SHORT COMMUNICATION

Development of a Small-Scale Variant of the Rapid Mix Test Experimental Bread Baking

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Abstract: To determine wheat quality, an experimental 80 g variant (mini-RMT) of the standard 1050 g Rapid Mix Test (RMT) was developed. Ten samples of wheat flour with known RMT values were analysed using the method. Results showed a strong correlation between RMT and mini-RMT values (r = 0.96). Mini-RMT bread volumes were smaller on average by 47.4 ml. A regression equation was constructed allowing the mini-RMT to be used in place of the RMT in wheat breeder laboratories. Anyway, these results are of limited plausibility due to the limited sample numbers and have to be verified on a larger sample set.

Keywords: experimental bread baking; quality; rapid mix test; wheat

As the basic part of nutrition, bread is of great significance and its quality has been the focus of extensive research (Dobraszczyk & Salmanowicz 2008; Mondal & Datta 2008; Liu *et al.* 2009; Singh *et al.* 2009; Tanács *et al.* 2010; Purlis 2011, and others). Bread quality is determined mainly using protein fractions, a procedure which is well documented (Pomerancz 1988; Kasarda 1989; MacRitchie 1992; Tronsmo *et al.* 2003). This offers a description of protein quality related to the composition of glutenin subunits (Payne *et al.* 1987; Shewry *et al.* 1992), gliadins (Sontag-Strohm *et al.* 1996) and relations between protein classes (Kasarda 1989; Singh *et al.* 1990). Starch properties (Patel *et al.* 2005), non-starch polysaccharides (Maeda & Morita 2003; Migliori & Gabriele 2010) and lipids (Agyare *et al.* 2005; Finnie *et al.* 2010) also play an important role in bread quality. All components affecting the bread quality were summarized in Goasaert *et al.* (2005). Because the baking process as a whole is not very clear (Mondal & Datta 2008), experimental baking is still the chief method for determining wheat quality. Various baking tests have been developed and used routinely in industry and research (Magnus *et al.* 1997). Bread is produced in the main using three methods. The first is the straight dough method, which involves mixing ingredients in a single step, normalized in AACC 10-09.01 and AACC 10-10.03 (AACC 1999a, b). The second is the sponge-and-dough method, in which ingredients are mixed in two steps. In the first step, leaven is prepared by mixing yeast, a defined amount of water, and flour. The leaven is then left to develop for several hours before being mixed with the remaining ingredients. This method employs normalization in AACC 10-11.01 (AACC 1999c). The third is the Chorleywood method, in which all ingredients are mixed in an ultrahigh mixer for several minutes (Giannou *et al.* 2003) and normalized in ICC 131. In most of the European Union, Rapid Mix Test (RMT) experimental baking is used on the basis of EEC Directive 2062/81. The RMT is a variant of the Chorleywood baking method, optimized by Seibel *et al.* (1987) and is still employed in this form today. Unfortunately, the RMT cannot be used for early generations in plant breeding because of the large amount of flour it demands (1050 g at least). In addition, the equipment needed to carry out the RMT is quite expensive. A micro-baking version of the RMT (micro-RMT) was developed by Kieffer *et al*. (1993) when 10 g of flour are used. A strong correlation was obtained between the micro-RMT and the standard RMT (r = 0.9). However, like in the case of the standard RMT, the equipment necessary to carry out the micro-RMT is expensive and measurement error is substantial. The availability of a small-scale variant (more or less than 100 g) of the standard RMT would therefore be highly valuable for wheat breeding and research. The aim of this paper was to develop just such a small-scale variant, the mini-RMT, using equipment which is routinely available.

Grain samples of ten winter wheat varieties (RW Nadal, Bodyček, Brentano, Briliant, Aladin, Manager, Nikol, Samanta, Elly and Graindor) were obtained from trials of the Institute for Supervision and Testing in Agriculture of the Czech Republic (Lípa testing location, harvest year 2009). The official classification of bread-making quality of the examined wheat varieties is available in Table 1.

RMT was carried out at the Institute for Supervision and Testing in Agriculture of the Czech Republic during wheat variety registration trials. Flour for the baking test was milled on a laboratory-scale Buhler MLU202 test mill (Buhler-Miag, Uzwil, Switzerland). RMT was carried out as prescribed by Seibel *et al.* (1987). Bread volume was measured using rapeseed displacement.

Mini-RMT was carried out as follows: flour for the baking test was milled on a laboratory-scale Yucebas WWGM test mill (Yucebas Makine, Izmir, Turkey). Flour moisture and water absorption were determined using an NIR Infratec 1241 Grain Analyzer (Foss, Hillerød, Denmark). 80 g of flour (14% water content), Diasta malt powder (KåKå CZ, Středokluky, Czech Republic) to obtain a falling number of 250 s, distilled water in keeping with the water absorption value (reduced by 5%), 4 g of Linco yeast (F.X. Wiennger, Passau, Germany), 1.2 g of salt, 0.8 g of saccharose, 850 µl of melted (40°C) pork lard and 16 µl of 0.01% ascorbic acid were mixed using an RT-150 kitchen mixer (Fagor Electrodomésticos, Mondragón, Spain) in two phases. Initial mixing took place

Table 1. Bread volumes for RMT and mini-RMT baking

Variety sample (classification of grain quality)	Bread volume (cm^3/100 g)	
	RMT baking	mini-RMT baking
RW Nadal (B)	568	500
Bodyček (A)	594	513
Brentano (A)	464	438
Briliant (A)	557	481
Aladin (A)	430	376
Manager (A)	495	450
Nikol (B)	514	463
Samanta (B)	485	450
Elly (A)	449	401
Graindor (A)	522	475
Average	507.8	454.7
SD	53.6	42.2
CV (%)	10.55	9.28

A – high quality wheat; B – complementary bread wheat; SD – standard deviation; *CV* – coefficient of variation for 30 sec. The mixer lid was then cleaned and mixing was performed for another 30 sec. The dough was then removed, formed by hand into a sphere and put into the fermentation device on a tray (the fermentation device must maintain a temperature of 32°C and minimum 80% moisture value). A Memmert WNB 10 water bath (Memmert, Schwabach, Germany) was used for the study. Initial fermentation was for 20 min. The dough was then removed from the fermentation device and allowed to rest for 10 min at laboratory temperature (20–24°C) covered with a tray. The dough was then weighed and divided into three equal sections using scissors. Each piece of dough was covered with a tray. The pieces of dough were rounded using a dough rounder (Ska-Tec, Prague, Czech Republic). Each rounded piece of dough was placed on a 10 cm Petri dish bottomed with nonstick baking foil (Tescoma, Zlin, Czech Republic) and covered with a tray. When all pieces had been rounded, the trays were removed and the Petri dishes with the rounded dough were placed into the fermentation device. The second fermentation round lasted for 25 min. Petri dishes with leavened dough were put into a Memmert kiln (Memmert, Schwabach, Germany) pre-heated to 205°C, then immediately steamed using 25 ml of distilled water (the bottom of the baking kiln was filled with 3 kg of lava stone and the water was poured over the stones). Baking took place for 30 min. The Petri dishes with the baked bread were then removed from the kiln and allowed to cool for one hour. The volume (in ml) of each loaf of bread was measured using rapeseed displacement, and the resulting values were summarized and recomputed on the basis of bread volume per 100 g of flour.

Bread volumes observed for the RMT and mini-RMT are summarized in Table 1. The correlation analysis of RMT and mini-RMT showed a significant positive correlation (r = 0.96; P < 0.01). The linear regression line (Figure 1) with the equation RMT (ml/100g) = –47.39 + 1.221 × mini-RMT (ml/100g) (R^2 = 0.925 and mean absolute error of 12.41 ml) was constructed. Since the P-value for the model was less than 0.01, there is a statistically significant relationship between RMT and mini-RMT at the 99.0% confidence level. To determine the level of repeatability for the method, the mini-RMT was performed four times using identical flour (Nikol variety). The results are summarized in Table 2.

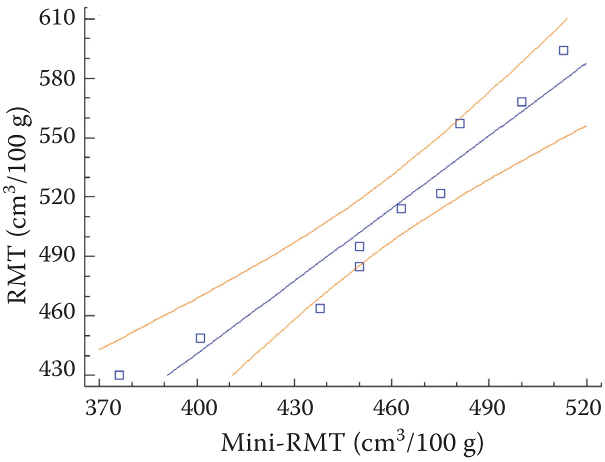

Figure 1. Linear regression model of RMT bread volume on mini-RMT bread volume (99% confidence limits)

Bread volumes obtained using the mini-RMT correlated strongly with those of the standard RMT but were lower on average by 47.4 ml. This bias may have been caused by differences in the formula and baking process, with the addition of water being the most probable factor. Relations between samples were maintained. In Kieffer *et al*. (1998), results of repeated micro-RMT tests indicated a coefficient of variation of ±5 % for bread volume, while the original RMT has a coefficient of variation of ±2 % for bread volume (Pelshenke *et al*., 2007). In the present experiment, results of repeated micro-RMT tests indicated a coefficient of variation ±0.35 %. Due to the limited amount of material the tests for repeatability could not be performed on a full-scale, so the repeatability of mini-RMT is of limited plausibility and has to be verified on a larger sample set. It can be presumed

Table 2. Bread volumes from repeated baking of Nikol variety

Replication	Bread volume (cm³/100 g)
1	425
2	428
3	428
4	428
Average	427.3
SD	1.5
CV (%)	0.35

SD – standard deviation; *CV* – coefficient of variation

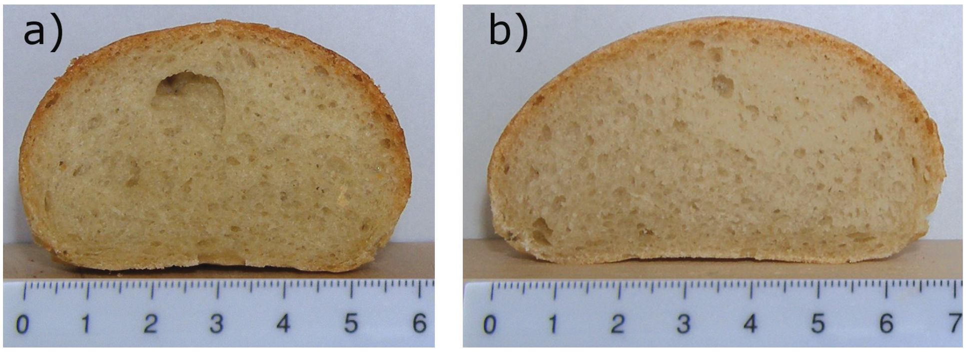

Figure 2. Bread loaves baked using the mini-RMT; (a) variety Samanta, (b) variety Elly

that RMT, micro-RMT and mini-RMT have similar repeatability.

Other characteristics are also employed to evaluate the bread. These include loaf structure, elasticity, browning and taste. These characteristics were not used in the present study to compare the standard RMT with the mini-RMT, since they are subjective and therefore strongly dependent upon the person doing the evaluation. Figure 2 demonstrates the possibility of using the mini-RMT for such an evaluation.

The presented mini-RMT has a potential for use in wheat breeder laboratories, although the results obtained in this work are of limited plausibility due to the limited sample numbers and have to be verified on a larger sample set, including the study of repeatability and reproducibility.

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