RAPID METHOD TO DETERMINE QUALITY OF WHEAT WITH THE MIXOGRAPH[1]

B. L. BRUINSMA, P. D. ANDERSON, and G. L. RUBENTHALER[2]

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ABSTRACT

Flour, ground whole wheat, and sifted meal mixograms of several classes of wheat that were harvested in 1975 were compared. The correlations between both flour mixograph peak time and absorption versus the sifted meal peak time and absorption were greater than 0.92 (r, 0.92). The whole wheat method is rapid, requires small samples of grain, and is easily adapted to screen breeders' wheat samples for quality characteristics.

The mixograph has been a tool for determining wheat and flour quality for a long time. Miller and Johnson (1) have reviewed publications about it; Finney and Yamazaki (2) have shown that the instrument could be used to predict mixing time, loaf volume, oxidation requirement, and water absorption.

Finney and Shogren (3) adapted the commonly used mixograph, which required 35 g of flour, for use with 10 g of flour. With 10-g samples, wheat quality can be estimated on early generation lines with limited seed quantities. Milling the flour, however, was a problem, and usually required an expensive, sophisticated micro flour mill that was not readily adapted to rapid screening analysis. Johnson and Swanson (4) developed a test for sifted whole-meal mixograph analysis, but this method used several successive grindings and screenings. Lamb (5) also used a sifted meal mixograph test for soft wheat, but the recommended sample size was 125 g.

We suggest a method for the analysis of sifted meal mixographs that is rapid, simple, and inexpensive; data correlate highly with the data from refined flour.

MATERIALS AND METHODS

We used five grinders to produce samples for mixograph analysis: the Weber, Udy Cyclone, Hobart, CRC Micro, and Straub mills. Three different sifting screens on a Strand sifter also were used. The samples were 34 varieties of grain harvested in 1975 representing hard red winter, hard red spring, soft white winter, hard white winter, and club wheats.

Moisture level was determined on a composite sample of the group; 50-g samples of each were tempered to two levels and ground. To find the optimum conditions for sample preparation, we ground the samples with each of the five grinders and sifted a subsample of the ground meals through 250-, 210-, and 177-μm screens.

[1]Cooperative investigations of the Agricultural Research Service, U.S. Department of Agricultural Chemistry, College of Agriculture, Washington State University. Scientific Paper No. 4857, College of Agriculture, Pullman, WA.

[2]Graduate assistant, physical science technician, and research food technologist (cereal), respectively.

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Mixograms (10 g) were obtained on the whole meal, sifted meal, and either or both corresponding Buhler or Quadrumat experimentally milled flour samples; peak time, flour absorption, and general appearance of the sifted meal mixograms were compared with the milled flour mixograms. All meals and flours were weighed to give 10 g on 14% mb. Flour absorptions were replicated and determined by the method of Finney (3).

RESULTS AND DISCUSSION

The mixograms for 100% whole wheat meals did not resemble those of the flours. Ground whole wheat meal doughs had less strength tolerance and absorbed considerably more water than did the corresponding flour sample. Some doughs tended to lose integrity after 5–6 min of mixing (Fig. 1), which caused the dough mass to cling to the side of the bowl. At this point, the dough appeared wet and escaped the mixing action of the pins. This characteristic loss of integrity, which was more apparent in the winter than in the spring wheats, was unexplained.

To eliminate this loss of dough integrity, and to develop a mixogram with

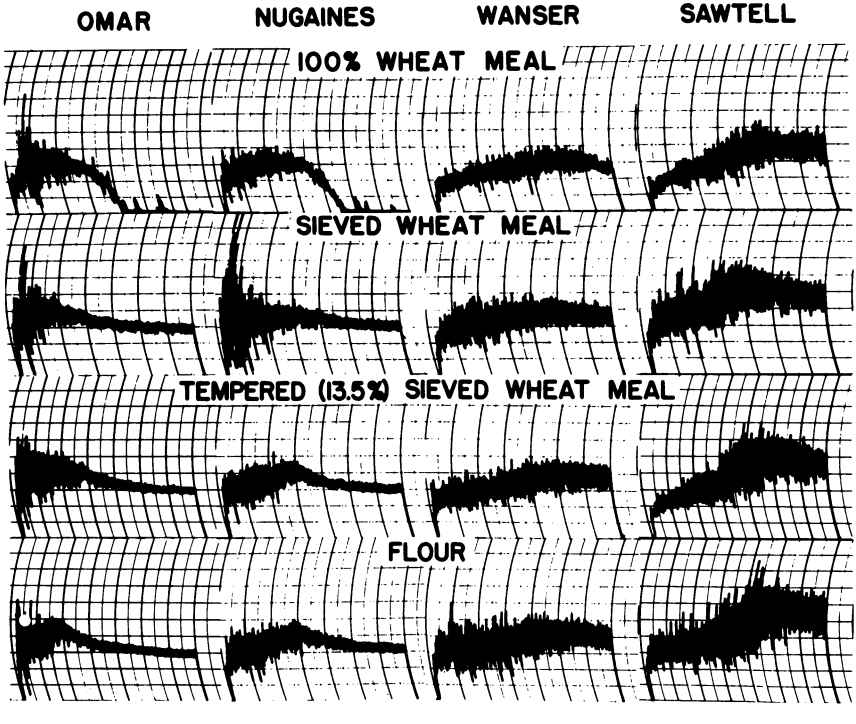

Fig. 1. Effects of 100% wheat meal, sieved wheat meal, tempered (13.5% mb) sieved wheat meal, and milled flour on dough development as measured by mixograph. Omar, Nugaines, Wanser, and Sawtell are cultivars that represent Western Club, soft white winter, hard red winter, and hard red spring classes, respectively.

characteristics more like that of the flour, we sifted the whole wheat meal for 1 min using one of three sifter screens, with average extraction rates for each of the sieves as follows:

Opening (μ)	250	210	177
Average extractions (%)	76–81	68–73	60–68

Because the difference was negligible among the mixograms from the sifted wheat meals sifted through each of the three screens, we decided to use the sieve with the highest extraction because it would keep the initial sample size small. The mixograms for sifted meal appeared similar to those for flour.

Three of the grinding methods were rapid and satisfactory, while two were unsatisfactory. The Udy Cyclone (1 mm), Weber (0.024 in.), and Hobart mills produced an excellent wheat meal for mixograph analysis. The other two mills

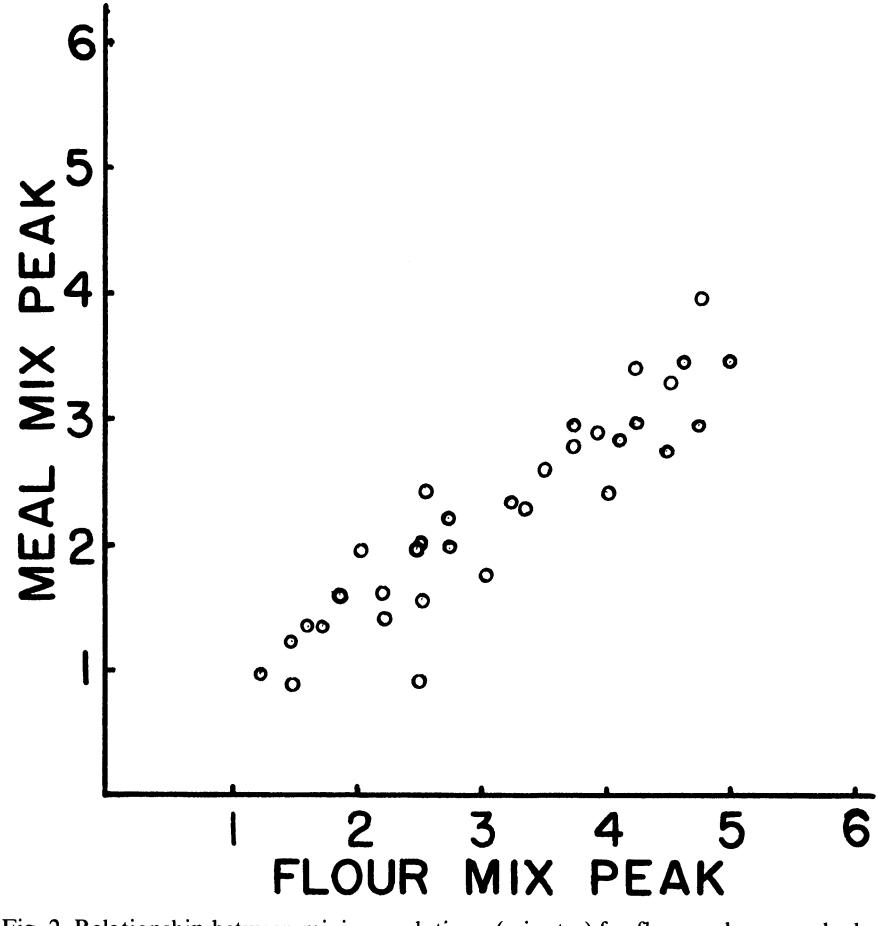

Fig. 2. Relationship between mixing peak times (minutes) for flour and prepared whole wheat meals.

would not provide a meal with sufficiently small, uniform particle size to give a representative mixogram. Therefore, further studies with these mills were discontinued.

When meals from the satisfactory grinders were sifted for 1–2 min over a 250-μ sieve, all provided a 75–80% extraction meal that produced identical mixograms for a given sample. The Udy Cyclone mill was used for the data reported in Fig. 1 and 2, and is being used routinely in this laboratory.

The sifted wheat meal mixogram had abnormal characteristics that varied widely among cultivars and classes of wheat. Many appeared dry during the first 2 min of mixing (Fig. 1). Tempered wheat (13.5% mb) that was ground and sifted yielded a mixogram most like that for the corresponding flour. This small increase in moisture did not affect the grinding or sifting properties of the wheat or meal.

Figure 1 illustrates the mixographs of four types of flour selected from the 34 varieties tested; these ranged from weak to relatively strong in dough mixing properties. Each can be compared with its associated sifted meal mixogram. Mix peaks between the curves correlated well (r, 0.92). Figure 2 is a plot of mix times for the flour and meal mixograms.

Absorption of flours and meals also was highly correlated (r, 0.99). As a general rule, sifted wheat meal has 1.8% higher absorption than does the corresponding milled flour.

SUMMARY

Using the techniques described above, a breeder can screen wheat lines for flour quality characteristics rapidly and with minimum expense. A single analysis requires 12–15 g of wheat for which moisture content is known. The sample can be tempered (12–24 hr), ground, sifted, and analyzed with the mixograph. This method offers a routine early generation screening technique that requires little expense for additional equipment and a modest investment of time and training.

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