April 7, 2017

Evaluating Whole Wheat Flour for Baker Acceptance

Background and summary of method

In order to obtain finely textured bread, the flour must also be finely ground. Some criteria are needed to determine what is the required fineness of the whole wheat flour.

For whole wheat flour the particle size distribution is wide ranging. Generally the endosperm grinds easily into fine particles, while the bran tends to form relatively large flakes especially from soft wheat varieties. Also the flakes of bran may not be effectively scraped free from endosperm during the milling. This will produce a reduced loaf volume, and therefore denser bread, than expected for the quality of the grain.

Generally the largest particles in whole wheat flour are the bran particles. By measuring the size, volume and weight of these largest particles in whole wheat flour, their density can also be obtained. The density will reflect the efficiency of the milling system to scrape the bran free from endosperm. With these data, comparisons can be made between various whole wheat flours and the loaves that can be made from them.

Ten samples of whole wheat flour from a variety of sources and with various breadmaking potential were used to develop and make a preliminary assessment of the method.

From this came a suggested range of parameters for whole wheat flour, which would maximize its potential for bread-making.

The best bread texture seems achievable when the bran particles greater than 850 microns*, contribute less than approximately 2 % of the total flour. Perhaps just as important, the bran particles need to be very light as a reflection that they have been well scraped free from endosperm. The density for the bran particles >850 microns* in size seems optimally to be 0.2 g/mL or less.
**Excluded by standard sieve size 20.*

Equipment

Standard stainless steel sieve, mesh size #20 (to exclude particles greater than 850 microns; *obtainable from www.seedburo.com*)
Catch tray or bowl for the sieves. *Can be bought with the sieves or use a kitchen bowl.*
Cover for top sieve. *Can be bought with the sieves or use a saucepan or skillet lid.*
Plastic Graduated Cylinders: 10 mL capacity (reading to 0.2 mL) and 25 ml capacity (reading to 0.5 mL) *Obtainable from hobby science stores or micro brewing suppliers.*
Plastic funnel to fit into the top of the 10 mL graduated cylinder. *Obtainable from hobby science stores or micro brewing suppliers.*
Balance or scale, with tare option and reading down to 0.1 grams
Flour brush

Method

1. Arrange the #20 sieve over a catch bowl, or inside a large bowl and have cover available such as a saucepan lid to place above the top sieve for dust control.

2. Mix whole wheat flour sample well, to ensure even particle size distribution and representation. Weigh out 100 grams exactly of the sample flour, and add to sieve.

3. Tap and shake the sieve arrangement until the flour has passed through both sieves, leaving only the particles too large to pass through. Complete this process by using a flour brush to brush the flour through the sieve. Take care to brush until all the particles that can pass through the sieve have had a good chance to do so. *Remember to tap the brush onto the sieve side, to release any bran particles remaining on the brush.*

4. Place the suitably sized graduated cylinder on the scale, and zero the weight.

5. Transfer the bran from the sieve to the graduated cylinder using the funnel. Return it to the scale and record the weight of the bran particles held back by the sieve.

6. Tap and vibrate the graduated cylinder to settle the bran into the least volume that it can occupy. Record the volume of the particles.

7. Prepare test loaves for the whole wheat flour using a consistent method. Assign a bread score to compare textures:
1= very dense
2 = dense
3 = medium dense
4 = medium light
5 = light

Results; see Tables 1 through 4 below:

Conclusions & Discussion

The best bread texture seems achievable when the bran particles that are greater than 850 microns, contribute less than approximately 2 % by weight of the total flour. Perhaps just as important, the bran particles need to be very light, as an indication that all have been well scraped free from endosperm. The density for the bran particles >850 microns in size seems optimally to be 0.2 g/mL or less.

Small amounts of coarse whole wheat flour can sometimes be reground in a Blendtec Kitchen mill (pin mill type) to achieve considerable reduction in maximum particle size. It may also be possible to regrind sifted off bran in a Blendtec pin mill to achieve considerable improvement in whole wheat flour character. *However, grain mills are designed for milling grains, they are not designed for re-grinding flour and their flow characteristics may not allow flour to flow freely through the mill. If this is the case the mill should not be used to regrind flour. The ideal is to be able to achieve the desired fineness in the flour in a single pass through the mill, i.e. without the need to sift or regrind.*

This flour assessment method is intended as a beginning to help us describe the physical character of a whole wheat flour, for bakers. A baker needs to know what can be expected from a particular style of flour grind, and be able to request a grind suited to their intended 100% whole grain product. If we fail to manage this, then bakers will continue to dilute their whole grain flours with refined flours, which compensate for loss of dough expansion when whole grain flours are not ground finely enough.

Table 1. Raw data from 100 gram samples of flour

Sample number	*001*	*002*	*003*	*004*	*005*	*006*	*007*	*008*	*009*	*010*
Weight (g) remaining on sieve # 16	*6.2*	*0*	*0.3*	*14.8*	*3.3*	*0.2*	*1.1*	*0.1*	*0.1*	*<0.01*
Volume (mL) remaining on sieve# 16	*18.0*	*n/a*	*3.0*	*22.0*	*6.6*	*1.4*	*3.8*	*0.8*	*0.3*	*<0.1*
Density (g/mL) of remainder on sieve #16	*0.34*	*n/a*	*0.10*	*0.67*	*0.50*	*0.14*	*0.29*	*0.13*	*0.33*	*0.10*
Weight (g) remaining on sieve # 20	*5.4*	*0*	*1.2*	*17.0*	*12.2*	*1.4*	*1.0*	*0.6*	*0.1*	*2.1*
Volume (mL) remaining on#20	*18.0*	*<0.1*	*7*	*30.0*	*24.5*	*5.6*	*3.8*	*2.2*	*1.2*	*4.6*
Density (g/mL) of remainder on #20	*0.30*	*n/a*	*0.17*	*0.57*	*0.5*	*0.25*	*0.26*	*0.27*	*0.08*	*0.46*
% > 850 microns (amount in grams remaining on #16 and #20)	*11.6*	*0*	*1.5*	*31.8*	*15.5*	*1.6*	*2.1*	*0.7*	*0.2*	*2.11*
Bread score	*2*	*5*	*5*	*n/a*	*n/a*	*4*	*5*	*5*	*4*	*n/a*

Table 2. Flour descriptions

Sample #	*Description*
001	*Chiddam Blanc de Mars wheat stone milled, evidently coarse*
002	*India-Jammu wheat milled on finest setting of Magic Mill (micronizing pin mill)*
003	*Whole Foods, 365 Brand, Whole Wheat Flour (hard red spring wheat)*
004	*Sonora wheat, first pass through Entoleter type mill (evidently very coarse)*
005	*Sonora wheat, second pass through Entoleter type mill (somewhat less coarse)*
006	*Chiddam Blanc de Mars wheat as in sample #001, remilled in pin mill on finest setting*
007	*Spelt, stone milled on newly produced and dressed stone mill*
008	*Hard red wheat, stone milled on newly produced and dressed stone mill*
009	*Khorasan wheat, stone milled on newly produced and dressed stone mill*
010	*Sonora wheat, stone milled coarse but coarsest bran known to have been sifted off.*

Table 3. Flour characteristics for successful bread (score 4 or 5)

Sample #	*002*	*003*	*006*	*007*	*008*	*009*
% particles > 850 microns	*0*	*1.5*	*1.6*	*2.1*	*0.7*	*0.2*
Density of particles >850 microns	*< 0.1*	*0.17*	*0.25*	*0.26*	*0.27*	*0.20 (average)*

Table 4. Flour characteristics for unsuccessful bread (score 1 through 3)

Sample #	*001*	*004*	*005*
% particles > 850 microns	*11.6*	*31.8*	*15.5*
Density of particles >850 microns	*0.30*	*0.60*	*0.5*