Method for Sponge and Dough Bread Baking

<table>
<thead>
<tr>
<th>Method Owner(s)</th>
<th>Approval date</th>
</tr>
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<tbody>
<tr>
<td>Program Manager of Bread and Durum Wheat Research</td>
<td>2016-09-02</td>
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</tbody>
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1.0 Scope and Field of Application

This method is applicable to experimentally or commercially milled, untreated wheat flour for the production of yeast-raised bread. It provides a test of the baking performance of flours under the conditions of high speed mixing, long fermentation and typical formulation used by plant bakeries in Japan.

2.0 Principle

The sponge-and-dough test baking method is carried out as described by Kilborn and Tipples (1968) and modified by Preston and Kilborn (1981). Dough is mixed in a Swanson type 200 gram pin mixer (National Manufacturing Co., Lincoln NE) at 90 rpm. Loaves are produced from 200 grams of flour in baking pans with cross-sectional dimensions similar to Canadian commercial baking pans. Loaf volume is reported on a 100-gram flour basis. Mixing energy is reported in watt-hours per kilogram (W-h/kg) of dough.

3.0 References


4.0 Materials

4.1 Labware

4.1.1 Laboratory glassware of various types and sizes including beakers, graduated cylinders, reagent bottles and volumetric flasks
4.1.2 Bottle top dispensers – Dispensette with variable volume; 0.5-5 mL, 1-10 mL and 5-50 mL
4.1.3 Metal tins, 250 mL, with lids
4.1.4 Magnetic stir bars
4.1.5 Timer
4.1.6 Table clock
4.1.7 Thermometer/Hygrometer combo

4.2 Equipment and Apparatus

4.2.1 Circulating water bath (Fisher Scientific)
4.2.2 Pin-type mixer (National Mfg. Co.)
4.2.3 Warming/resting cabinet (GRL)
4.2.4 Sheeter (GRL)
4.2.5 Moulder (GRL)
4.2.6 Fermentation cabinets (National Mfg. Co.), one set to 27.0°C (78% RH) and a second set to 38.0°C (85% RH)
4.2.7 Electric reel oven (National Mfg. Co.)
4.2.8 Proof height gauge
4.2.9 Cooling rack
4.2.10 Electronic balances
4.2.11 Thermometer
4.2.12 Stir plate
4.2.13 Baking crocks with lids
4.2.14 Loaf pans for 200g loaves. Approximate pan dimensions currently being used:

<table>
<thead>
<tr>
<th>GRL in-house pans (Volume: 1,120 ml)</th>
</tr>
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<tbody>
<tr>
<td>Pan Dimensions in centimeters</td>
</tr>
<tr>
<td>Top Outside</td>
</tr>
<tr>
<td>Top Inside</td>
</tr>
<tr>
<td>Bottom Outside</td>
</tr>
<tr>
<td>Bottom Inside</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pan Dimensions in inches</th>
<th>Length</th>
<th>Width</th>
<th>Depth</th>
</tr>
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<tbody>
<tr>
<td>Top Outside</td>
<td>7</td>
<td>4 7/8</td>
<td>2 7/8</td>
</tr>
<tr>
<td>Top Inside</td>
<td>6 5/8</td>
<td>4 3/8</td>
<td></td>
</tr>
<tr>
<td>Bottom Outside</td>
<td>5 5/8</td>
<td>3 5/8</td>
<td>2 3/4</td>
</tr>
<tr>
<td>Bottom Inside</td>
<td>5 1/4</td>
<td>3 3/8</td>
<td></td>
</tr>
</tbody>
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5.0 Formula and Ingredients

5.1 Formulation (% of total flour weight, i.e. baker’s percent)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Sponge</th>
<th>Dough</th>
<th>Total</th>
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<tbody>
<tr>
<td>Flour</td>
<td>70.0</td>
<td>30.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Yeast</td>
<td>2.2</td>
<td>-</td>
<td>2.2</td>
</tr>
<tr>
<td>Salt</td>
<td>0.1</td>
<td>1.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Sugar</td>
<td>-</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Ammonium phosphate</td>
<td>0.1</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Shortening</td>
<td>-</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Nonfat dry milk</td>
<td>-</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Malt (60°L)</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>40 ppm</td>
<td>-</td>
<td>40 ppm</td>
</tr>
</tbody>
</table>
5.2 Ingredients

5.2.1 Yeast, compressed, commercial
5.2.2 Salt, non-iodized fine sodium chloride, commercial grade
5.2.3 Sucrose, fine granulated, commercial grade
5.2.4 Ammonium phosphate, monobasic, reagent grade
5.2.5 Ascorbic acid, reagent grade
5.2.6 Malt syrup
5.2.7 NFDM, Skim milk powder
5.2.8 Flour
5.2.9 Distilled water, reverse osmosis

6.0 Solutions

6.1 Yeast suspension (2.2% of flour weight)
*Note: Prepare a fresh solution every time you bake.*

6.1.1 Weigh 52 g of freshly crumbled yeast and add about 150 mL distilled water.
6.1.2 Stir to make a suspension.
6.1.3 Bring to 250 mL with distilled water in a volumetric flask.
6.1.4 Transfer the solution with a magnetic stirrer to a 1 L dispensing bottle fitted with a 50-mL variable pump dispenser set and calibrated to dispense 25 mL.
6.1.5 Keep stirring the solution until the required volume for each sample has been dispensed.

6.2 Salt (18.8% w/v) solution (2% of flour weight)

6.2.1 Weigh 93.8 salt into a beaker and add about 250 mL distilled water.
6.2.2 Stir until dissolved.
6.2.3 Bring the solution to 500 mL with distilled water in a volumetric flask.
6.2.4 Store for up to one week in a 1 L dispensing bottle fitted with a 5 mL variable pump dispenser set calibrated to dispense 1.3 mL to the sponge.
6.2.5 After the sponge stage, change to a 50 mL variable pump dispenser set calibrated to dispense 20 mL to the dough.

6.3 Sugar (50% w/v) solution

6.3.1 Weigh 250 g sugar into a beaker and add about 400 mL distilled water.
6.3.2 Stir until dissolved.
6.3.3 Bring the solution to 500 mL with distilled water in a volumetric flask.
6.3.4 Store for up to one week in a 1 L dispensing bottle fitted with a 50 mL variable pump dispenser set and calibrated to dispense 20 mL to the dough.

6.4 Ammonium phosphate solution (10% w/v or 0.1% of flour weight)

6.4.1 Weigh 25 g ammonium phosphate into a beaker and add about 150 mL distilled water.
6.4.2 Stir until dissolved.
6.4.3 Bring to 250 mL with distilled water in a volumetric flask.
6.4.4 Store for up to 1 month in a 250-mL dispensing bottle fitted with a 5-mL variable pump dispenser set and calibrated to dispense 2 mL.

6.5 Malt stock solution
6.5.1 Weigh appropriate amount\(^1\) of malt and add about 100 mL distilled water.
6.5.2 Stir well to obtain a uniform consistency.
6.5.3 Bring to 200 mL with distilled water in a volumetric flask.
6.5.4 Transfer to a 250 mL reagent bottle.
6.5.5 Store at 4°C for up to one week.

6.6 Malt baking solution (0.3% of flour weight)
6.6.1 Gently shake the bottle of stock solution (6.5) before preparing the baking solution.
6.6.2 Using a 25-mL graduated cylinder, measure 20 mL of stock solution into a beaker.
6.6.3 Add 40 mL of distilled water and stir well.
6.6.4 Store the malt baking solution for up to one week in a 250-mL dispenser bottle. Use Eppendorf® pipette with 2.5 mL Eppendorf tip, calibrated to dispense 2 mL to the sponge and 1 mL to the dough.

6.7 Ascorbic acid solution (40 ppm of flour weight)
Note: Prepare this solution every time you bake.

6.7.1 Weigh 0.40 g ascorbic acid and add about 70 mL distilled water.
6.7.2 Stir until dissolved.
6.7.3 Bring to 100 mL with distilled water in a volumetric flask.
6.7.4 Store the solution in a 100-mL dark dispenser bottle (to protect from light) fitted with a 5-mL variable pump dispenser set and calibrated to dispense 2 mL.

7 Procedure

7.1 Equipment and Labware Set-up

Note: Set up equipment 45 to 60 mins before starting. Throughout the procedure, verify that all equipment is running properly.

7.1.1 Turn on the water bath, set at 25°C to circulate through mixing bowl jacket.
7.1.2 Remove the mixing bowl from the mixer.
7.1.3 Turn the mixer on and allow the mixer to run (90 rpm) to warm up and equilibrate for calibration.
7.1.4 Set up the P2M software.
7.1.5 Turn on the warming (resting) cabinet, set to 30°C (no humidity control).

\(^1\) If using syrup, the amount of malt is determined such that 0.5 mL of the solution prepared in step 6.5 above brought to 450 mL distilled water and added to 50g wheat starch produces an amyllograph peak viscosity of 100 BU. If using a dry malt product, dispense dry or in solution to 0.3% flour weight basis.
7.1.6 Turn on the proofer with settings at 27°C and 78% RH, fill the water reservoir (located on top) if the level is below half.
7.1.7 Turn on the second proofer with settings at dry bulb 38°C, wet bulb 33°C (85% RH), and fill the water reservoir (located on top) if the level is below half.
7.1.8 Place in the oven one 1L metal container filled with water.
7.1.9 Turn on the oven and set to 420°F (216°C)
7.1.10 Verify if there is a need to calibrate the moulder weight and if the moulder belt requires tightening (this step can be ignored if not using a GRL moulder).
7.1.11 Grease baking pans and place inside them in the warming cabinet.

7.2 Sample Mixture Preparation

Note: Include at least one blank sample and one, preferably two, check samples for every bake. Since the check sample determines the proofing time for the samples to be tested based on the time it takes the check sample to reach a proof height of 120 mm, the check flour should be the first sample after the blank. The second check is randomly sequenced in the day’s bakes.

7.2.1 Prepare one bake record per sample. Record sample number (sample ID), bake date, bake method, moisture content (if this value is old, a new moisture content should be taken), and farinograph absorption (14% mb).
7.2.2 Use a baking schedule to track the processing time for each sample.
7.2.3 Weigh 70% of the total flour weigh (corrected to 14% moisture basis) into a 250-mL metal tin (pre-weigh all flour samples in advance before starting the first mix and place into numbered tins, each number corresponding to the sample number).
7.2.4 Cover the metal tin(s) until ready to mix.

7.3 Mixing the sponge

7.3.1 In a 600 mL beaker, weigh the amount of distilled water required for bake absorption (see Appendix 1 for factors to consider).
7.3.2 To the water, dispense 1.3 mL salt solution (6.2), 2.0 mL ammonium phosphate solution (6.4) and 2.0 mL malt baking solution (6.6). Set the beaker aside.
7.3.3 Place the dry ingredients (7.2.3) into the 200-g National mixer bowl.
7.3.4 Create a depression in the center of the dry ingredients by pushing some of the mixture to the sides of the bowl.
7.3.5 Dispense 25 mL yeast suspension (6.1) and 2.0 mL ascorbic acid solution (6.7) (this is added last because it is light sensitive) into the beaker containing the previously combined wet ingredients (7.3.2).
7.3.6 Pour the combined solutions into the depressed center of the dry ingredients in the mixer bowl.
7.3.7 Stop the mixer warm up.
7.3.8 Secure the bowl onto the mixer.
7.3.9 Start the mixer and P2M software.
7.3.10 Mix the sponge for 2.5 minutes using a timer.
7.3.11 Remove the sponge from the mixer bowl and mixer pins and place on the greased balance pan. Record sponge weight on the baking schedule.

7.3.12 Transfer the sponge into the appropriately numbered greased baking crock.

7.3.13 Put the baking crock with the sponge in the fermentation cabinet.

7.3.14 Record the time as soon as finish mixing the last sample or start mixing the blank.

_Fermentation takes 4.5 hours. Turn the mixer on one hour before fermentation is done._

### 7.4 Mixing the dough

7.4.1 Weigh 30% of the total flour weigh (corrected to 14% moisture basis), 6g shortening and 4g skim milk powder into a 250-mL metal tin (pre-weigh all flour samples in advance before starting the first mix and place into numbered tins, each number corresponding to the sample number).

7.4.2 In a 600 mL beaker, weigh the amount of distilled water required for bake absorption (see Appendix 1 for factors to consider).

7.4.3 To the water, dispense 20 mL salt solution (6.2), 20 mL sugar solution (6.3) and 1.0 mL malt baking solution (6.6). Set the beaker aside.

7.4.4 Place the dry ingredients (7.4.1) into the 200-g National mixer bowl.

7.4.5 Create a depression in the center of the dry ingredients by pushing some of the mixture to the sides of the bowl.

7.4.6 Pour the combined solutions into the depressed center of the dry ingredients in the mixer bowl and immediately add the sponge (7.3.13).

7.4.7 Stop the mixer warm up.

7.4.8 Secure the bowl onto the mixer.

7.4.9 Start the mixer and P2M software.

7.4.10 Mix the sponge and dough to 10% past peak (the P2M software will indicate this by moving the red line to peak).

7.4.11 Once the optimum peak is reached, immediately stop the mixer and P2M software.

7.4.12 Grease the baking crock (numbered according to the sample number), balance pan and your hands.

7.4.13 Remove the dough from the mixer bowl and mixer pins and place on the greased balance pan. Record dough weight and dough temperature on the baking schedule.

7.4.14 Record the dough weight in the P2M software.

7.4.15 Transfer the dough into the appropriately numbered greased baking crock and cover with a lid.

7.4.16 Put the covered baking crock with the dough in the warming cabinet and let the dough rest for 15 minutes.

_At this point, the next sample can be mixed following the baking schedule._

### 7.5 Punching

7.5.1 Remove the crock from the warming cabinet.

7.5.2 Grease your hands and remove the dough from the crock.

7.5.3 Punch the dough 7 times (gently slap against your hand and roll) then round into a ball.

7.5.4 Place the dough ball back into the crock and return to the warming cabinet for another 15 minutes.
7.6 Sheet and Moulding

7.6.1 Remove the crock from the warming cabinet.
7.6.2 Sprinkle flour onto the countertop, only if needed.
7.6.3 Remove the dough from the crock and, if needed, dust its surface by rolling it onto the flour-dusted countertop. Gently tap any excess flour off the dough.
7.6.4 With the rough edge facing toward you, sheet the dough one pass through gap #1 (set at 11/32 inch). As the dough passes through the gap, catch it as it exits from underneath.
7.6.5 Place the dough on the moulder belt and adjust the sheeter gap to #2 (set at 7/32 inch).
7.6.6 Sheet the dough one pass through gap #2. As the dough passes through gap #2, catch it as it exits from underneath.
7.6.7 Place the dough on the moulder belt and adjust sheeter gap to #3 (set at 5/32 inch).
7.6.8 Sheet the dough one pass through gap #3. As the dough passes through gap #3, catch it as it exits from underneath.
7.6.9 Place the bottom of the dough sheet so it is lying on the moulder belt closest to the roller. Gently stretch this end to make it “square” (leading edge parallel to the moulding rolls) then manually create a roll by rolling the dough edge up and towards you 3 times.
7.6.10 Lift the dough and place the rolled end into the rollers.
7.6.11 Drop the top roller onto the dough piece.
7.6.12 Start the moulder and guide the dough sheet into the rolls. The dough will mould for 30 seconds (automatic timer).

7.7 Panning

7.7.1 In a pre-warmed greased baking pan, put the appropriately numbered, full-length label face down in the bottom of the pan.
7.7.2 Remove the dough roll from the moulder and place on the countertop.
7.7.3 Manually evaluate the stickiness by touching each end with your index fingers.

   (i) If the dough sticks to your fingers but recovers to original form, the bake absorption is considered acceptable.
   (ii) If the dough is sticky and does not recover to original form, make a note to decrease the water absorption for the next bake replicate.
   (iii) If the dough does not stick to your fingers, it is considered too dry. Make a note to increase water absorption for the next bake replicate.

7.7.4 Place the dough roll into the greased baking pan so that it is pushed to one side and the seam is straight and facing down (by doing this, the break and shred on the bread will be on one side only, making it easier to evaluate).
7.7.5 In the pan, dust your fingers with flour and tuck the ends under.
7.8 Proofing

7.8.1 Place the pan with dough into the proofer and verify that thermometers and hygrometers are at 38°C and 85% RH, respectively.

7.8.2 Record the temperature and RH at regular intervals throughout the bake schedule.

7.8.3 After 65 minutes, remove the pan containing the “check” dough from the proofer.

7.8.4 Measure the height of the “check” dough:

(i) If the height after 65 minutes proofing is at 120 mm, the yeast is considered very active and proof time for all samples that day must be decreased. Then for subsequent bakes with that same yeast, decrease the amount of dry yeast by 0.3 g and proof for 70 minutes.

(ii) If the height after 65 minutes proofing has not reached 120 mm, return the check dough back to the proofer for an additional 5 minutes (total of 70 minutes).

(iii) If the height after 70 minutes proofing is still below 120 mm, the yeast is considered less active and proof time for all samples that day must be increased. Then for subsequent bakes with that same yeast, increase the amount of dry yeast by 0.3 g and proof for 70 minutes.

Note: The “check” dough is allowed to proof to a height of 120 mm after approximately 70 minutes. The proof time is recorded and used to make adjustments for all subsequent samples.

7.9 Baking

7.9.1 After 70 minutes proofing (or equivalent time to achieve 120 mm height), place the pan in the rotary oven.

7.9.2 Bake for 30 minutes at 216°C (420°F).

7.9.3 Remove the pan from the oven.

7.9.4 Remove the loaf from the pan.

7.9.5 Immediately weigh the loaf and record the weight.

7.9.6 Place the loaf on a baking rack to cool.

7.10 Loaf Evaluation

7.10.1 After one hour, measure the loaf volume using the Volscan Profiler 300 or other volume measurement device.

7.10.2 Record the loaf top ratio (LTR) using the maximum height (mm) and maximum width (mm) measurements from the Volscan Profiler 300. Calculation: LTR = (maximum height – 70) / maximum width. The number 70 is the inside depth in mm of the GRL-manufactured 200 g pans. If using a different pan, with a different inside pan depth value, adjust this calculation accordingly. LTR can also be measured using a height gauge.

7.10.3 Optional: Digital crumb images may be taken (e.g. C-Cell measurements) and when required, loaf and crumb photographs may be taken.
8 APPENDIX 1: Factors to consider in calculating bake absorption

8.1 Bake absorption = Farinograph absorption - X%; adjustments are made based on subjective assessment by the baker of the dough just before panning.
8.2 Adjust (+/-) for difference in water resulting from flour weight correction to 14% moisture basis.
8.3 Adjust for displacement of water in fresh yeast solution – calculate this displacement in-house or use the information provided in AACC International Method 10.10-03.
8.4 Adjust for displacement of water in sugar-salt solution – calculate this displacement in-house.