

Note on a Simple Device for Monitoring Batter Expansion in Layer Cakes During Baking¹

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Functionality of free flour lipids in white layer cakes was demonstrated by Kissell et al (1979). Continuation of these studies showed that flour lipids are important factors in oven expansion and that volume measurements alone are not an adequate test for lipid functionality, ie, volumes of cakes that collapse provide no indication of degree of oven expansion. A simple means for objective measurement of expansion therefore seemed essential. Practical considerations dictated that the method be adaptable to routine baking and cause minimum disruption of standard procedures with negligible effects on cake volume and contour.

Although various methods have been employed for measuring batter expansion in the oven (Kissell and Yamazaki 1979, Miller and Derby 1964, Voisey et al 1979), the techniques are not generally applicable to routine baking. The device described in this report permits objective monitoring of expansion of batters baked in steel pans in a reel or rotating oven. With only minor adjustments in operation and time, it can be applied to routine sequential baking of several cakes.

MATERIALS AND METHODS

Construction Details

A strip of aluminum (approximately 1 cm × 28 cm × 0.6 mm) is bent at a 90° angle 2-3 mm from one end (Fig. 1). An alnico magnet (20 × 5 × 5 mm) is cemented in the angle with epoxy resin. After the resin has hardened, the strip is bent at 90°, flush with the top of the magnet and in an opposite direction to the the first bend. The strip is then bent in a U, back over the magnet, and finally the free end is bent at 90°, as shown in Fig. 1.

The scale is constructed of balsa wood, 1 mm (1/32 in.) × 3 mm × 8 cm. Lines are scribed at 5-mm intervals along the strip with a fine ballpoint pen, and centimeter lines are designated with numbers (1-7) placed above the lines close to the left edge of the scale. The scales are constructed most conveniently by scribing lines across a strip of wood 6-8 cm wide and 8 mm long, and then cutting strips to the desired width on a paper-cutting board.

Application

The scale is clamped to the free end of the aluminum support with a small alligator clip (Fig. 1). After the batter has been poured, the magnet is clipped to the outside of the pan so that it is held in the angle formed by the underside of the rim and the side of the pan (Fig. 1). The scale is then positioned vertically in the center of the pan, resting on the bottom. (The supports should be adjusted beforehand by attaching to empty pans and bending as necessary.) The pan is placed in the oven with the scale facing the window, and readings are made at desired intervals. To simplify calculations,

intervals should be timed with a timer that reads to 0.1 min (eg, Lab-Line model 1445, Lab-Line Instruments, Inc., Melrose Park, IL). The reel oven in this laboratory operates at about 2 rpm, permitting readings at minimum intervals of 0.4-0.5 min, with some variation resulting from stoppage of the oven for addition and removal of cakes.

RESULTS AND DISCUSSION

A cake with the device in position is shown in Fig. 2. (Usually a numbered slip of cardboard is clipped under the scale, as shown.) The slight depression that forms in the top of the cake around the scale has negligible effect on the overall contour. More than 50 bakes have been conducted in duplicate, with one duplicate in each bake containing a scale. Volume differences between the duplicates have never exceeded the normal variation between duplicates baked without the scale (least significant difference for control flour, < 25 cc). Typical plots of height vs oven time are shown in Fig. 3.

Among various materials used for construction of scales, balsa wood has proved to be the most suitable. It is rigid, of low density,

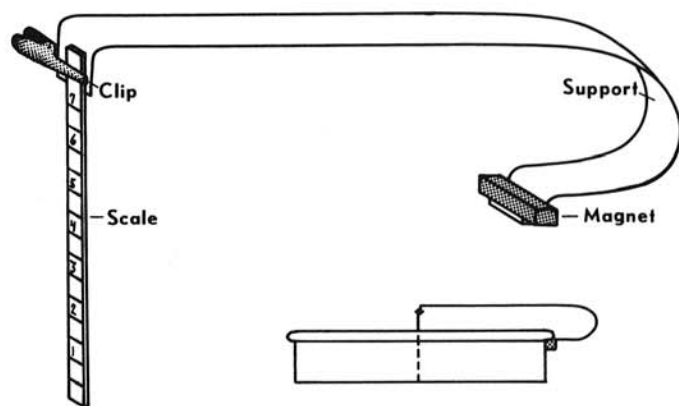


Fig. 1. Details of device for monitoring cake volume during baking, showing aluminum support, magnet for attachment to pan, and balsa wood scale held with alligator clip. Inset diagram shows attachment to pan.

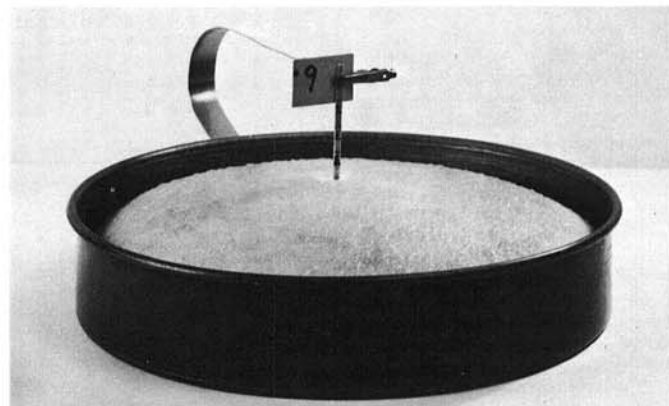


Fig. 2. Measuring device in position after removal of cake from oven, showing numbered cardboard clipped under scale to aid in identification during baking.

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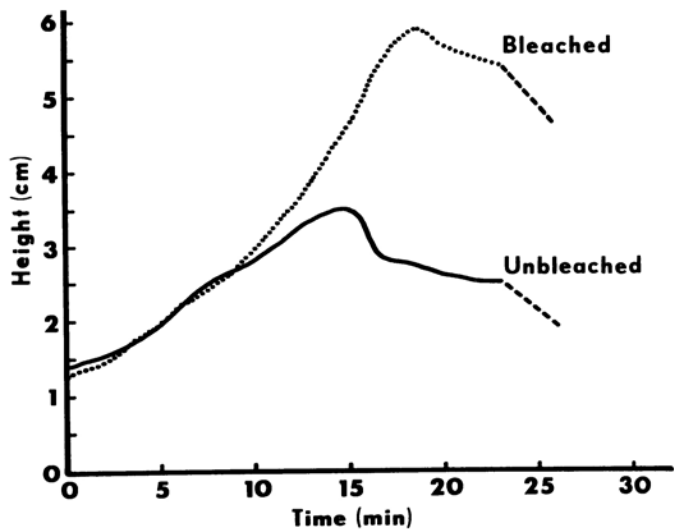


Fig. 3. Typical curves obtained with monitoring device (read at approximately 0.5-min intervals). — = unbleached patent flour (Logan), ... = same flour after chlorination, ---- = loss in height after removal from oven.

and available in thin stock. Scales are normally discarded after use. However, if indelible ink is used, scales can be washed, bleached with household bleach, dried, and reused. If several cakes are baked in sequence, having a number of supports on hand minimizes interruptions and delays. If desired, supports can be shaped to position the scale other than in the center of the pan.

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