NOTE ON DETERMINATION OF GAS PRODUCTION[1]

M. D. SHOGREN[2], K. F. FINNEY[2], and G. L. RUBENTHALER[3] Cereal Chem. 54(3): 665-668

Gas production is a relatively simple but basic test for measuring yeast potency (1), or for indicating the presence of yeast-inhibiting or -stimulating materials in wheat-flour systems (2,3). Determination of gas production in a yeast-fermented dough may be affected by errors associated with evaporation, loss of material during mixing of dough, and, particularly, with the limited or variable availability of nutrients in nonoptimized systems. Our concern for minimizing such errors led to the development of a method for determining gas production which has been used successfully for several years in the Hard Winter Wheat Quality Laboratory (3,4).

MATERIALS AND METHODS

A blend of straight-grade flours milled from many hard winter wheats harvested throughout the Great Plains of the U.S. was used and contained 12.8% protein (14% mb).

Gassing power was determined with pressure meters equipped with pressure gauges (National Manufacturing Co.).

The unbleached, unmalted flour (10 g on a 14% mb) was weighed into a glass insert (250-ml beaker cut to fit meter bowl). Other ingredients added were 0.4 g nonfat dry milk (NFDM), 0.6 g sugar, 0.15 g salt, 0.025 g malt (about 50 α-amylase DU/g, 20°C), 0.2 mg potassium bromate, 0.225 to 0.3 g compressed yeast, and 3.5 to 20 ml water. The materials were mixed with a glass stirring rod which remained in the glass insert within the meter bowl during fermentation.

Yeast suspension was added last, and the meter was zeroed exactly 1.5 min after the yeast suspension began to leave the pipet. Doughs were fermented at 30°C for 5 hr.

Doughs containing 2.75% yeast were mixed with 35, 45, 55, 63.5, 73.5, 100, and 200% water. Also, doughs containing 2-1/4, 2-3/8, 2-1/2, 2-5/8, 2-3/4, 2-7/8, and 3% yeast were mixed with 100% water. Meter readings were taken after 2, 3, 4, and 5 hr of fermentation.

RESULTS AND DISCUSSION

Gassing power (mm Hg) was plotted against percentage water (Fig. 1). Each curve was extrapolated to zero gassing at 0% water. Baking absorption of the flour was 63.5%, the gassing power value for which fell on the steep part of each curve. At 2 hr, about 2.5 gassing power units were equivalent to 1% water and at 5 hr, about 9 gassing power units were equivalent to 1% water (63.5% absorption).

[1]Mention of specific instruments or trade names is made for identification purposes only and does not imply any endorsement by the U.S. government.

[2]Respectively: Research Food Technologist and Research Chemist, U.S. Grain Marketing Research Center, USDA, ARS, North Central Region, Manhattan, KS 66502.

[3]Present address: Research Food Technologist, Western Wheat Quality Laboratory, USDA, ARS, Western Region, Washington State Univ., Pullman, WA 99163.

As water increased within each fermentation time, gassing power increased and reached a constant maximum at 100% absorption.

The rapid increase in gas production with increasing water up to 100% and the small increase above 100% might be explained in terms of the availability of yeast nutrients. Some water is obviously necessary for bringing nutrients and yeast into intimate contact. As more water is available but still limiting, the rate at which nutrients are made available and utilized should increase, and fermentation rate should increase. A level of 100% water apparently produced optimum fluidity, and additional water did not further increase availability of fermentable products to yeast.

The ability of the method to enable further detection of differences in gas production was demonstrated by various yeast concentrations in increments of 1/8% (Fig. 2). The average increase in gassing power for 1/8% yeast was about 11, 15, 18, and 22 mm Hg at 2, 3, 4, and 5 hr, respectively.

The gas production test, with a breadmaking formula, has been used in the Hard Winter Wheat Quality Laboratory since about 1940 to test and standardize yeast in test baking, to study the effect of heavy metals on gas production during breadmaking (2), and to detect the extent to which flour-fractionating-reconstituting techniques or flour fractions have impaired or contributed to gas production (3,4).

The AACC official method of testing yeast was designed primarily to test the diastatic activity of a flour, because the test formula included only flour, water, and yeast. Thus, the method did not subject yeast to the relatively high and

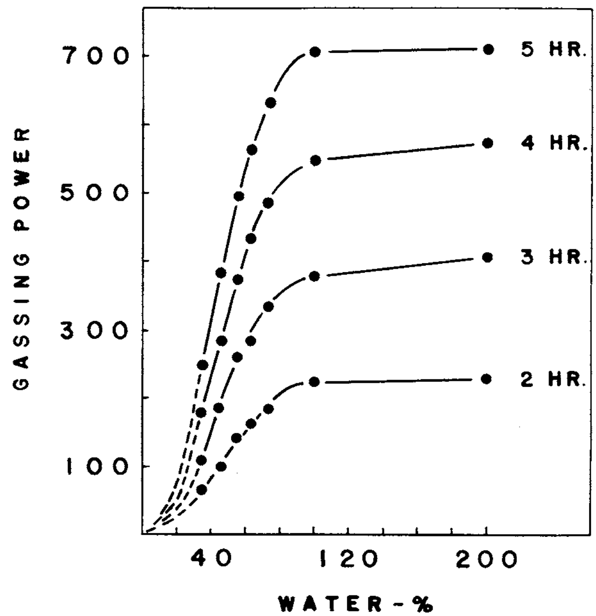

Fig. 1. Gassing power (mm Hg) *vs.* percentage water when 2.75% yeast was used and fermentation periods were 2, 3, 4, and 5 hr.

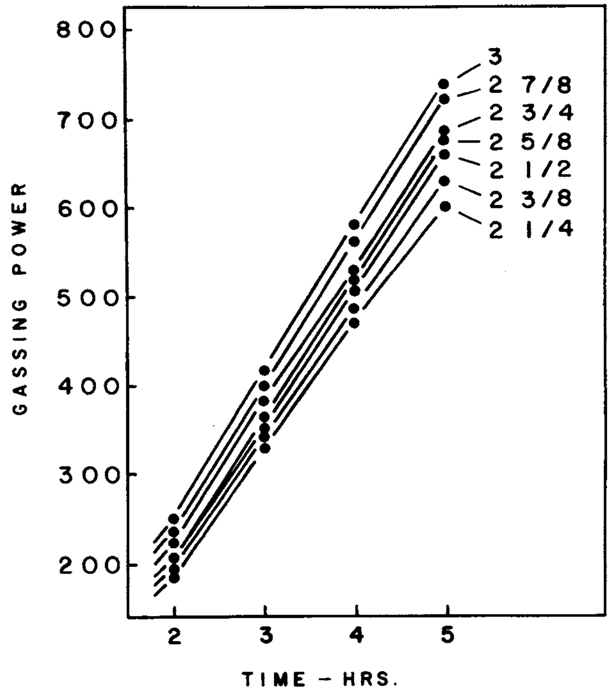

Fig. 2. Gassing power (mm Hg) *vs*. fermentation time when 100% water was used with 2-1/4, 2-3/8, 2-1/2, 2-5/8, 2-3/4, 2-7/8, and 3% yeast.

prolonged gas production rate encountered during breadmaking with sugar in the formula.

When the gassing test formula contained the usual breadmaking ingredients, there was assurance that yeast activity was a function of the effects of each ingredient, such as sugar and salt, as well as the effect of interaction between ingredients. Most importantly, gas production with a typical breadmaking formula was related directly to breadmaking studies (5,6).

Some gas production studies cited above were made with amounts of water equal to the breadmaking absorption required by each flour for uniform dough consistency. The 100% absorption method, however, was preferred in studies where increased differentiation and maximum gas production values were desired (3,4).

We have found that certain breadmaking ingredients (shortening, NFDM, malt, and oxidizers) of our gassing test formula could be omitted without materially affecting gassing values in studies related to breadmaking with sugar in the formula. In sugar-free breadmaking formulas (no added sugar), however, an appropriate quantity of malted flour (depending on fermentation time and yeast concentration) would replace sugar in the gassing test formula. For simplicity and to save time, an adequate gassing test formula should contain at least flour, water, salt, yeast, and sugar or malted flour.

Literature Cited

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