Flour Tests

Flour Falling Numbers

(AACC Method 56-81B) Units are expressed in seconds using the Perten Falling Numbers instrument. Numbers above 400 seconds reflect factors other than alpha- amylase activity (such as particle size). The correlation between alpha-amylase activity and falling number is best for samples with falling number values between 200 and 300 seconds. For cake flours and batters, 350 seconds is a common minimum value. For breakfast cereals or cookies and other high sugar products, values of 250 seconds are more common cut-off values.

Flour Crude Protein

Protein determined by NIR using a Unity NIR instrument calibrated by nitrogen combustion analysis using Elementar Nitrogen Analyzer. Units are recorded in % protein converted from nitrogen x 5.7 and expressed on 14% moisture basis.

Flour protein differences among cultivars can be a reliable indicator of genetic variation provided the varieties are grown together, but can vary from year to year at any given location. Flour protein from a single, non-composite sample may not be representative. Based on the Soft Wheat Quality Laboratory grow-outs, protein can vary as much 1.5 % for a cultivar grown at various locations in the same ½ acre field.

Flour protein of 8% to 9% is representative for breeder's samples and SWQL grow-out cultivars. As flour protein increases, the expansive capability of the cookie during the baking process decreases. Flour protein is negatively correlated to cookie diameter ($r=-0.62$, $p<0.0001$) with the cookie shrinking 0.4 cm for every 1 percentage point increase in protein[1]. The effect of flour protein on cookie size is related in part to increased water absorption due to greater protein content, however the amount of cookie shrinkage is greater than that explained by increased water absorption alone.

Protein Quality

Protein quality is an evaluation of "elasticity" or gluten strength and is not the same as protein quantity. A cultivar possessing a low quantity of protein could still exhibit strong gluten strength. Gluten strength is thought to be a desirable characteristic for cracker production. Gluten strength is measured using a mixograph and is graded on a scale of 1-8, with 1 as weakest and 8 as strongest gluten. Evaluation of gluten strength using the mixograph or farinograph is difficult for soft wheat flours that are 8.5% protein and lower. Since the representative protein range for breeders' samples is 8-9%, many of these flours are not adequately evaluated using the mixograph or farinograph methods. The Lactic Acid SRC, which does not require mixing action to assess gluten, tends to be a better measurement of protein quality when evaluating soft wheats. Lactic acid hydrates the native matrix of insoluble polymeric protein (IPP) present in the flour.

Flour Ash

(AACC Method 08-01) Basic method, expressed on 14% moisture basis.

Flour Amylase activity

(AACC Method 22-06) Units are expressed in α- amylase activity as SKB units/gram (@ 25°C).

Flour micro Alpha Amylase activity

(Adapted by Mary Gutierri) The new method adapts AACC Method 22-02 using the Ceralpha K-CERA (Megazyme) alpha amylase assay procedure for measuring alpha amylase activity at higher throughput in a microwell plate. All reagents, controls and precautions are as described in the Megazyme manual. Units are expressed as described as Ceralpha Units per gram (CU/g). The new assay is described completely as the Micro Assay for Flour Alpha Amylase Activity.

Solvent Retention Capacity Test (SRC)

(Flour Lactic Acid, Sucrose, Water, and Sodium Carbonate Retention Capacities AACC Method 56-11) Units are expressed as %.

Water SRC is a global measure of the water affinity of the macro-polymers (starch, arabinoxylans, gluten, and gliadins). It is often the best predictor of baked product performance. Water SRC is correlated to Farinograph water absorption but does not directly measure the absorption of the glutenin macropolymer hydration during mixing as does the Farinograph. Water SRC is negatively correlated to flour yield and softness equivalent among flour samples milled on the Quad advanced flour mill (r=-0.43 and r=-0.45, respectively). Lower water values are desired for cookies, cakes, and crackers, with target values below 51% on small experimental mills and 54% on commercial or long-flow experimental mills.

Sucrose SRC is a measure of arabinoxylans (also known as pentosans) content, which can strongly affect water absorption in baked products. Water soluble arabinoxylans are thought to be the fraction that most greatly increases sucrose SRC. Sucrose SRC probably is the best predictor of cookie quality, with sugar snap cookie diameters decreasing by 0.07 cm for each percentage point increase in sucrose SRC. The negative correlation between wire-cut cookie and sucrose SRC values is r=-0.66 (p<0.0001). Sucrose SRC typically increases in wheat samples with lower flour yield (r=-0.31) and lower softness equivalent (r=-0.23). The cross hydration of gliadins by sucrose also causes sucrose SRC values to be correlated to flour protein (r=0.52) and lactic acid SRC (r=0.62). Soft wheat flours for cookies typically have a target of 95% or less when used by the US baking industry for biscuits and crackers. Sucrose SRC values increase by 1% for every 5% increase in lactic acid SRC. The 95% target value can be exceeded in flour samples where a higher lactic acid SRC is required for product manufacture since the higher sucrose SRC is due to gluten hydration and not to swelling of the water soluble arabinoxylans.

Sodium carbonate SRC is a very alkaline solution that ionizes the ends of starch polymers increasing the water binding capacity of the molecule. Sodium carbonate SRC increases as starch damage due to milling increases. Sodium carbonate is an effective predictor of milling yield and is negatively correlated to flour yield on the Quad advanced milling system (r=-0.48, p<0.0001). It also is one of several predictors of cookie diameter (r=-0.22, p<0.0001). Normal values for good milling soft varieties are 68% or less.

Lactic acid SRC measures gluten strength. Typical values are below 85% for “weak” soft varieties and above 105% or 110% for “strong” gluten soft varieties. See the above discussion of protein quality in this section for additional details of the lactic acid SRC. Lactic acid SRC results correlate to the SDS-sedimentation test. The lactic acid SRC is also correlated to flour protein concentration, but the effect is dependent on genotypes and growing conditions. The SWQL typically reports a protein-corrected lactic acid SRC value to remove some of the inherent protein fluctuation not due to cultivar genetics. Lactic acid is corrected to 9% protein using the assumption of a 7% increase in lactic acid SRC for every 1% increase in flour protein. On average across 2007 and 2008, the change in lactic acid SRC value was closer to 2% for every 1% protein.

Flour Damaged Starch

Flour Damaged Starch is measured by the Chopin SDMatic starch damage instrument using the supplied AACC calibration. Starch damage is a measure of the damage to the starch granule occurring during the milling process.

Flour Moisture

(AACC Method 44-15A) Units are expressed as % of flour.

Flour Moisture

(Air-oven method, modified AACC 44-16):

Apparatus

1. Moisture dish (about 5.5cm diameter x 1.5cm height, with slipover lid)
2. Air oven – a convection oven which maintains temperature 140 ± 1oC.
3. Aluminum plate

Procedure

1. Scoop out approximately 1/2 teaspoon of flour into a moisture dish and cover the dish with a lid. As many as 36 samples may be run at once.
2. Record the weight of the dish plus lid containing the flour sample (initial weight).
3. Open the lid and place the dish and lid in the oven at 140°C. Once all dishes and lids have been placed in the oven, allow the temperature to return to 140°C and set a timer for 15 minutes.
4. At the end of the 15 minute drying time, cover the dishes with the lids and transfer them to an aluminum plate outside the oven to cool for 5 minutes. It is recommended that no more than 12 dishes be taken out of the oven at once in order for the cooling time to remain consistent.
5. Record the weight of the dish plus lid containing the dried flour (final weight). Continue weighing all dishes that have been taken out of the oven.
6. Empty the samples from the dishes, brush any residue from the dishes and lids, and record the weights (dish weight).
7. Percent moisture may be calculated using the following equation:

   % Moisture = [(Initial Weight - Final Weight)
   / (Initial Weight - Dish Weight)] * 100

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1. Correlations and prediction models cited in this section are based on 2289 samples milled at the Soft Wheat Quality Laboratory in 2007 an 2008 on the Quadrumat Advanced milling system.