to extension measured by the NIRS and by extensigraph was 0.90 with a relative predictive determinate (RPD) of 3.4; that of extensibility was 0.86 with an RPD of 3.4. The high correlation between the NIRS and standard extensigraph measurements showed that the NIRS technique had excellent potential as a rapid small-scale method to predict both dough extensibility and resistance to extension.

Adaptation of polyphenol oxidase measuring methods (AACCI Method 22-85) for wheat meal and flour and their relationship to alkaline noodle color.

S.H. Park, B.W. Seabourn, O.K. Chung, and P.A. Seib.

Noodle darkening is catalyzed by polyphenol oxidase (PPO) activity, and a method for measuring PPO activity of wheat kernels has been approved by the AACCI. Here we modified that PPO method (AACCI Method 22-85) for whole wheat meal and refined flour and measured PPO on 76 samples including 72 HRWW samples from the Southern Regional Performance Nursery (SRPN, n=46) and the Wheat Quality Council (WQC, n=26) harvested in 2002, and four hard white wheats grown (2003) in Kansas. The modified method was less time consuming (10 min vs. 60 min for reaction time) and less laborious. Its repeatability for wheat meal was the best (coefficient of variance, CV = 3.0%), followed by flour (CV = 9.8%), and kernel (CV = 12.4%). The correlations (r, n = 76) between kernel and meal, kernel and flour, and meal and flour PPO levels were 0.75, 0.56, and 0.55 ($P<0.0001$), respectively. The meal PPO showed the highest negative correlation (r = -0.73****) with noodle brightness (L*), followed by kernel (r = -0.63****) and flour (r = -0.44**, $P<0.05$) for SRPN samples and Lakin (n = 47).

Applying single-kernel sorting technology to developing scab-resistant lines.

F.E. Dowell and E.B. Maghirang.

We are using automated, single-kernel near-infrared (SKNIR) spectroscopy instrumentation to sort Fusarium head blight infected kernels from healthy kernels and to sort segregating populations by hardness to enhance the development of scab-resistant hard and soft wheat cultivars. We sorted three replicates of 192 samples into a damaged fraction yielding an average of 61.3 ppm DON and a healthy fraction yielding an average of 0.73 ppm DON. This collaborative work with Dr. Gene Milus and Peter Horevaj investigated the resistance of SRWW lines to DON and NIV chemotypes of *F. graminearum*. In another study, we also sorted the soft portion of a 'hard x soft' cross into FHB-infected and healthy fractions, and likewise sorted the hard portion into FHB-infected and healthy fractions. The 'hard x soft' crosses were separated into the hard and soft portions in 2006 where the respective portions were inoculated and planted. The 2007 scabby and healthy fractions of the hard and soft lines will be planted this autumn to determine if our sorting will result in populations with FHB resistance. This work is in coöperation with Dr. Anne McKendry and Dr. Stephen Baenziger. Other work in coöperation with Dr. Stephen Wegulo, Julie Breathnach, and Dr. Stephen Baenziger used the automated SKNIR system to rapidly assess lines for FHB resistance by running multiple samples and obtaining a count of infected and healthy kernels. We have done this for about 300 lines and the information is being used to select resistant lines for further testing.

Characterization of chemically modified waxy, partially waxy, and wild type tetraploid wheat starch.

L.E. Hansen, D.S. Jackson, R.A. Graybosch, J.D. Wilson, and R.L. Wehling.

Durum wheats contain two granule-bound starch synthase (GBSS) genes (*wx-A1*and *wx-B1*) controlling amylose synthesis; the other major starch polymer in durum wheat is amylopectin. Starches with little or no amylose are waxy. A GBSS null (nonproducing) gene results in a starch granule with reduced amylose content, or a partial waxy character. Sets of wild type, partial waxy (wx-A1 null or wx-B1 null), and waxy (wx-A1 and wx-B1 double null) durum wheat lines were developed in several genetic backgrounds. Seed from the individual genotypes, wild type to full waxy, were composited across genetic backgrounds with the intent of removing confounding genetic background effects. The starches from each genotype from two crop years were isolated using dough ball washing followed by flow table separation. Protein (0.1% to 0.4% dwb), lipid (0.0% to 0.3% dwb), and amylose (0% to 30% dwb dependent upon genotype) contents in the isolated starches were determined. These isolated starches had mostly large granules with a size distribution profile similar to commercially prepared waxy or wild type starches. Hydroxypropylation using propylene oxide was performed three times on each sample, resulting in an average molar substitution of 0.040 (± 0.010). Rapid-visco analyses were performed and profile changes, defined as the average of the mathematical difference of substituted minus native results in cp of the pasting curves for waxy (peak viscosity, 176; breakdown, 329; final viscosity, -206; setback, -53.5; and pasting time, -0.8) and wild type (peak viscosity, 510; breakdown, 677; final viscosity, 646; setback, 813; and pasting time, -2.2) were observed. Substituted fully waxy starches had increased peak viscosities, breakdowns, reduced final viscosities, setbacks, and pasting times. Regular (full wild type) substituted starches had increased peak viscosities, breakdowns, final viscosities, setbacks, and decreased pasting times. These modified forms of starches are used as thickeners in foods and frozen preparations such as pie fillings, sauces, gravies, and salad dressings. Rapid-visco analyses results for the partial waxy genotypes and a phosphorus di-ester cross-linking reaction will also be presented.

Digital image analysis of cereals.

J.D. Wilson.

Image analysis is the extraction of meaningful information from images, mainly digital images by means of digital-processing techniques. The field was established in the 1950s and coincides with the advent of computer technology, as image analysis is profoundly reliant on computer processing. As computer sciences has expanded with respect to data storage and processing speed, the applications of digital image analysis also has expanded into all areas of science and industry. The cereal sciences industry also has expanded the use of image analysis to include classification and morphological identification of cereal grains, phytopathological identification of diseases, milling yield and quality of various cereals, starch size distribution as related to quality, bread volume and crumb grain scores, noodle quality and numerous other aspects of cereal processing and research. Starch constitutes the greatest weight portion of the wheat endosperm (65–75%) and contributes its own unique functional qualities such as texture, volume, consistency, aesthetics, moisture, and shelf stability to various baked products. Particle size, distribution, and shape have long been recognized as an important variable in the efficiency of a range of processes including predicting rheology and flow behavior. Digital image analysis coupled to light microscopy offers the ability to have physical parameters recorded for each individual particle and to distinguish among individual granules, agglomerated granules, and nonstarch particles.

Discrimination of soft and hard white wheat kernels using the single-kernel characterization system parameters and kernel imaging.

T.C. Pearson, D.L. Brabec, and H. Dogan.

Natural variation in the hardness of wheat kernels often results in an overlap between hard and soft classes in the distribution of hardness indices (HI) as measured with the single-kernel characterization system (SKCS) and is a major contributor to classification errors. This is particularly true for the case of the hard white and soft white wheat classes. To address this problem, a color camera was incorporated into the SKCS system so that color and kernel size data could be combined with SKCS measurements for classification purposes. Samples of hard red, soft red, hard white, and soft white wheat were classified using the SKCS system with and without the camera and results compared. Using the camera system, errors for separating hard from soft white classes were reduced to less than 5%, compared to 17.1% using SKCS alone. Furthermore, improved data processing applied to the low-level data currently produced by the SKCS system led to greater than 50% reduction in classification errors between soft white and hard red as compared to using HI data alone. Similar improvements in classification accuracies for 300-kernel mixtures of soft and hard white also were achieved, which should aid grain inspectors in properly identifying mixtures of these two classes. Unfortunately, for the soft and hard red classes, incorporating the camera data decreased classification accuracy while increasing the complexity of the system.

Effect of high molecular weight glutenin subunits (HMW-GS) on tortilla quality.

V. Pierucci, M. Tilley, R.A. Graybosch, and K. Tilley.

Tortillas are the most popular non-bread wheat based product. Flour used in tortilla production has been typically optimized for bread making. The flour properties that determine good quality bread do not necessarily provide good quality tortillas. In this study, the influence of HMW-GS was investigated on tortilla quality. Two biotypes derived from the HRWW cultivar Centurk were used, which contained the following HMW-GS: 2*, 7+9, 2+12 and 2*, 7+9, 5+10. The flours were paired according to protein content of 10.02% (2+12) and 9.92% (5+10) in Group 1 and 10.30% (2+12) and 10.42% (5+10) in Group 2. Tortillas were prepared in a laboratory scale and analysis was carried out at days 0, 2, 4, 7, and 14. Diameter, rollability, and textural properties using the TA-TX2 Texture Analyzer were determined. Tortilla diameter was statistically larger in tortillas made from low protein flour containing HMW-GS 2+12 ($p > 0.05$) among the four conditions. Independently of the protein content used, flour with subunits 5+10 showed a better overall rollability than flour with subunits 2+12. Texture analysis revealed no difference in tortilla stretchability among the flours. However, the rupture force (Fr) of tortillas was affected by flour protein content. When lower protein content was used, Fr was greater for tortillas made with HMW-GS 2+12, conversely, when higher protein content was used, Fr was greater for tortillas made with HMW-GS 5+10. These results indicated better tortillas were obtained with higher protein content flours containing HMW-GS 5+10.

Improving grain-breeding programs through NIR-based, single-kernel sorting.

F.E. Dowell, E.B. Maghirang, and P.S. Baenziger.

We developed automated visible and near-infrared (NIR) spetroscopy procedures and instrumentation to select kernels with specific hardness, protein, and color traits to enhance the development of FHB-resistant, hard and soft wheat cultivars. The system also shows potential to sort for other characteristics such as FHB damage, vomitoxin levels, ergosterol levels, vitraeousness, sprout damage as measured by α-amylase content or falling number, moisture content, selenium content, Karnal bunt-infected kernels, and waxy character. Our single-kernel, NIR system can sort single kernels based on specified properties at a rate of about one kernel/2 s (500–1000 g/day). We also have high-speed sorting technology that can sort visible defects at rates as much as 80,000 kernels/s (300 bu/hr). This technology is now used routinely for such applications as purifying red or white breeding lines, removing Karnal but-infected kernels during routine inspection for the APHIS national surveys, and selecting waxy seeds from segregating populations. Although most of our work has been with wheat, we also have shown applications for proso millet, barley, rice, and sorghum.

Objective image analysis for bread quality characteristics using a C-Cell instrument.

Y.R. Chen, F. Xie, B.W. Seabourn, and M.S. Caley.

Bread volume, crumb grain, crumb texture, and crumb color are the most important quality factors evaluated in wheat-based bread products. Each of these factors can be estimated by using separate instruments or by experienced baking experts. The objective of this study was to investigate the potential of a C-Cell instrument in evaluating all these bread factors concurrently. Based on C-Cell image data collected from pup loaves of a set of 53 HRWW breeding lines, correlation coefficient of loaf volume obtained by rapeseed displacement with data obtained by C-Cell images was 0.90. After all data from C-Cell images and crumb grain scores were categorized into seven levels based on number of cells, the average data of each category were then correlated with the average sample crumb grain score. The correlation coefficient of the average crumb grain scores (0-6 scales) subjectively determined by an expert baker with the average cell number, the average cell wall thickness, the average coarse/fine cluster, and the average crumb fineness (number of cells/mm^2) was 0.97, -0.93, 0.89, and 0.91, respectively. The results indicated that the C-Cell instrument had the capability potential to determine all of the important bread attributes simultaneously.

Precooked, fiber-enriched wheat flour obtained by extrusion: rheological and functional properties.

H. Gajula, S. Liu, S. Alavi, T. Herald, M. Tilley, S.R. Bean, and R. Madl.

Functional and rheological properties of different process conditions of extruded wheat flour with 0%, 10%, 20%, and 30% fiber levels were studied in the production of cookies and tortillas. Functional and rheological properties were evaluated using Rapid Visco Analyzer and mixograph equipment. Results showed that peak viscosity increased for the 20% fiber level of extruded wheat flour (123.1 cP) and nonsignificant difference was shown for all other fiber-level extruded wheat flour for lower process conditions and to nonextruded wheat flours. The pasting properties for the high processing treatment (treatments are explained above) were decreased from 98.2 cP to 52 cP with increasing fiber level content. Mixograph peak time was observed similar for all fiber levels in high processing extruded wheat flour and nonextruded wheat flour and decreased in low processing extruded wheat flour. Peak height (66.6 cm) was higher in high processing extruded wheat flour as compared to low processing extruded wheat flour (26.8 cm) and nonextruded wheat flour (44.6 cm). Quality parameters including weight, height, width, width/thickness, spread factor, rollability, and extensibility were evaluated for cookies and tortillas made from precooked wheat flour and compared with those of nonextruded wheat flour. As the percent fiber content was increased, the quality parameters deteriorated for both nonextruded and extruded wheat flour cookies. The deterioration was more significant in the high processing tortillas. No significant difference ($p < 0.05$) was observed in rollability of nonextruded wheat flour tortillas whereas a significant difference ($p < 0.05$) was observed in extensibility values for extruded wheat flour tortillas.

Rapid assessment of insect fragments in flour milled from wheat infested with known densities of immature and adult Sitophilus oryzae (L.) (Coleoptera: Curculionidae).

M.D. Toews, J. Perez-Mendoza, J.E. Throne, F.E. Dowell, E.B. Maghirang, F.H. Arthur, and J.F. Campbell.

Milling wheat infested with low densities of internal feeding insects can result in flour containing insect fragments. The Food and Drug Administration (FDA) enforces a standard or defect action level stating that a maximum of 75 insect fragments per 50 g flour is allowed. However, the relationship between level of infestation and number of resulting fragments is not well documented, and a more rapid method for enumerating insect fragments is needed. We characterized the number of insect fragments produced from milling small lots of wheat spiked with known densities and life stages of *S. oryzae*. Insect fragments were enumerated with near-infrared spectroscopy (NIRS), a quick nondestructive procedure, and with the industry standard flotation method. Results showed that an individual small larva, large larva, pupa, or adult produced 0.4, 0.7, 1.5, and 27.0 fragments, respectively. NIRS-predicted counts of less than 51 (from small larvae), less than 53 (from large larvae), less than 43 (from pupae), or 0 (from adults) indicated that there were less than 75 actual fragments in that sample because the upper bound of associated 95% inverse prediction confidence intervals was less than the standard; NIRS-predicted counts of greater than 98, greater than 117, greater than 108, or greater than 225 fragments (same life stages as above) signaled that these flour samples contained more than 75 actual fragments. These data suggest that NIRS could be adopted for rapid assessment of insect fragments resulting from relatively low levels of infestation with immature life states, but was not accurate enough for enumerating fragments resulting from adults at densities relevant to FDA standards.

Registration of Guymon wheat.

B.F. Carver, R.M. Hunger, J.T. Edwards, P. Rayas-Duarte, A.R. Klatt, D.R. Porter, B.W. Seabourn, G. Bai, F..E. Dowell, L. Yan, and B.C. Martin.

Guymon (Reg. No. CV- 1018, PI 643133) is a HWWW cultivar developed and released coöperatively by the Oklahoma Agricultural Experiment Station and the USDA–ARS in 2005. Guymon is recommended for grain-only and dual-purpose production systems in an area of the southern High Plains centered by the city serving as its namesake, Guymon, OK. Guymon is an F_2-derived line selected from the cross 'OK95G701/WI89-163W' performed in 1995. OK95G701 was eventually released by the Oklahoma AES and the USDA–ARS as Intrada, whereas WI89-163W was subsequently named and released by AgriPro-Coker as Platte. Single heads were collected from a F_2 bulk population grown at Stillwater, OK, in 1997. In the following year, selection was imposed in Stillwater, OK, on the $F_{2:3}$ head rows based on late-spring freeze tolerance, stem extension, spike density and size, kernel size, uniformity of phenotype at harvest maturity, and consistent kernel color. The head-row progeny was evaluated in 1999 at Stillwater and Lahoma, OK, and selected on the basis of forage accumulation, autumn vegetative growth habit, simulated-grazing tolerance, spring green-up, heading date, test weight, grain yield, wheat protein content, kernel hardness, and kernel size. Subsequent generations were advanced by bulk-selfing in the field. Minimal roguing of slightly taller variants was performed each year until 2004 despite this line being F_2 derived. With an initial frequency of 1.5% red kernels, seed from the 2003 harvest were passed through a single-kernel sorter to reduce the frequency of red kernels to <0.3% (Engineering Research Unit, USDA–ARS–GMPRC, Manhattan, KS). From a final breeder-seed increase in 2004, we detected 0.0 to 0.2% red kernels based on the NaOH-bleach test of multiple samples. As of the 2006–07 crop year, Guymon is a F_2-derived line in the F_{12} generation.

Registration of Okfield wheat.

B.F. Carver, R.M. Hunger, J.T. Edwards, D.R. Porter, T.F. Peeper, B.W. Seabourn, P. Rayas-Duarte, A.R. Klatt, and B.C. Martin.

Okfield (Reg. No. CV-1019, PI 643087) is a HRWW cultivar developed and released coöperatively by the Oklahoma Agricultural Experiment Station and the USDA–ARS in 2005. Okfield is recommended for dryland wheat production using either grain-only and dual-purpose management systems in the west-central Great Plains. Reasons for its release were tolerance to imazamox herbicide, improved winter dormancy retention relative to other imazamox-tolerant cultivars, and good stay-green capacity of the flag leaf. Okfield resulted from a single cross between an imazamox-tolerant BC_3F_2 plant with the pedigree 'TXGH12588-120*4/FS4' and the HRWW experimental line HBZ374C, eventually released as 2174 by the Oklahoma AES and the USDA–ARS in 1997. 2174 has the pedigree 'IL71-5662/PL145 (PI 600840)//2165'. TXGH12588-120 is an unreleased sister line of the HRWW cultivar TAM 110, and FS4 was derived by sodium azide-induced mutagenesis of the cultivar Fidel. The BC_3F_2 population was provided by American Cyanamid Co. Ownership of the gene mutation was subsequently transferred to BASF Corporation. The F_1 plant generation was produced in the greenhouse in 1998, and the F_2 generation was advanced at Stillwater the following year. Single heads were collected from plants which survived a single application of imazamox (36 gai/ha) in February 1999.

Separating waxy from wild-type kernels using an automated NIR sorting system.

F.E. Dowell, R.A. Graybosch, W.A. Berzonsky, and S.R. Delwiche.

Waxy (amylose-free) wheat is gaining interest because it converts to ethanol faster than other wheat, is a possible low-fat replacement for vegetable shortening, is used to produce modified food starches, and has unique absorption and pasting characteristics. Several breeding programs are developing waxy lines in an attempt to take advantage of these potential new markets. After crosses between waxy and nonwaxy breeding lines, the frequency of waxy progeny may be as low as 1/64. The ability to segregate waxy seed from segregating populations can provide breeding materials enriched in the number of individuals with this desired trait. We have shown that near-infrared spectroscopy can separate the waxy kernels (all null alleles) from partial waxy kernels (at least one null allele and one functional allele) or wild-type kernels (all functional alleles). Our automated system can separate waxy from nonwaxy kernels at a rate of about 1 kernel/2 s, which is a rate sufficient to select waxy kernels from breeding lines or to purify contaminated samples. Testing on hundreds of samples over several years shows that waxy kernels can be selected from segregating lines with about 100% accuracy. We have applied this technology to sorting hard red winter, hard red spring, and durum wheat, in addition to sorting waxy proso millet. Prior to our research, the only ways to distinguish between full and partial waxy were iodine staining and the use of molecular markers. These techniques are too slow and tedious for purifying large seed samples, thus our technology offers significant advantages to breeding programs working on the waxy characteristic.

Starch granule size distribution of hard red winter and hard red spring wheat: Their relationship to wheat, flour, and bread-making quality.

S.H. Park, J.D. Wilson, and B.W. Seabourn.

Starch was isolated from 98 HRWW and 99 HRSW lines. Granule size/volume distributions of the isolated starches were analyzed using a laser diffraction particle size analyzer. Significant differences were observed in the size distribution between the HRWW and HRSW. The B-type granules (< 10 μm in diameter) occupied volumes in the range 28.5–49.1% (mean 39.9%) for HRWW whereas HRSW B-type granules occupied volumes in the range of 37.1–56.2% (mean 47.3%). The mean granule sizes of the distribution peaks less than 10 μm in diameter also showed a significant difference (HRWW, 4.32 vs. HRSW, 4.49 μm), but the mean sizes of the distribution peaks larger than 10 μm were not significantly different (21.54 vs. 21.47 μm). Numerous wheat and flour quality traits also showed significant correlation to starch granule size distributions. Most notably, protein content was inversely correlated with parameters of B-type granules. Crumb grain score seemed to be affected by starch granule size distribution, showing significant inverse correlations with B-type granules. Furthermore, the linear correlations were improved when the ratio of B-type granules to protein content was used, and in addition, polynomial relation was applied. There seemed to an optimum range of B-type granules for different protein content flour to produce bread with better crumb grain.

The relationship of bread quality to kernel, flour, and dough properties.

F.E. Dowell, E.B. Maghirang, R.O. Pierce, G.L. Lookhart, S.R. Bean, F. Xie, M.S. Caley, J.D. Wilson, B.W. Seabourn, M.S. Ram, S.H. Park, and O.K. Chung.

We measured the relationship between bread quality and 49 HRSW) or 48 HRWW grain, flour, and dough quality characteristics. The estimated bread quality attributes included loaf volume, bake mix time, bake water absorption, and crumb grain score. The best-fit models for loaf volume, bake mix time, and water absorption had R^2 values of 0.78 to 0.93 with five to eight variables. Crumb grain score was not well estimated, and had R^2 values around 0.60. For loaf volume models, grain or flour protein content was the most important parameter included. Bake water absorption was best estimated when using mixograph water absorption and flour- or grain-protein content. Bake water absorption models could generally be improved by including farinograph, mixograph, or alveograph measurements. Bake mix time was estimated best when using mixograph mix time, and models could be improved by including glutenin data. When the data set was divided into calibration and prediction sets, the loaf volume and bake mix time models still looked promising for screening samples. When including only variables that could be rapidly measured (protein content, test weight, single kernel moisture content, single kernel diameter, single kernel hardness, and bulk moisture content, and dark hard and vitreous kernels), only loaf volume could be predicted with accuracies adequate for screening samples.

The relationship between different biotypes and protein composition of HRWW flours and their affect on alkaline noodle color and texture.

S.H. Park, M. Tilley, S.R. Bean, B.W. Seabourn, and R.A. Graybosch.

Twenty-five samples of biotypes derived from two HRWW) cultivars, Centurk and OK102, were grown in a randomized complete block design at Mead, NE. The biotypes varied in their (HMW-GS composition with five different HMW-GS allelic combinations present across the samples (2*, 7+8, 2+12; 2*, 7+9, 2+12; 2*, 6*+8*, 3+12; 2*, 6*+8*, 5+10; and 2*, 7+9, 5+10). These lines were selected to determine the relationship between HMW-GS and protein composition on color and texture of alkaline noodles. Protein composition, including insoluble polymeric protein (IPP), soluble polymeric protein (SPP), gliadin, and albumin and globulin (AG) was found to vary significantly between the various HMW-GS combinations. Flour protein content was not significantly different between the various sets. For mixograph mixing time, 83.6% of the variation among the samples was explained by HMW-GS composition, whereas 89.0% of the mixing tolerance variation was. Most noodle color traits were not significantly affected by HMW-GS groups except for a and b values at 24 hr after production. For cooked noodle texture, water uptake was significantly affected by HMW-GS groups but cooking loss was not. Noodle texture profiles including hardness, springiness, chewiness, resilience, cohesiveness, and adhesiveness were significantly affected by HMW-GS types. Overall protein composition was significantly correlated with noodle texture: SPP % was positively correlated with hardness (r = 0.83, P<0.0001) and negatively with springiness (r = -0.77, P<0.0001), resilience (r = -0.76, P<0.0001), and adhesiveness (r = -0.44, P<0.05), whereas IPP% was negatively correlated with hardness (r = -0.74, P<0.0001). Protein composition was also significantly correlated with cooking water uptake and noodle color.

The relationship between single wheat kernel particle size distribution and the Perten SKCS 4100 Hardness Index.

T.C. Pearson, J.D. Wilson, J. Gwirtz, E.B. Maghirang, F.E. Dowell, P. McCluskey, and S.R. Bean.

The Perten Single Kernel Characterization System (SKCS) is the current reference method to determine single wheat kernel texture. However, the SKCS calibration method is based on bulk samples, and there is no method to determine the measurement error on single kernel hardness. The objective of this research was to develop a single-kernel hardness reference based on single-kernel particle size distributions (PSD). A total of 473 kernels drawn from eight different classes were studied. Material from single kernels crushed on the SKCS was collected and milled in a fabricated mill, which simulates the last two rolls of a Quadrumat Jr. The PSD of each single kernel was then measured using a laser particle counter. Calibrations using data from the PSD and SKCS were then used to estimate single kernel PSD and classify kernels into their genetic classes. Wheat kernels from soft and hard classes having SKCS hardness indices (HI) between 40 and 60 typically had a PSD that is expected from their genetic class, even though their HI overlapped. That is, soft kernels tend to have more particles below 21 micrometers than hard kernels do after milling. As such, a combination of HI and PSD gives better discrimination between genetically hard and soft classes than either parameter measured independently. Additionally, use of SKCS predicted PSD combined with other low level SKCS parameters appears to reduce classification errors into genetic hardness classes by about 50% over what can currently be accomplished with HI alone.

Use of NILs to determine glutenin composition and functionality in flour.

S. Mondal, M. Tilley, J.N. Alviola, R.D. Waniska, S.R. Bean, K.D. Glover and D.B. Hays.

Tortillas were prepared from each deletion line and the parent lines. The elimination of certain HMW-GS alleles alter distinct, but critical aspects of tortilla quality such as diameter, shelf stability and overall quality. Two deletion lines possessing HMW-GS 17+18 at *Glu-B1* and deletions in *Glu-A1* and *Glu-D1* had significantly larger tortilla diameters, yet tortilla shelf life was compromised or unchanged from the parent lines used to develop the deletion lines or the commercial tortilla flour used as a control. Alternatively, a deletion line possessing *Glu-A1* and *Glu-D1* (HMW-GS 1, 5+10) and a deletion in *Glu-B1* also significantly improved tortilla diameters. Although the increase in diameter was less than the line possessing only HMW-GS 17+18 at *Glu-B1*, the stability of the tortillas were however maintained and improved compared to the parent lines containing a full compliment of HMW-GS. Thus, presence of subunits 5+10 at *Glu-D1* alone or in combination with subunit 1 at *Glu-A1* appears to provide a compromise of improvement in dough extensibility for improved tortilla diameters while also providing sufficient gluten strength to maintain ideal shelf stability.

Personnel news.

GMPRC welcomes Dr. Thomas Herald as the new Research Leader for the Grain Quality and Structure Research Unit. Dr. Herald joins us from Kansas State University where he served as a professor in the Food Science Institute.

Dr. Herald was raised in Michigan. He earned his B.S. degree in Food Science from Michigan State University, East Lansing MI in 1980. He served as a Peace Corps Volunteer from 1980-1983 in Swaziland, Southern Africa. Dr. Herald completed his M.S. and Ph.D. degrees in Food Science at Michigan State University in the area of food chemistry. Dr. Herald worked in the food industrial sector with Yoplait USA and Kellogg's. He recently completed a 16 + year career at Kansas State University holding the rank of professor in the Food Science Program. Dr. Herald's research focus was on the chemical and physical properties of food and food ingredients. He has 58 peer-reviewed publications and numerous invited presentations at national and international meetings. As Research Leader for the GQSRU, Dr. Herald will integrate his technical background into the identification and utilization of wheat cultivars and sorghum hybrids for use in value-added systems that will include both food and non-food applications.

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