# AACC APPROVED METHODS
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# APPROVED METHODS
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# YEAST ACTIVITY, $CO_2$ PRODUCTION

Proposed 11-4-87

## Definition

The yeast activity test dets rate of $CO_2$ production of yeast in straight-dough, sweet-dough, and lean-dough systems. Yeasts considered are commercial materials: compressed yeast (CY) with 30% solids, active dry yeast (ADY) with 92% solids, and instant active dry yeast (IDY) with 95% solids.

Dough formulations are calcd so that equal wts of straight doughs, sweet doughs, and lean doughs contain equal wts of yeast solids. This permits ready comparison of gassing activity among various yeasts (on equiv solids basis) and also among different dough systems.

Actual wt of dough is not prescribed in the following tests, because different mixers may be used. Amt of dough piece used in any of the gas-measuring instruments must be exactly the same within each lab, altho it may differ between labs.

Results are expressed as ml $CO_2$ (at std barometric pressure) per hr per g yeast solids.

## Scope

Applicable to evaluating $CO_2$ production for CY and ADY with one procedure and for IDY with a different procedure. For each of these two yeast groups, formulas are given for three different dough systems: 1) sweet dough system with high sugar level of ca 20%, 2) straight dough system typical of a white bread system contg ca 8% sugar, and 3) lean dough system with no added sugar, typical of Italian or French bread system. Table I gives amts of yeast for each system.

**TABLE I**
**Yeast Amounts in Yeast Activity Tests**

| Dough System | Yeast[a] | Weight of Dough Piece (g) | Weight of Yeast (g) | Weight of Yeast Solids (g) | Weight of Yeast Solids per 100 g Dough (g) |
|---|---|---|---|---|---|
| Straight dough | CY | 731 | 8.56 | 2.57 | 0.3509 |
| | ADY | 731 | 2.79 | 2.57 | 0.3509 |
| Sweet dough | CY | 739 | 8.48 | 2.54 | 0.3509 |
| | ADY | 739 | 2.82 | 2.59 | 0.3509 |
| Lean dough | CY | 687.5 | 8.05 | 2.42 | 0.3509 |
| | ADY | 687.5 | 2.62 | 2.41 | 0.3509 |
| Straight dough | IDY | 731 | 2.7 | 2.565 | 0.3509 |
| Sweet dough | IDY | 739 | 2.73 | 2.593 | 0.3509 |
| Lean dough | IDY | 687.5 | 2.54 | 2.413 | 0.3509 |

[a]CY = compressed yeast, ADY = active dry yeast, IDY = instant active dry yeast.

## Yeast Activity, $CO_2$ Production (continued)

### Apparatus

1. Any suitable instrument for measuring vol of $CO_2$ evolved during a dough fermentation. Possible instruments include:
   a. Gasograph (a discontinued version of the Risograph)
   b. National pressure meter (National Mfg., Div. of TMCO, Inc., Lincoln, NE).
   c. Risograph (RDesign, Pullman, WA).
   d. SJA fermentograph (Nassjo Metallverkstad, Nassjo, Sweden).
2. Any suitable dough mixer (e.g., Hobart mixer) with water jacket for temp control.
3. Water bath or incubator (43°, 110° F) for rehydrating yeast.
4. Water bath for $CO_2$ measuring device.

For Compressed and Active Dry Yeasts

### Formulas

| | *Sweet Dough System* | | *Straight Dough System* | | *Lean Dough System* | |
|---|---|---|---|---|---|---|
| *Ingredients* | *CY* | *ADY* | *CY* | *ADY* | *CY* | *ADY* |
| Flour, bread type | 400 g | 400 g | 400 g | 400 g | 400 g | 400 g |
| Sugar, baker's sucrose | 80 g | 80 g | 32 g | 32 g | ... | ... |
| Salt, baker's | 8 g | 8 g | 8 g | 8 g | 8 g | 8 g |
| Nonfat dry milk, baker's | 16 g | 16 g | 16 g | 16 g | ... | ... |
| Shortening, Crisco or equiv | 12 g | 12 g | 12 g | 12 g | 12 g | 12 g |
| Yeast | 8.09 g | 2.73 g | 8 g | 2.7 g | 7.52 g | 2.45 g |
| Water (see Note 1) | 215 ml | 220 ml | 255 ml | 260 ml | 260 ml | 265 ml |

Adjust dough wt to permit easy handling for internal vol of $CO_2$ measuring device. Do not change ratio of individual ingredients. (See note 2.)

### Procedure

*Pretreatment of yeast*

CY: Five (5) min before mixing, crumble yeast (accurately weighed to nearest 0.01 g) into 250-ml beaker and soak in approx 100 ml of total water used for making dough.

ADY: Warm to room temp for at least 30 min before use. Add 25 ml of a 3% sugar soln at 43° (110° F) to 250-ml beaker (beaker at room temp). Accurately weigh dry yeast to nearest 0.01 g and add to sugar soln with initial mild hand stirring. Rehydrate at 43° (110° F) for 10 min with sufficient stirring to obtain uniform suspension of yeast.

*Mixing of dough*

1. Weigh out all dry ingredients except yeast and place into mixer bowl. Make sure temp circulator is set to desired temp (about 30° [86° F]) to bring

## Yeast Activity, $CO_2$ Production (continued)

dough out at 30° (86° F).

2. Add yeast suspension to mixer bowl. Use remainder of dough water to rinse in yeast. (For ADY, subtract 25 ml from total dough water to compensate for 25 ml sugar soln used to rehydrate yeast.) Mix dough to full development. Bring dough out of mixer at 30° (86° F) by adjusting circulator to obtain that temp. Give dough 5-min bench rest while measuring temp.

*Determination of gas production*

1. Place suitable-sized dough piece into each chamber of $CO_2$ measuring device. Permit 5-min period for temp equilibration. Then start $CO_2$ measurement (temp of water batch at 30° [86° F]). Measure $CO_2$ evolution over 90-min period.

2. Report total vol of $CO_2$ evolved per hr per g of yeast solids. If a pressure meter is used, values must be converted to vol of $CO_2$ at std barometric pressure.

## For Instant Active Dry Yeast

### Formulas

| *Ingredients* | *Sweet Dough System* | *Straight Dough System* | *Lean Dough System* |
|---|---|---|---|
| Flour, bread type | 400 g | 400 g | 400 g |
| Sugar, baker's sucrose | 80 g | 32 g | ... |
| Salt, baker's | 8 g | 8 g | 8 g |
| Nonfat dry milk, baker's | 16 g | 16 g | ... |
| Shortening, Crisco or equiv | 12 g | 12 g | 12 g |
| Yeast, IDY | 2.73 g | 2.7 g | 2.54 g |
| Water | 220 ml | 260 ml | 265 ml |

Adjust dough wt to permit easy handling for internal vol of $CO_2$ measuring device. Do not change ratio of individual ingredients.

### Procedure

*Pretreatment of yeast*

Permit yeast to reach room temp at least 30 min before use. Accurately weigh IDY to nearest 0.01 g into small weighing boat.

*Mixing of dough*

Weigh out all dry ingredients except yeast and place into mixer bowl, adding yeast last. Mix dry ingredients thoroly with spatula. Then add dough water. Mix dough to full development. Bring dough out of mixer at 30° (86° F). Give dough 5-min bench rest while measuring temp.

## Yeast Activity, $CO_2$ Production (continued)

*Determination of gas production*

1. Place suitable-sized dough piece into each chamber of $CO_2$ measuring device. Permit 5-min period for temp equilibration. Then start $CO_2$ measurement (temp of water batch at 30° [86° F]). Measure $CO_2$ evolution over 90-min period.

2. Report total vol of $CO_2$ evolved per hr per g of yeast solids. If a pressure meter is used, values must be converted to vol of $CO_2$ at std barometric pressure.

### Notes

1. Use 100 ml for 5-min bench time for CY rehydration. Use 25 ml for ADY rehydration.

2. Check dough with physical dough test: farinograph, 58–62%; mixograph, 8 min.

# RESIDUAL CARBON DIOXIDE IN BAKING POWDER

Final approval 5-5-60; reviewed 10-8-76 and 10-27-82; revised 11-4-87

## Apparatus

Chittick carbon dioxide app (Fig. 1), consisting of mounted gas-measuring buret, *D*, graduated from −25 ml to +200 ml in 1-ml divisions and numbered at 10-ml intervals; and 300-ml leveling bulb, *E*, mounted on carriage sliding on metal guides. A 250-ml wide-mouthed Pyrex decomposition flask, *A*, is connected to system by means of 2-hole stopper, thru one hole of which passes extended tip of 25-ml acid-dispensing buret, *F*. *A* and *F* are suspended flexibly by means of rubber tubing to conveyor tube, *B*, which is provided with three-way stopcock, *C*, to allow equalization of pressure in system. (Available from Sargent-Welch, 7300 North Linder, Skokie, IL 60077.)

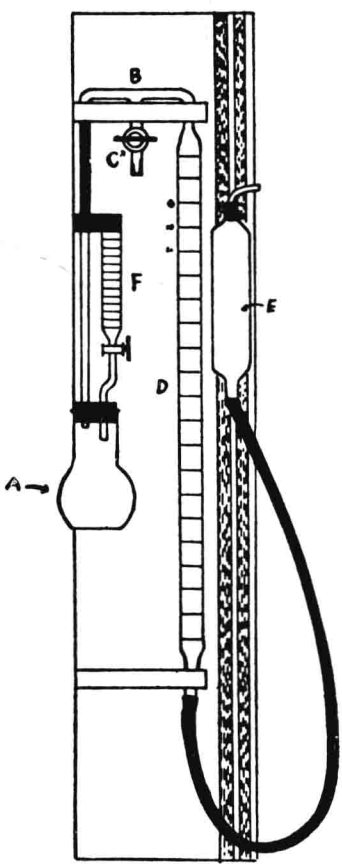


Fig. 1. Chittick carbon dioxide apparatus.

## Residual Carbon Dioxide in Baking Powder (continued)

### Reagents

1. $H_2SO_4$, reagent grade (1 + 5), or HCl, reagent grade (1 + 2).
2. Displacement soln. Dissolve 100 g NaCl in 350 ml water. Add ca 1 g $NaHCO_3$, 2 ml 0.1% methyl orange soln, and just enough $H_2SO_4$ (1 + 5) to make acid (decided pink color). Stir until all $CO_2$ is removed.

### Procedure

*Preparation of sample*

1. Water bath method
   a. Place 1.7 g baking powder in clean, dry, 250-ml wide-mouthed Soxhlet extn flask normally used with Chittick app (*A* in Fig. 1). Add 20 ml water. Put flask on cover of water bath (single or multiple) in which boiling water is kept at const level of 2 in. below top of bath. (Water in bath must be boiling vigorously all thru detn. Opening in cover of bath must be 3 in. diam to prevent flask from touching water.)
   b. Evap contents of flask until there is no visible evidence of moisture in residue or inside surface of flask. (Sample should be completely dry in 1.5–2 hr.) Leave flask on water bath 2 hr. Add 10 ml water and let stand until flask is at room temp (ca 1 hr).
2. Oven method
   a. Place 1.7 g of sample in clean, dry flask (*A* in Fig. 1). Tap flask to spread sample evenly on bottom.
   b. Add 10 ml water with pipet. Stir with glass rod to break up powder that may have caked on bottom of flask. Wash down stirring rod and sides of flask with 10 ml water.
   c. Place flask in air-drying oven set to maintain temp of 100 ± 2°, on shelf near center of oven, and evap to dryness. After 5 hr remove from oven, add 10 ml water, and cool to same temp as air surrounding Chittick app.

*Determination*

1. Attach extn flask *A* (Fig. 1) to Chittick app. Open stopcock *C* and by means of leveling bulb *E* bring displacement soln to 10-ml graduation above zero mark. (This 10 ml is practically equal in vol to that of acid to be used in decomposition.) Let app stand 1–2 min to ensure that temp and pressure within app are same as those of room.
2. Close stopcock, lower leveling bulb somewhat to reduce pressure within app, and slowly run into decomposition flask from buret *F* 10 ml of $H_2SO_4$ (1 + 5) or HCl (1 + 2).
3. To prevent liberated $CO_2$ from escaping thru acid buret into air, keep

## Residual Carbon Dioxide in Baking Powder (continued)

displacement soln in leveling bulb at all times during decomposition at lower level than that in gas-measuring tube.

4. A magnetic stirrer may be used as alternate means of achieving equil. Add plastic-covered stirring bar to flask before connecting flask to app. Place heat insulator (such as aluminum foil-wrapped asbestos) between flask and stirrer. Add acid and manually shake flask to disperse and wet sample. Then turn on stirrer and let stir vigorously for 10 min to secure equil.

5. Rotate and then vigorously agitate decomposition flask to secure intimate mixt of contents. Let stand 5 min to secure equil.

6. Equalize pressure in measuring the tube by means of leveling bulb and read vol of gas in tube. Observe temp of air surrounding app and also barometric pressure.

### Calculation

Multiply ml of gas evolved by factor given in Table in Method **12-29**, corresponding to actual temp and pressure. This corrd reading divided by 10 equals % $CO_2$ by wt.

### Reference

Association of Official Analytical Chemists. 1984. Official Methods of Analysis, 14th ed. Sec. 8.002-8.005, p. 170.

# AGTRON COLOR TEST FOR FLOUR

First approval 10-24-74; revised 10-27-82 and 11-4-87

## Definition

This method dets flour color as contributed by sources other than carotenoid pigments.

## Scope

Applicable to flour, including durum flour.

## Apparatus

1. Model M40, M-45, M-400-A, M-500-A, or M-600-S Agtron set on green mode for measuring 546-nm wavelength.
2. Agtron sample cups.
3. Agtron certified calibration disks "63" and "85."
4. Automatic pipet—automatic dispenser with 25-ml reservoir.
5. Timer to indicate min and sec.
6. Lens paper.
7. Glass stirring rod 4 mm in diam and approx 13 cm long fitted with 11-mm pure gum semitransparent rubber policeman.

## Reagent

Distd water.

## Procedure

1. Turn on Agtron power and leave on constantly to ensure meter stability (24-hr stabilization time is recommended if power has been turned off).
2. Wipe surfaces of sample cups and sample well with lens paper. Glass bottoms of sample cups are soft glass and should be handled carefully to prevent scratches.
3. In clean sample cup, weigh to 14.0% mb 20 g flour to be tested (see Method **82-24**).
4. Add 25 ml distd water using automatic pipet.
5. Mix flour-water mixt, using stirring rod with rubber policeman, with smooth, circular motion for 2 min. Mixing is sufficient when flour-water slurry becomes smooth and uniform with no lumps or dry flour in recesses of sample cup. During mixing use tip of policeman to dislodge dry flour from junction of wall and bottom of cup.
6. Set slurry aside in dust-free area to stand for 5 min after mixing is complete or until total elapsed time of 7 min from addn of water.
7. During 5-min standing time, calibrate Agtron by placing certified disk "63" in sample well and adjusting meter, using zero dial, to read the certified value indicated on back of disk (e.g., "63" disk at 4.5).

## Agtron Color Test for Flour (continued)

8. Place certified disk "85" in sample well and adjust meter to read the certified value on back of disk (e.g., "85" disk at 94.0).

9. Continue checking with "63" and "85" disks until reading remains const.

10. Place sample that has stood for 5 min in sample well and record Agtron reading to nearest one-half unit. Take reading as soon as needle stabilizes.

11. Recheck calibration setting with certified disks before reading each sample.

### Notes

1. Extreme care must be taken to ensure that sample cup is clean and that reflectance surface is not scratched as these will give lower values.

2. Be sure amts (water and flour 14% mb) are correct. Improper consistency or nonuniformity of slurry will give false values.

3. Leave sample well for receiving sample cup in instrument at all times as temp influences values.

4. Calibration disks should not be allowed to heat up, since prolonged heating and exposure to strong ambient light will discolor disks; therefore do not leave them on top of instrument.

5. Because enzymatic action may be increased by wetting flour, adhere strictly to time schedule for mixing and reading values.

6. Contact Filper Magnuson, Inc., to obtain special certified flour disks.

### References

1. Murthy, P. R., and Dietz, J. H. 1974. Agtron evaluation of cereal flour. Cereal Chem. 51:126.
2. Patton, J., and Dishaw, M. A. 1968. Flour color evaluation with the green Agtron. Cereal Sci. Today 13:4.
3. Shuey, W. C., and Skarsaune, S. K. 1973. The relation between flour mineral content and flour color reflectance values. Cereal Sci. Today 18:229.
4. Skarsaune, S. K., and Shuey, W. C. 1975. The effect of several variables on instrumental flour color. Cereal Foods World 20:286.

# WHEAT HARDNESS AS DETERMINED BY NEAR-INFRARED REFLECTANCE

First approval 10-8-86; revised 11-4-87

## Definition

Near-infrared reflectance (NIR) spectroscopy provides a rapid measurement of certain compositional factors of a ground sample of grain. Reflectance signal is affected by particle size (near-infrared absorption increases with increase in particle size), and particle size of ground wheat increases with hardness. Therefore, NIR can be used to indicate hardness of wheat as well as other factors relating to composition.

## Scope

Applicable to all classes of wheat.

## Apparatus

1. Sample mill, cyclone (Udy Corp., 201 Rome Court, Fort Collins, CO 80524).
2. NIR instrumentation capable of precise measurement of reflectance of ground wheat at 1680 nm and 2230 nm.

Available instruments include:

a. Model GAC III, Dickey-john Corp. (Box 10, Auburn, IL 62615).
b. Model 400, Technicon Industrial Systems (511 Benedict Ave., Tarrytown, NY 10591).
c. Model 51A, Pacific Scientific, Gardner/Neotec Instrument Division (2431 Linden Lane, Silver Spring, MD 20910).
d. Model 8120, Near Infrared Specialities (110 S. Alpine, Suite 107A, Rockford, IL 61108).
e. Scanning monochromators such as: (1) model 6250 of Pacific Scientific, (2) model 500 of Technicon Industrial Systems, (3) model 70 of Trebor Industries, Inc. (P.O. Box 2159, Gaithersburg, MD 27060), (4) model 1200 of L. T. Industries (6110 Executive Blvd., Rockville, MD 20852).

## Standard Samples

Std samples: five samples of hard and five samples of soft wheat, certified as std test samples for hardness, from Federal Grain Inspection Service (USDA, 10383 North Executive Hills Blvd., P.O. Box 20285, Kansas City, MO 64195). Store samples at 2–5° in sealed containers; warm to room temp for testing.

## Procedure

*Preparation of test sample*

Remove foreign material from sample before grinding. Foreign material is material other than wheat. Sample may be cleaned by use of Carter-Day

## Wheat Hardness as Determined by Near-Infrared Reflectance (continued)

dockage tester or by hand sieving. Take material passing thru 12/64-in. round hole sieve and remaining over 1/12-in. round hole sieve. Aspirate off, or remove by handpicking, any remaining chaff or light material.

*Standardization of grinder and NIR instrument*

1. Following manufacturer's instructions, insert the following calibration consts into all NIR instruments listed in **Apparatus** except the Dickey-john instrument:

$K_0 = -243.0$
$K_1$ (1680 nm) $= -1098.9$
$K_2$ (2230 nm) $= 1474.8$.

Insert the following calibration consts into the Dickey-john instrument:

$K_0 = -243.0$
$K_1$ (1680 nm) $= -2.6464$
$K_2$ (2230 nm) $= 3.5517$.

2. Draw representative samples of approx 15 g from each of the 10 std samples. Grind each of these 10 subsamples with mill (recommended feed rate for grinding is 1 g/sec).

3. Use manufacturer's recommended procedure to prep and then measure NIR signals from each of the 10 subsamples. Record hardness score for each sample as given by NIR instrument with above calibration. Compute mean hardness score for the five hard samples and for the five soft samples.

4. Compare these scores with std mean values provided by FGIS (nominally 75 and 25) and compute slope and bias adjustments needed to make mean values agree within $\pm 0.05$. Insert bias and slope adjustments into your NIR instrument, using manufacturer's instructions, to complete stdzn of your grinder and instrument.

*Method*

1. For testing, moisture content of unground sample should be between 9 and 15%.

2. Draw representative sample of approx 15 g from sample to be tested. Grind subsample with the stdzd mill, using same procedure used in stdzn step. Prep ground sample for NIR measurement as recommended by manufacturer.

3. Insert sample into instrument and record hardness reading. Retain two significant figures in measurement.

### Reference

Williams, P. C., and Sobering, D. C. 1986. Attempts at standardization of hardness testing of wheat. II. The near-infrared reflectance method. Cereal Foods World 31:417.