



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?

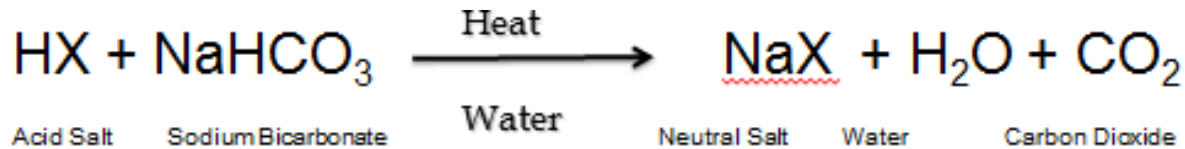
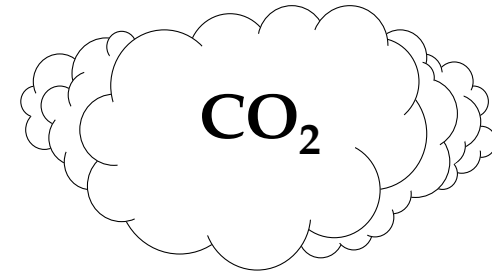
- A chemical reaction that results in the production of gas
- Leavening means to rise
- Baking Powder – the complete reaction



# Why we need leavening



# The leavening equation

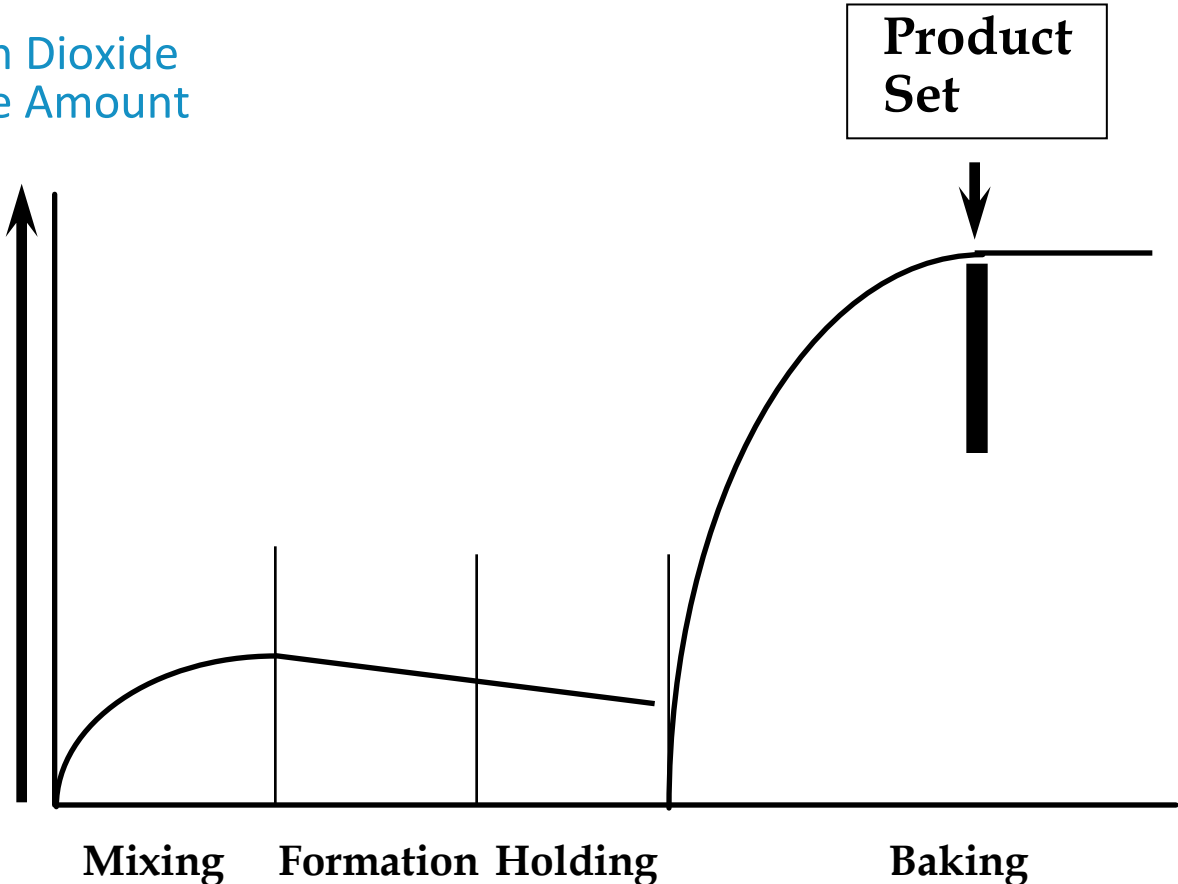


- Acid has many options and controls the reaction



# 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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