

# Wheat methods and tests used to measure quality – as of September, 2011

At the Grain Research Laboratory, unless otherwise specified,

- Analytical results for wheat are reported at 13.5% moisture content.
- Analytical results for flour and semolina are reported at 14.0% moisture content.
- [AACC methods](#) cited are from AACC International: *Approved Methods of Analysis*, 11th Edition.
- [ICC methods](#) cited are those of the International Association for Cereal Science and Technology (ICC): *ICC Standards: Standard Methods of the International Association for Cereal Science and Technology*, 7th supplement, 1998.
- Grade determinants and procedures are those used by Industry Services, Canadian Grain Commission.

## Wheat methods and tests

### Alkaline water retention capacity (AWRC)

Alkaline water retention capacity is determined using AACC Method 56-10.02. Centrifugation is done at 1000 x g using a swinging bucket rotor.

### Alpha-amylase activity

The alpha-amylase activity of wheat and flour is determined by the method of Kruger and Tipples (1981), *Cereal Chemistry* 58:271-274.

### Alveogram

ICC Standard Method No. 121 is followed, using the Chopin Alveograph NG. Flour samples are stored following milling, for a minimum of seven days prior to analysis.

### Alveogram – semolina

Alveograms are obtained using the Chopin Alveograph NG following AACC Method 54-30.02. Following milling, semolina samples are stored at room temperature for at least three days prior to analysis.

### Amylograph peak viscosity

Sixty-five grams of flour and 450 millilitres of distilled water are used with the Brabender amylograph and the pin stirrer. Other details are as in AACC Method 22-10.01. Peak viscosity is reported in Brabender units.

### Ash content

To determine wheat, flour or semolina ash content, AACC Method 08-01.01 is used. Samples are incinerated overnight in a muffle furnace at 600°C.

### Canadian short process

The Canadian short process baking test, as described by Preston et al. (1982), *Canadian Institute of Food Science and Technology Journal* 15:29-36, is followed, using 150 ppm ascorbic acid as the oxidant and reducing the salt to 2%. Dough is mixed in a Swanson type 100-200 gram pin mixer (National Manufacturing Co., Lincoln NE) at 116 rpm. Loaves are produced from 200 grams of flour in baking pans with cross-sectional dimensions similar to Canadian commercial baking pans. Loaf volume is reported on a 100-gram flour basis. Mixing energy is reported in watt-hours per kilogram (W-h/kg) flour and watt-hours per kilogram of dough.

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## **CIELAB tristimulus colour measurement of flour/semolina-water slurry**

A stand alone top-port spectrophotometer is used to determine the colour of flour-water slurry and durum wheat semolina-water slurry. The samples are made into slurries by mixing 10 g of flour or semolina at 14% moisture basis with 12.5 ml of distilled water. After mixing with an overhead stirrer equipped with a paddle stirring shaft (2 min, 100 rpm), the slurry is poured into a Petri dish (45 mm diameter) and set aside for 5 min before analysis. The colour of the flour/semolina-water slurry is determined using a Minolta Spectrophotometer Model CM-5 equipped with d/8 geometry and illuminated area of 30 mm diameter. Results are reported as the mean of duplicate determinations of L\*, a\*, and b\* parameters of the CIELAB colour model, which represent lightness, redness, and yellowness values, respectively. Results are for a 10° standard observer and D65 illuminant.

- L\*: 100 white, 0 black
- a\*: +60 red, -60 green
- b\*: +60 yellow, -60 blue

## **CIELAB tristimulus colour measurement of flour**

A Minolta Model CM-5 stand alone top-port spectrophotometer (d/8 geometry and illuminated area of 30 mm diameter) is used to determine the colour of a wheat flour sample. A Petri dish (45 mm diameter) is loosely filled with a subsample of flour. The dish is tapped gently until the flour is leveled and no gaps are apparent through the base of the dish. The depth of flour is at least 10 mm. Results are reported as the mean of duplicate determinations of L\*, a\*, and b\* parameters of the CIELAB colour model, which represent lightness, redness, and yellowness values, respectively. Results are for a 10° standard observer and D65 illuminant.

- L\*: 100 white, 0 black
- a\*: +60 red, -60 green
- b\*: +60 yellow, -60 blue

## **Cookie test**

The cookie test is performed according to AACC Method 10-50.05.

## **Extensogram**

This test is conducted using AACC Method 54-10.01 with the exception that the dough is not stretched at 90 minutes and, for Canada Western Extra Strong, the total dough mixing time is fixed at two minutes. Length is in centimetres, height is in Brabender units (BU), and area is in square centimetres. The extensograph is set so that 100 Brabender units equal a 100-gram load.

## **Falling number**

The falling number is determined on a 7-gram sample of ground wheat or semolina by AACC Method 56-81.03. A 300-gram sample of wheat is ground in a Falling Number Laboratory Mill 3100 according to ICC Standard Method No. 107. The falling number test is used to evaluate the amount of sprout damage in Canadian wheats. Alpha-amylase is an enzyme found in sprout-damaged wheat. If germination occurs there is a dramatic increase of this enzyme.

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## Farinogram

This test is conducted using AACC Method 54-21.01, following the procedure for constant flour weight using the small bowl.

- Farinograph absorption is the amount of water that must be added to flour to give the required consistency. It is reported as a percentage.
- Dough development time (DDT) is the time required for the curve to reach its maximum height reported to nearest 0.25 minute.
- Mixing tolerance index (MTI) is the difference, in Brabender units, between the top of the curve at the peak and the top of the curve measured five minutes after the peak is reached.
- Stability is defined as the difference in time, to the nearest 0.5 minute, between the point at which the top of the curve first intersects the 500-BU line (arrival time) and the point at which the top of the curve leaves the 500-BU line (departure time).

For CWES, farinograph absorption is determined at 63 rpm. Remaining quality parameters are measured at 90 rpm based on absorption obtained at 63 rpm. For additional details, see the Farinograph Handbook, AACC, 1960.

## Flour yield

Wheat is cleaned, scoured and tempered overnight to optimum moisture as described by Dexter and Tipples (1987), Milling 180(7):16, 18-20. All millings at the Canadian Grain Commission's Grain Research Laboratory are performed in rooms with environmental control maintained at 21°C and at 60% relative humidity.

- Common wheat is milled on an Allis-Chalmers laboratory mill using the Grain Research Laboratory sifter flow as described by Black et al. (1980), Cereal Foods World 25:757-760. Flour yield is expressed as a percentage of cleaned wheat on a constant moisture basis. For Canada Western Red Spring (CWRS) wheat, flour yield also is expressed at a constant ash content of 0.50%, as described by Dexter and Tipples (1989), Milling 182(8):9-11.
- No. 1 CWRS - 13.5 composites are milled to straight grade and patent flours using a tandem Bühler laboratory mill as described by Martin and Dexter (1991), Association of Operative Millers - Bulletin April: 5855-5864 to allow direct comparison of the milling and baking properties of the current and previous year's crop. Sixty percent extraction patent flours are also used for noodle evaluation.

## Gluten index - semolina

Durum semolina gluten index is determined using AACC Standard Method 38-12.02, following the procedure for whole meal.

## Grade colour

Flour grade colour is determined using a Colour Grader Series IV (Satake UK, Stockport, UK) according to Flour Testing Panel Method No. 007/4 (Flour Milling and Baking Research Association 1991), and expressed in Satake International colour grade units. The lower the number, the brighter the colour.

## Hard vitreous kernels

The percentage of hard vitreous kernels (HVK) is determined by examination of a 25-gram sample divided from a sieved 250 gram sample. The sample is analyzed for the natural translucency associated with hardness. Kernels are classed as HVK or non-vitreous as defined in the Canadian Grain Commission's Official Grain Grading Guide, Chapter 4, Wheat.

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## Maltose value

Maltose value is determined according to AACC Method 22-15.01.

## Moisture content - flour

To determine the moisture content of flour, a 10-gram sample is heated for one hour in a semi-automatic Brabender oven at 130°C.

## Moisture content - wheat

The moisture content of wheat is determined using the Model 919 moisture meter calibrated against the AACC method 44-15.02, following the procedure for two-stage air-oven.

## Noodle colour

Colour is determined on a raw noodle sheet using a Hunterlab Labscan II spectrophotometer using the CIE (1976) L\*, a\* and b\* colour scale with a D65 illuminant.

- L\* is a measure of brightness.
- a\* indicates red-green chromacity. Positive values indicate increased redness.
- b\* indicates yellow-blue chromacity. Positive values indicate increased yellowness.

## Noodle preparation

Noodles are prepared following the method of Kruger et al (1994), Cereal Chemistry 71:177- 182. Yellow alkaline noodles are prepared with a 1% kansui reagent (9:1 sodium and potassium carbonates) at a 32% water absorption. White salted noodles are prepared using a 1% sodium chloride solution at a 30% water absorption level to maintain proper dough crumb and sheeting characteristics.

## Particle size index

Particle size index (PSI) is a measure of the texture of a wheat kernel. AACC Method No. 55-30.01 is modified by using a UDY cyclone sample mill fitted with a feed rate regulator and a 1.0-millimetre screen. A 10-gram sample from 22 gram of ground, blended wheat is sieved over a U.S. Standard 200-mesh sieve for 10 minutes in a Ro-tap sieve shaker. The weight of throughs X 10 is recorded as the PSI.

## Protein content (N (nitrogen) x 5.7)

Protein content (N (nitrogen) x 5.7) of the composite samples is determined by combustion nitrogen analysis (CNA). Samples are ground on a UDY cyclone sample mill fitted with a 1.0-millimetre screen. Sample size is 250-milligrams and samples are not dried before analysis. Protein content is calculated from total nitrogen as determined using a LECO Truspec N CNA analyzer calibrated with EDTA or an Elementar rapid N cube calibrated with L-aspartic acid and reported on a constant moisture basis. Moisture content is determined by the AACC Method No. 44-15.02, following the procedure for one-stage air-oven. The method for Dumas CNA analysis is explained in Williams, Sobering, and Antoniszyn. 1998. Protein testing methods at the Canadian Grain Commission. In: *Wheat Protein Symposium: proceedings*; 1998 March 9-10; Saskatoon, Saskatchewan.

## Remix-to-peak baking test

The remix-to-peak baking test is a modification of the remix baking test of Irvine and McMullan (1960), Cereal Chemistry 37:603-613, as described in detail by Kilborn and Tipples (1981), Cereal Foods World 26:624-628. Dough is mixed to peak consistency at the second mixing stage.

## Semolina colour

Durum semolina colour is determined using a Minolta colorimeter model CR-410 with a D65 illuminant. Colour readings are expressed on the CIE (1976) colour space system for L\* (lightness), a\* (red-green) and b\* (yellow-blue). Differences in particle size have a significant effect on colour readings. Semolina samples with similar particle size distributions are used for comparability.

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## Semolina dough sheet colour

Semolina dough sheets are prepared as described by Fu et al. (2011), *Cereal Chemistry* 88:264-270. The colour of the dough sheet surface is measured at 0.5 and 24 hrs after sheeting with a Minolta colorimeter model CR-410 with a D65 illuminant. Colour readings are expressed on the CIE (1976) colour space system for L\* (lightness), a\* (red-green) and b\* (yellow-blue).

## Semolina yield and milling yield of durum wheat

Durum wheat is milled on a four stand Allis-Chalmers laboratory mill in conjunction with a laboratory purifier as described by Black (1966), *Cereal Science Today* 11:533-534, 542. The mill flow is described by Dexter et al. (1990), *Cereal Chemistry* 67:405-412. For the calculation of yield, semolina is defined as having less than 3% pass through a 149-micrometre sieve. Milling yield is the combination of semolina and flour. Both milling and semolina yields are reported as a percentage of the cleaned wheat on a constant moisture basis.

All semolina analysis and pasta processing is conducted using granular products with a constant extraction of 70%. Semolina granulars are prepared by adding the most refined flour stream(s) to semolina until 70% extraction is reached.

## Spaghetti

Spaghetti is processed from semolina using a customized micro-extruder (Randcastle Extrusion Systems INC, New Jersey, U.S.A.). The barrel of the extruder has 3/4 inch internal diameter with a 12:1 working length to diameter ratio. The screw extends into the hopper where agitators are attached to enhance dough crumb conveying. The hopper can be covered, and the system can be sealed with vacuum. Temperature can be precisely controlled along the extruder barrel. Semolina (200 g) and water (30% absorption) are first mixed in an asymmetric centrifugal mixer (DAC 400 FVZ SpeedMixer) to generate fine and uniform dough crumbs consistent with commercial requirements. The dough crumbs are placed in the hopper, then vacuum is applied to eliminate introduction of air bubbles. A four-hole, 1.8 mm, Teflon coated spaghetti die is used for extrusion. Spaghetti is dried in a pilot pasta drier (Bühler, Uzwil, Switzerland) at the Canadian International Grains Institute.

## Spaghetti colour

Spaghetti colour is determined using a Minolta colorimeter model CR-410 with a D65 illuminant. Colour readings were expressed on the CIE (1976) colour space system for L\* (lightness), a\* (red-green) and b\* (yellow-blue). For colour measurement, a 6.5-centimetre band of spaghetti strands is mounted on white cardboard using double-sided tape.

## Spaghetti firmness

Cooked spaghetti firmness is determined using the Stable Micro Systems TA.XT2i Texture Analyser with accompanying Texture Expert software. The basic principle for the firmness measurement was based on Oh, N.H. et al. (1983), *Cereal Chemistry* 60:433-438. Cooking time is fixed at 8 min for spaghetti samples with a diameter of 1.7-1.8 mm. Cooked spaghetti is drained and immediately aligned on the base plate for cutting test without rinsing in cold water. A fixed compression depth of 4.9-millimetre is used (crosshead height calibrated to 5.0-millimetre). The crosshead speed is 1.0 mm/sec. Cutting forces of five strands are recorded at a compression depth of 25% and 50% of the cooked strand diameter, and at fixed distances of 0.8 and 1.2 mm of penetration into the spaghetti.

## Spaghetti strand diameter

Dry spaghetti diameter is the average of ten randomly chosen strands which are measured with a caliper. A TA.XT2i texture analyzer with Texture Expert software is used to determine cooked spaghetti diameter by subtracting the distance the blade travels to the surface of spaghetti (trigger force 3 g) from the the set distance.

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## Speck count

Speck count is determined using the software RAR-SpecCnt(S) developed by RAR Software Systems (Winnipeg, Manitoba). A semolina sample is compressed to 1 cm in thickness in a sample holder with a clear glass top, and then scanned using a flatbed scanner to acquire a 5 cm x 5 cm image for processing. The image is used to identify potential specks within the sample using object detection algorithms. Each detected object is then evaluated for the average darkness (%GL), the average colour of each component (%RGB), the average colour of each component within the darkest region of the object (%RGB Max), and the size (total area). If the detected object falls within previously specified ranges, the object is identified as a speck. Once all the specks have been identified, they are categorized by the darkness (low, medium and high) as well as the size (small, medium and large) of the speck. Total, dark, and large specks are averages of at least five replicates and their numbers are expressed in 50 cm<sup>2</sup> of semolina sample surface.

## Sponge-and-dough

The sponge-and-dough baking test is based on a 4.5-hour fermentation, 70% sponge system as described by Kilborn and Preston (1981), *Cereal Chemistry* 58:198-201. Ascorbic acid is used as the oxidant at 40 ppm. Dough is mixed in a Swanson type 100-200gram pin mixer (National Manufacturing Co., Lincoln NE) at 116 rpm. Loaves are produced from 200 grams of flour in baking pans with cross-sectional dimensions similar to those of Canadian commercial baking pans. Loaf volume is reported on a 100-gram flour basis. Mixing energy is reported in watt-hours per kilogram (W-h/kg) of flour and watt-hours per kilogram of dough.

## Starch damage

Starch damage is determined using AACC Method 76-31.01 Damaged Starch: Spectrophotometric Method. Starch damage is expressed as a percentage of flour weight. The method is also referred to as the Megazyme method.

## Test weight

Test weight is determined using the 0.5 litre measure, a Cox funnel to standardize the pouring rate, and a striker to level the contents of the container. The grain in the container is poured into the pan of an approved electronic scale for weighing. The scale connects to a computer which calculates the test weight of the grain in kilograms per hectolitre (kg/hL) from grams weighed by the scale. If the computer interface is not available, test weight conversion charts are used.

## Test weight - harvest survey

Test weight is determined using the Schopper chondrometer equipped with a 1 litre (1 L) container. The weight in grams of the measured litre of wheat is divided by 10. The result is reported in kilograms per hectolitre (kg/hL) without reference to the moisture content.

## Texture characteristics – Noodles

Texture measurements are carried out using a computer-assisted Stable Micro Systems TA-XT2i Texture Analyser and represent the average of four replicate cookings in which each cook evaluated five sets of noodles. Characteristics are determined as per Oh, N.H. et al. (1983), *Cereal Chemistry* 60:433-438.

- Maximum cutting stress (MCS, g/mm<sup>2</sup>) reports the bite or firmness of the cooked noodle (g/mm<sup>2</sup>)
- Resistance to compression (RTC, %) correlates with the noodle's firmness and chewiness.
- Recovery % correlates with the noodle's firmness and springiness.

## Weight per 1000 kernels

Broken kernels and foreign material are handpicked from a sample to create a cleaned sample. The number of kernels in a 20-gram subsample of the cleaned sample is then counted using an electronic seed counter.

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**Wet gluten content - flour**

ICC Standard Method No. 137/1 is followed using the Glutomatic System 2200 with 80-micrometre metal sieves.

**Wet gluten content - semolina**

Semolina wet gluten content is determined using AACC Standard Method 38-12.02, following the procedure for whole meal.

**Yellow pigment content**

Yellow pigment content of durum semolina is determined using AACC Method 14-50.01.

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# Wheat methods and tests used to measure quality – Discontinued

## AGTRON colour

The AGTRON colour of flour and durum wheat semolina is determined using AACC Method 14-30.01. An AGTRON direct reading reflectance spectrophotometer is used. [discontinued effective 2011]

## Dry gluten content - semolina

Semolina dry gluten content is determined using AACC Standard Method 38-12.02, following the procedure for whole meal. [discontinued effective 2011]

## SDS sedimentation

SDS sedimentation volumes are determined by a modified version of Axford and Redman (1979), Cereal Chemistry 56:582-584, using 3% SDS as described by Dexter et al. (1980) Canadian Journal of Plant Science 60:25-29. [discontinued effective 2011]

## Semolina colour

Durum semolina colour is determined using a Minolta Model CM-525i spectrophotometer with a D-65 illuminant and expressed as  $L^*$ , which indicates lightness,  $a^*$  which represents redness, and  $b^*$  which represents yellowness.  $L^*a^*b^*$  is referred to as the CIELAB colour space. Differences in particle size have a significant effect on colour readings. Semolina samples with similar particle size distributions are used for comparability. [discontinued effective 2011]

## Semolina yield

Durum wheat is milled on a four stand Allis-Chalmers laboratory mill in conjunction with a laboratory purifier as described by Black (1966), Cereal Science Today 11:533-534, 542. The mill flow is described by Dexter et al. (1990), Cereal Chemistry 67:405-412. Semolina is defined as having less than 3% pass through a 149-micrometre sieve. Milling yield, the combination of semolina and flour, and semolina yield are reported as a percentage of the cleaned wheat on a constant moisture basis. [discontinued effective 2011]

## Spaghetti

Spaghetti is processed from semolina using the micro-processing method of Matsuo et al (1972), Cereal Chemistry 49:707-711, and dried at 70°C in a computer controlled laboratory-scale dryer (AFREM, Lyon, France). [discontinued effective 2011]

## Spaghetti colour

Spaghetti colour is determined using a Minolta Model CM-525i spectrophotometer with a D-65 illuminant and expressed as  $L^*$  which indicates lightness,  $a^*$  which represents redness, and  $b^*$  which represents yellowness.  $L^*a^*b^*$  is referred to as the CIELAB colour space. For colour measurement, a 5-centimetre band of spaghetti strands is mounted on white cardboard using double-sided tape. [discontinued effective 2011]

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### **Spaghetti firmness**

Spaghetti firmness is determined using the Stable MicroSystems TA.XT2i Texture Analyser following a modified version of the procedure described by Sissons et al (2008), *Cereal Chemistry* 85(3):440–444. Due to the limited amount of dried spaghetti, optimum cook time and cooked spaghetti texture are determined using 5-grams of 5-centimetre long strands. For cooked spaghetti texture evaluation, a fixed compression depth of 4.9-millimetre is used (crosshead height calibrated to 5.0-millimetre). Maximum cutting force is defined as the peak force obtained when cutting through five strands. Maximum cutting stress is defined as the peak force divided by the contact area between the pasta blade and five spaghetti strands. Diameter of cooked spaghetti are recorded for each cutting test. [discontinued effective 2011]

### **Speck count**

Speck count is determined as described by Dexter and Matsuo (1982), *Cereal Chemistry* 59:63-69. [discontinued effective 2011]

### **Yellow pigment content**

Yellow pigment content of durum wheat and semolina is determined using AACC Method 14-50.01.

Wheat pigments will not be reported effective 2011.