Reduced Variance in the Sugar-Snap Cookie Baking Method Using a Cylinder and Plunger to Produce a More Uniform Dough

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ABSTRACT

A cylinder and plunger were fabricated and used to apply moderate pressure to produce more uniform doughs prior to rolling out, cutting, and baking sugar-snap cookies by AACC method 10-52. Use of the cylinder and plunger reduced the standard error by approximately 29% and reduced the number of rebakes required due to lack of agreement between duplicates by 97%.

The primary purpose of the U. S. Department of Agriculture, Agriculture Research Service, Soft Wheat Quality Laboratory (SWQL) is to evaluate milling and end-use potential of eastern U.S. soft wheat breeding lines and commercially grown cultivars for public breeding programs in Missouri, Arkansas, and states east of the Mississippi River. Samples from private breeders, whose numbers have increased substantially during the recent decade, are also evaluated. In addition, the SWQL is mandated to develop improved methods for measuring and predicting wheat flour milling and end-use quality. Promising early generation breeding lines are resubmitted to the SWQL for two to five years for quality evaluation involving testing procedures that predict milling and baking potential. Those tests include the sugar-snap cookie baking test.

For over 35 years the SWQL has used the micro method III test baking procedure (Finney et al 1950) for evaluating and predicting soft wheat flour baking quality by measuring the spread of two sugar-snap cookies baked from 40 g of flour. Micro method III was recently accepted as a standard method of the American Association of Cereal Chemists and designated AACC method 10-52 (AACC 1983).

Micro Method III

Micro method III was collaboratively studied by two operators at each of eight laboratories (Gaines 1980). The laboratories similarly ranked eight flours that varied in quality based on cookie size. However, cookie diameter least significant difference between duplicate (LSD) values ranged among the collaborators from 0.289 to 1.209 cm. LSD values above about 0.5 cm make diameter measurements relatively ineffective in ranking potential new wheat releases, differentiating among flour qualities, or studying cookie formula treatments. The most desirable ambient conditions for evaluating sugar-snap cookie quality by AACC method 10-52 are 20–21°C and 30–50% relative humidity (Gaines and Kwolek 1982). Above those ranges cookie doughs become sticky and reduced in dough consistency. Also, the optimum dough water level must be reduced, which alters dough density and increases day-to-day variance. This paper reports a device and procedure that materially reduces the statistical variance of sugar-snap cookie diameter produced by AACC method 10-52.

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MATERIALS AND METHODS

Flours

About 1,700 wheats from the 1982 through 1987 soft red winter (SRW) and soft white winter (SWW) crops of the eastern United States were milled into straight-grade flours either by an Allis-Chalmers mill (Uniform Nursery samples) or by a Quadrumat Junior mill (Advanced Nursery samples) according to Yamazaki and Andrews (1982). Those flours are designated Uniform or Advanced, respectively. Wheats were tempered to 15% moisture level for at least 15 hr prior to milling.

Cookie Doughs

Sugar-snap cookie doughs were prepared according to AACC method 10-52. The formulation included (by flour weight) 60% sugar, 30% shortening, and optimum water absorption level normally between 12 and 20% of the flour weight.

Dough Procedure

Cookie doughs produced from flours from 1982, 1983, and about half of the 1984 flour samples were prepared in the traditional manner. That is, after mixing, the dough was removed from the mixing bowl, carefully concentrated by hand into a mass, and divided into two approximately equal parts with the aid of a spatula. Care was taken to minimally manipulate or compress the dough. Doughs were placed on specially designed baking sheets, rolled once, and then cut with the cookie cutter. Dough outside the stainless steel cutter was removed with a spatula before raising the cutter. Baking in a reel type oven was begun immediately (10 min at 400°F).

Modified Dough Procedure

Cookie doughs produced from about half of the 1984 flours and from the 1985, 1986, and 1987 flours were produced in a manner similar to the above, except that after mixing, all dough was scraped from the mixing bowl into an aluminum cylinder placed on the metal work table. The dough was rearranged and evened in the cylinder by a spatula using radial cuts, care being taken to avoid compressing the dough. The dough was then pressed in the cylinder with moderate pressure using a flat aluminum plunger, which produced a comparatively uniformly dense dough within the cylinder. The plunger was lifted out of the cylinder and the cylinder was lifted from the compressed dough. The dough was then cut in half at the diameter. Each dough-half was placed on the cookie sheet, rolled and cut as described above, and baked ten minutes. The effect on the mean and standard deviation of cookie diameter, weight, and top grain score of using light, medium, and heavy pressure to compress cookie dough in the cylinder were determined. All data were evaluated by analysis of variance.

Plunger and Cylinder

Both the plunger head and handle and the cylinder were manufactured from solid aluminum (Figure 1). The plunger head diameter (2.625 in.) is only 0.002-in. smaller than the inside diameter of the cylinder (2.627 in.). It is sufficiently thick (0.500 in.) so that during the compression process the plunger is guided by the cylinder in a near 90° vertical path as the dough is compressed, thereby minimizing variation within each dough.

RESULTS AND DISCUSSION

Standard Method

For the two crop years before using the cylinder and plunger, the pooled standard deviation of duplicates of cookie diameters was 0.17 cm for both Quadrumat (Advanced nurseries) and Allis-Chalmers (Uniform nurseries) flours, respectively (Table I). For many years the SWQL imposed a requirement that whenever the cookie diameter of duplicate bakes varied by more than 0.25 cm, a third replicate was baked. For the 1982 and 1983 crop years a third replicate was required 284 times out of 891 duplicate bakes (about 32% of the time), which required at least an additional seven days test baking for two technicians. Usually, when duplicate bakes from a particular flour did not agree, there was a relatively large (up to 4 g) difference in the weight of the two cookies baked as one of the duplicates. That was assumed to result from a difference in the density of the two pieces of dough placed on the cookie sheet (data not reported).

Revised Method

Cookies from 74 wheats of the 1984 crop were baked in duplicate using the cylinder and plunger to produce more uniformly dense dough prior to cutting and rolling. The pooled standard deviation of duplicates for cookie diameter was significantly ($P = 0.05$) lowered to 0.12 cm (Table I). Duplicates agreed such that only three flours required a third replication.

The second half of the 1984 crop was evaluated for cookie quality after an improved air conditioning and humidity control system was installed in the baking laboratory. Nearly ideal temperature and relative humidity conditions prevailed (20–21°C, 30–50% rh). Since then standard deviations of duplicate cookie diameters have remained at about 0.10 cm, and only three triplicate bakes have been required.

Effects of Plunger Pressure

The effects of plunger pressure on cookie weight and diameter were also studied. Light pressure resulted in doughs with visable air pockets and a somewhat lumpy appearance. Medium pressure created a comparatively smooth, homogeneous disk of dough. Heavy pressure forced some dough out under the cylinder and created a visable oil slick appearance on the dough surface. There were no statistically significant differences in average cookie weight, diameter, top grain appearance, or the difference between the weight of the two cookies produced due to plunger pressure. However, most consistent results were achieved using medium pressure (Table II).

Conclusions

Since 1984, when the SWQL began using a cylinder and plunger to prepare cookie dough prior to rolling and cutting, pooled standard deviation of duplicate cookie diameters has been reduced by about 29% (0.17–0.12 cm) and the requirement for rebakes by reduced by 97%. In addition, by improving laboratory temperature and humidity control, standard deviation between duplicate cookie diameters was reduced from 0.12 to 0.10 cm.

Although there were no statistically significant differences in average cookie weight or diameter due to plunger pressure, an intermediate pressure that creates a comparatively smooth, homogeneous disk of dough is recommended.

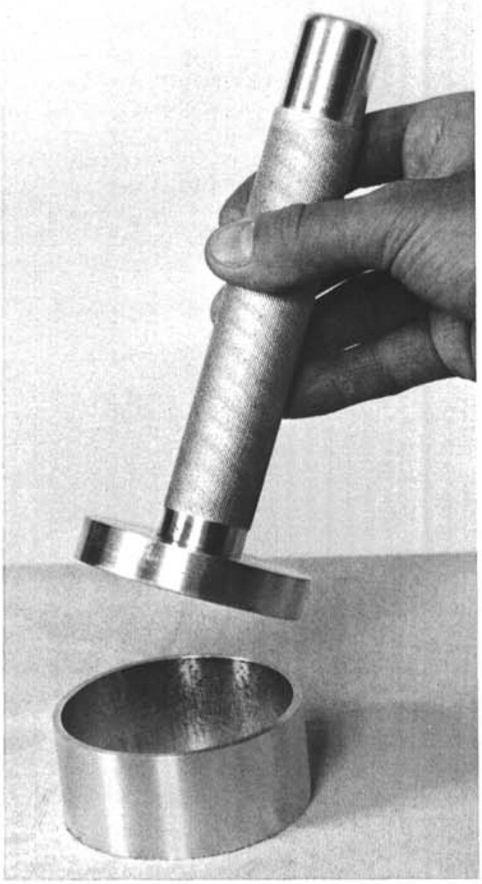

Fig. 1. The experimental cookie dough press is composed of three solid aluminum parts. The plunger handle (1-in. diam × 6-in. height) is screwed to the plunger head (2.625-diam × 0.500 in. height). The cylinder (2.627-in. i.d. × 1.213-in. height) has a wall thickness of 0.103 in.

TABLE I
Effects of Using a Cylinder and Plunger on Pooled Standard Deviations of Duplicate Determinations of Cookie Diameter

Test Bake Conditions[a]	Crop Year(s)	Nursery	Cookie Bake (no.)	Third Bake (no.)	Pooled SD of Duplicates[b] (cm)
A	1982, 1983	Advanced	395	140	0.17 a
A	1982, 1983	Uniform	496	144	0.17 a
B	1984	Advanced	74	3	0.12 b
C	1984–1987	Advanced	150	0	0.10 c
C	1984–1987	Uniform	405	3	0.10 c

[a]A = Bake tests run without using cylinder and plunger and without improved laboratory climate control. B = Bake tests run using the cylinder and plunger but without improved laboratory climate control. C = Bake tests run using the cylinder and plunger with improved laboratory climate control.

[b]Means in a column followed by the same letter are not significantly different at the $P = 0.05$ level of probability.

TABLE II
Effect of Using Light, Medium, or Heavy Pressure to Compress Cookie Dough[a]

Pressure	Two-Cookie Diameter (cm)	Two-Cookie Weight (g)	Weight Difference Between Two Cookies (g)	Top Grain Score
Light	18.3 a (+0.12)	46.4 a (+0.94)	0.3 a (+0.25)	5.8 a (+0.75)
Medium	18.3 a (+0.13)	46.7 a (+0.71)	0.3 a (+0.32)	6.2 a (+0.72)
Heavy	18.3 a (+0.14)	47.0 a (+1.07)	0.4 a (+0.26)	6.2 a (+1.34)

[a]All data are means of 10 replications. Means in a column followed by the same letter are not significantly different at the $P = 0.05$ level of probability.

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