Production: CAKE

Objective: AIB Standard Method - Effects of Chemical Leavening Agents on Cake Texture

Investigation Purpose:
Rhodia Corporation's Phosphates, Hydrocolloids and Food Ingredients Division (Formerly Rhone-Poulenc's Food Ingredients Division) has conducted extensive testing on the effect of chemical leavening agents on the texture of baked products. Selections of Rhodia's research on yellow layer cakes is presented in this study to illustrate how the Texture Analyzer quantifies textural differences which result from different types of chemical leavening agents. Rhodia conducted Texture Profile Analysis (TPA) tests, which (i) compressed a cake sample either a fixed distance, (ii) withdrew to the original sample height as it was determined by the trigger force, (iii) allowed the sample to rest/ recover during a fixed time period, and (iv) repeated the compression to precisely the original penetration distance. Based on the product's behavior, hardness (or softness), springiness, cohesiveness, gumminess (valid only for semi-solid products), chewiness, fracturability and resilience can be quantified. This study focuses on hardness, springiness, and cohesiveness.

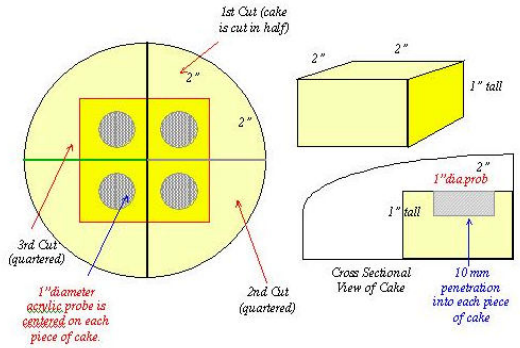
Type of action: Texture profile analysis (TPA)

Test mode setting:

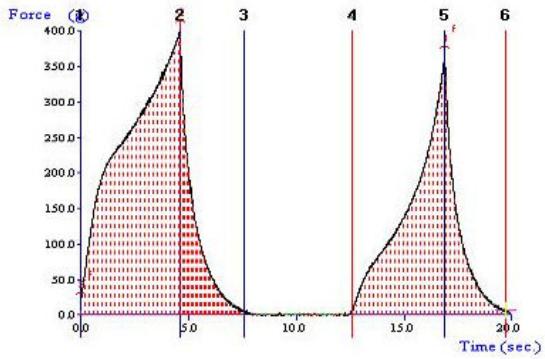
Speed	Test mode	Trigger	Target	Hold
2 mm/s	TPA_distance	5 gf	10 mm	3 sec

Accessory:
ϕ 25 mm cylinder probe. Acrylic, Platform

Sample Preparation:
A standard yellow layer cake formula with 14 different chemical leavening acids was tested. The acids were comprised of three primary leavening groups (MCP, SALP, and SAPP acids) and a variety of other acids. Except for the sulphates and organo acids, Rhodia tested its own brand name products. Each leavening agent, its neutralising value, and generic name is listed below.
The cakes were stored in 'saran'-wrapped cardboard boxes for 24 hours after they were baked and their volumes and weights had been recorded. The cakes were cut immediately before testing in accordance with the cutting pattern depicted below. The exposed edges were abutted against the cardboard box between tests to prevent drying out.



Typical plots:



Test Set-Up:
Each cake sample was positioned centrally under the probe and the test commenced. Analysis was conducted only after all of the tests were completed and archived for each cake set.

Data Analysis:

☒Hardness

☒Springiness

☒Cohesiveness

☒Chewiness

☒Resilience

Hardness is the peak force of the first curve (2f).
Springiness is a ratio of the distance between anchors 4:5 over the distance between anchors 1:2.
Cohesiveness is a ratio of the total areas under the two curves (area 4:6 / area 1:3).
Chewiness is the product of **Hardness*** **Cohesiveness*** **Springiness**.
Resilience is the ratio of the area during the first withdrawal over the area of the first penetration (area 2:3 / area 1:2).

Results

The following table shows the average data for eight test repetitions for each cake. The springiness and cohesiveness values were extremely repeatable, with coefficients of variation (% cv) between 0.5% and 3% cv. Hardness values were also very repeatable with most % cv's ranging between 4% and 9%, however, several cakes had % cv's of 16% and 20%. The very high reproducibility indicates that this test precisely quantifies the cake textures. While these results appear similar, the differences were statistically significant and were in accordance with sensory judgements by the technicians conducting the tests.

Application Study Conclusion

Each leavening agent (i) releases the carbon dioxide at different times in the dough & bake cycle and at different release rates, and (ii) neutralizes different amounts of soda (unreacted soda or acid remaining in the finished product may contribute undesirable flavor in the finished product). Formulators choosing leavening acids must realize that their choice will affect the specific gravity, volume, hardness, springiness, cohesiveness and resilience of the final baked product. The Stable Micro Systems Texture Analyzer can precisely define and differentiate the texture of chemically leavened baked products, particularly with regard to springiness, cohesiveness and resilience.

The results for this application study have been kindly provided by Rhodia Corp & Texture Technologies Corp., USA and the method approved for use by the American Institute of Baking.