A New Approach to the Pearling Test for Grain Hardness

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Grain hardness has been described as “the most important aspect of wheat utilization” (5). Indeed, grain hardness determines grade classification for international trade and process methods in milling and food manufacture. Hard wheats produce a degree of damaged starch, needed for most baking processes, whereas low starch damage is required for cookies, grocery flour, wafers, and some noodles and steamed buns.

Grain hardness is routinely determined by near infrared spectroscopy, but the relevant equipment must be calibrated on the basis of particle size index or pearling resistance results.

The particle size index has often been adopted in preference to pearling resistance because of difficulties in obtaining access to and using the Strong-Scott barley pearler.

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Materials and Methods
A commercial flour miller (Allied Mills, Australia) provided grain samples and relevant NIR calibrations, based on PSI results. These included 35 hard wheats (varieties Sunco and Sunvale, with protein contents ranging from 10.0 to 15.2% and moisture from 9.1 to 12.2%) and 23 soft wheats (Sunsoft and QAL2000, with protein contents ranging from 8.5 to 12.0% and moisture from 9.7 to 11.3%). Additional samples were provided from the breeding program of the Plant Breeding Institute, University of Sydney.

The optimized procedure involved placing 10.0 grams of cleaned grain into the Kett Pearlest rice pearler (Kett Electric Laboratory, Tokyo, Japan, http://www.kett.co.jp) (Figure 1). The rubber disc, rubber ring, and polishing plate used for rice milling were replaced with the more abrasive disc, ring, and plate provided as satisfactory means to determine grain hardness quantitatively, providing differentiation between many samples of hard and soft grain.

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Fig. 1. The Kett Pearlest rice pearler, fitted with highly abrasive disk and rotor, suitable for wheat grain pearling.
optional accessories by Kett. After pearling for 2 minutes at the regular motor speed, the resulting pearls were weighed, and the result ("pearling resistance") was expressed as a percentage with respect to the original grain mass.

Results and Discussion

As the procedure was being optimized, it was evident that the amount removed by abrasion after two minutes of pearling decreased progressively for grain loads up to about 10 grams and then decreased again for larger sample sizes. On the other hand, the amount removed continued to increase with longer pearling times, but a two-minute period was optimal for hard-soft differentiation.

Good differentiation was provided between the sets of hard and soft grain samples when the optimized pearling test was applied in duplicate. Reproducibility was also good, with a standard error of about 2%. In Figure 2, the comparison is provided between the PR (Kett) results and the routine use of NIR reflectance analysis of wholemeal samples, based on calibration with the PSI test (arbitrary units). The “tightness” of grouping samples was similar for the two methods.

Higher-than-expected PR values have been reported to be given by very moist grain samples (2). This effect was also encountered with the use of the Kett pearler, but the changes in PR values were not enough to be considered significant in the moisture range normally encountered.

A reliable and convenient test for hardness in many small samples is needed in breeding programs, especially when hard X soft crosses are made. In addition, hardness is affected by growth conditions to some extent, being partly related to the protein content of the grain. Grain samples from a breeding program were also evaluated by the Kett pearling test. Pearling resistances for the known varieties (Chara and Rosella) were correct for their known hardness types, according to the ranges in Figure 2. In addition, several advanced lines were tested, coming from a hard X soft crossing program. The results for these covered much of the range of pearling resistances in Figure 2, but they were mainly soft.

Conclusion

The Kett rice pearler proves to be a satisfactory means of determining grain hardness quantitatively using the principal of the traditional pearling-resistance test of McCluggage (4), but with much more convenient equipment. The modified test is simple and fast to use, suiting both breeder and mill laboratories.

Acknowledgments

We appreciate the loan of the Kett pearler by Tony Blakeney. Grain and NIR results were provided by Di Miskelly and John Dines, Allied Mills, Australia. Breeder samples came from Akram Khan, Plant Breeding Institute, University of Sydney. Ewa Orszulok also contributed to the study. The project was a part of the Student Research Scheme of CSIRO, carried out by Rachael Rodney.

Fig. 2. Grain-hardness results obtained for 58 grain samples using the optimized Kett pearling resistance test and the routine near-infrared method (calibrated for particle size index). Hard-grain samples (top right) were well distinguished from the soft-grained samples (lower left) by both tests. PSI—particle-sized index.

References


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