



Expertise that Inspires



Optimizing Chemical Leavening in Whole Grain Bakery Products

Sharon Book - June 25, 2015

Bakery Products



Muffins, biscuit, cakes, flour tortillas, doughnuts, pizza crust, pancakes, waffles, cookies, crackers, etc.



Bakery Ingredients

- Flour & water
 - Wheat – all purpose or whole grain
- Other ingredients to enhance
 - Sweeteners
 - Sugar, corn syrups, etc
 - Fats
 - Shortening, oil, margarine
 - Produce substitute (Applesauce, pumpkin)
 - Others
 - Milk
 - Eggs
 - Flavor
 - Vanilla, etc
 - Leavening
 - **Chemical**
 - Biological (yeast)
 - Mechanical (air incorporation)



What to do with ingredients?

- Measure
- Mix dry ingredient
- Combine wet and dry ingredients
- Form
- Bake



What is Chemical Leavening?

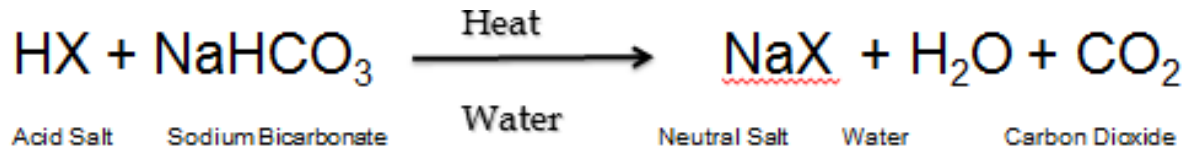
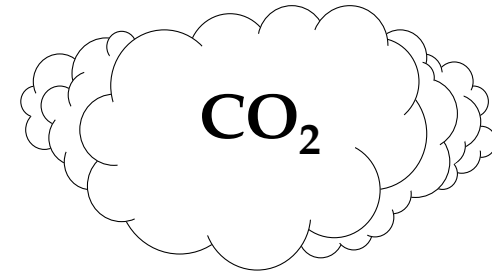
- A chemical reaction that results in the production of gas
- Leavening means to rise
- Baking Powder – the complete reaction



Why we need leavening



The leavening equation

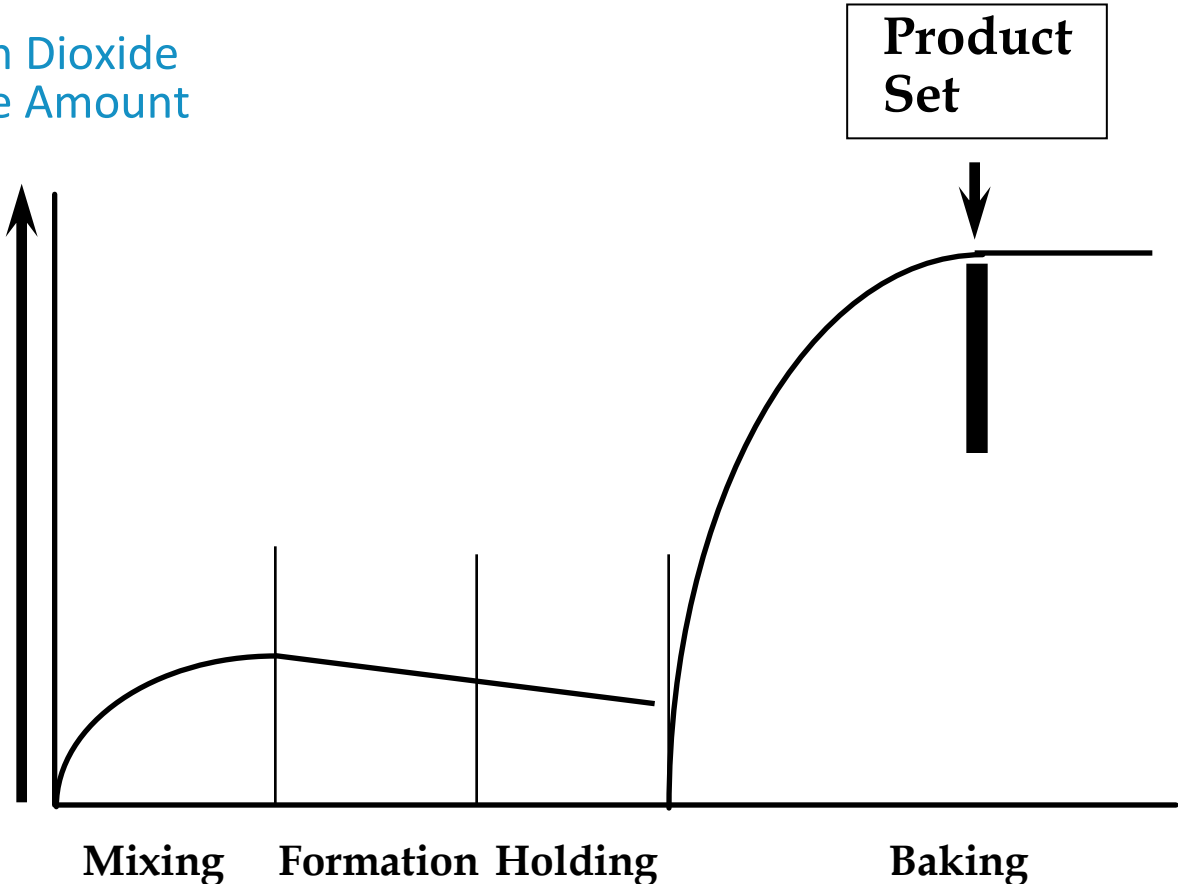


- Acid has many options and controls the reaction



Profile of CO2 Release

Carbon Dioxide Release Amount



Leavening acid options

- Listed on ingredient statements (sometimes as part of leavening with sodium bicarbonate)
 - Monocalcium phosphate (MCP)
 - Cream of Tartar (tartaric acid)
 - Calcium acid pyrophosphate (CAPP)
 - Dicalcium phosphate dihydrate (DCPD)
 - Glucono delta lactone (GDL)
 - Sodium acid pyrophosphate (SAPP)
 - Sodium aluminum phosphate (SALP)
 - Sodium aluminum sulfate (SAS)



Leavening acid

- Differ in when and how they react
 - Some are fast
 - Some are slow
 - Some only react when heated
- Other acid sources
 - Buttermilk
 - Fruits
 - Vinegar









Effect of AP:WW flour on muffin

All purpose flour	Whole wheat flour	Height (mm)	Hardness (g)
100	0	47.9	723
80	20	44.4	418
60	40	43.1	476
40	60	42.8	459
20	80	41.7	514
0	100	40.9	585



Flour and acid effect on muffin appearance

Flour	All Purpose	Whole Wheat
CAPP		
SAPP-28		
MCP-SALP		



Flour and acid effect on muffin properties

Flour/acid	Volume (ml/g)	Hardness (g)	Springiness	Cohesiveness	Width (mm)
AP/CAPP	2.48	476	0.943	0.586	65.5
AP/SAPP-28	2.25	416	0.922	0.568	66.8
AP/MCP-SALP	2.33	564	0.943	0.620	66.8
WW/CAPP	2.42	583	0.886	0.524	66.2
WW/SAPP-28	2.27	508	0.858	0.515	68.7
WW/MCP-SALP	2.33	593	0.898	0.582	68.7



Flour & acid effect on biscuit properties

Flour/acid	Height (mm)	Hardness (g)	Springiness	Cohesiveness
AP/SALP	35.7	361	0.869	0.632
WW/SALP	32.8	340	0.598	0.479
WW/CAPP	33.2	368	0.683	0.522
WW/SAPP-40	31.4	409	0.735	0.472



Conclusions

- Chemical leavening is a simple acid-base reaction
 - The base is sodium bicarbonate
 - The acid has many options to control the reaction and influence final product characteristics
- Ingredient changes of flour and acid have mixed effects on final product characteristics
 - Always test!



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