

Lecture 16 - Batters and Doughs



- Text Reading
 - Batters and Doughs – Chapter 15
 - Questions 1, 3, 4–7, 9, 11–14


Flour Mixtures

- Quick breads
 - Muffins, biscuits, cream puffs, pancakes
- Yeast breads
- Cakes
 - Shortened and unshortened
- Cookies
- Pastry



Basic Ingredients



- Flour
- Liquid
- Fat
- Egg
- Sugar
- Leavening agents 
- Salt
- Flavourings







What are their functions?



Flour






- Contributes **proteins** and **starch** to baked product **structure** 
- May contribute protein and sugar for the **Maillard reaction** 
- May contribute **yeast food** for biological leavening 
- Contains **enzymes** which **may weaken the structure** 





Liquid



- Serves as a **solvent** for salt, sugar and other solutes
- Assists in the **dispersion** of other ingredients
- May contribute to **chemical reactions** 
- Enhances **development of gluten** 
- Contributes to **leavening** and **gelatinization** during baking 




Fat

- Contributes to tenderization of baked products 
 - Inhibits gluten development
 - Inhibits starch gelatinization
- Helps leaven products by incorporation of air 
- Adds stability to batter through emulsification



Eggs

- Contributes to the **structure** of baked products
- Contributes heat denatured **proteins, steam** for leavening and **moisture** for starch gelatinization
- Egg yolk contributes **emulsifying** agents 



Sugar



- Sweetening
- Facilitates air incorporation by shortening
- Inhibits development of gluten
- Inhibits gelatinization of starch
- Elevates temperature at which egg and flour proteins denature
- Enhances carmelization and Maillard reaction
- Food for yeast to ferment
- Affects texture – crumb smoother, softer and whiter





Leavening Agents

- Produces **gas** by **physical**, **chemical** or **biological** methods
- Type chosen by **ingredients** in recipe and **manipulation** methods to be used
- Produces air, steam, carbon dioxide, nitrogen, ammonia or ethanol



Balancing Ingredients

- Liquid ingredients vs dry ingredients
- Structural enhancers vs structural inhibitors
 - Enhancers
 - Flour, egg, egg white, water, milk
 - Inhibitors
 - Fat, sugar, egg yolk, acid



Flour

- Classes of wheat

- Hard 

- Soft 

- Durum 

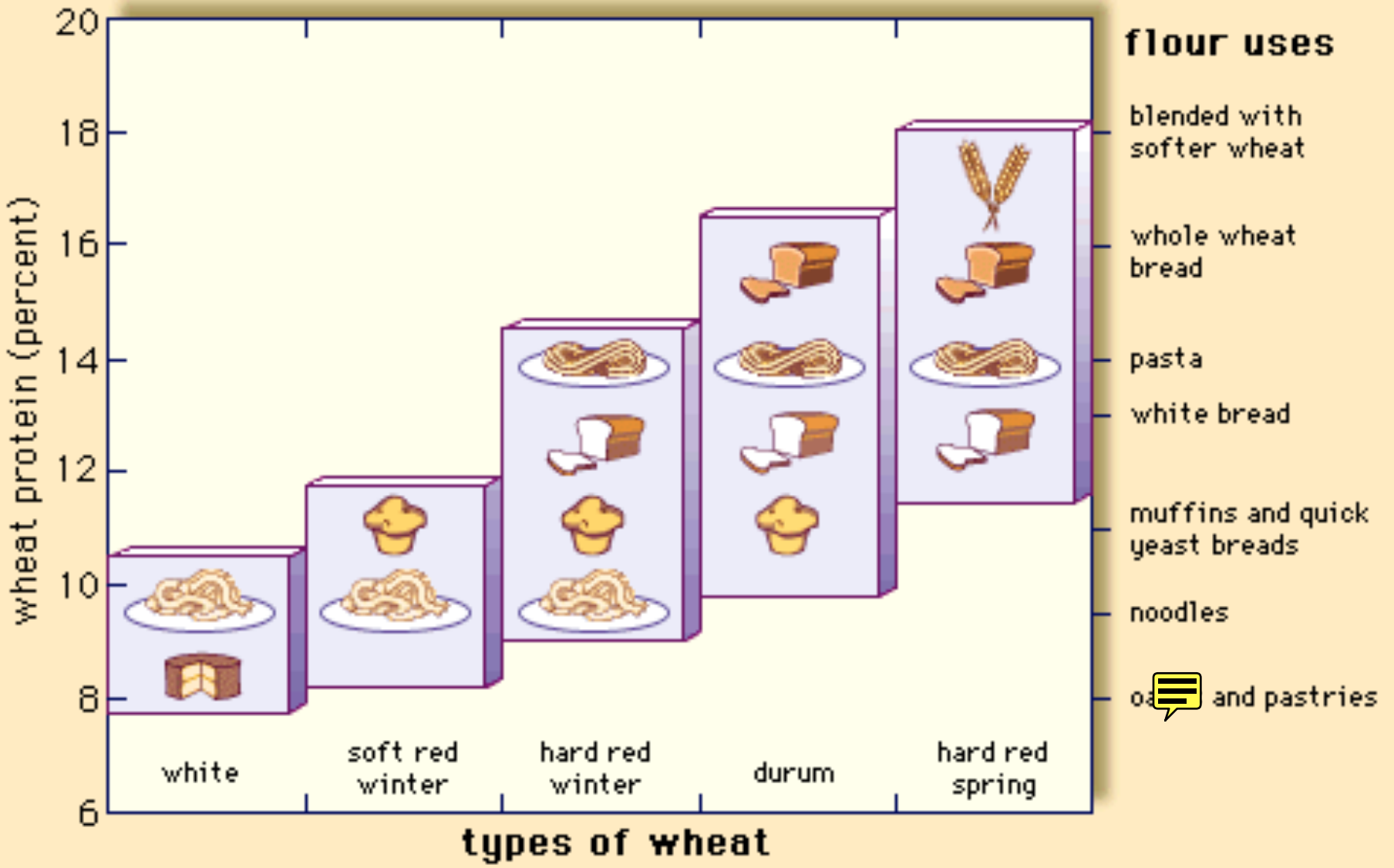
- Milled flours

- Enriched white

- Patent flour 

- Whole wheat flour 







Wheat Intake

Incoming wheat is weighed, sampled and analyzed, passed through a preliminary cleaner and magnet, then stored according to class, grade and protein content.



Cleaning & Tempering

Cleaners remove weed seeds, dirt and other extraneous material through machines which separate by size (separator), specific gravity (destoner) and shape (disc separator). Frictional cleaning equipment scours the surface of the kernel, removing surface contamination and the outermost layers of the bran. During tempering, water is added to toughen the outer bran coats for easier separation from the endosperm and to mellow the endosperm for grinding.



The Milling Process

Milling is essentially a process of grinding and separating. Grinding is done on break rolls, sizing rolls and reduction rolls to reduce the endosperm into flour. Separation of the different sized flour particles is done using machines called sifters and purifiers.



Classification of Flour Streams

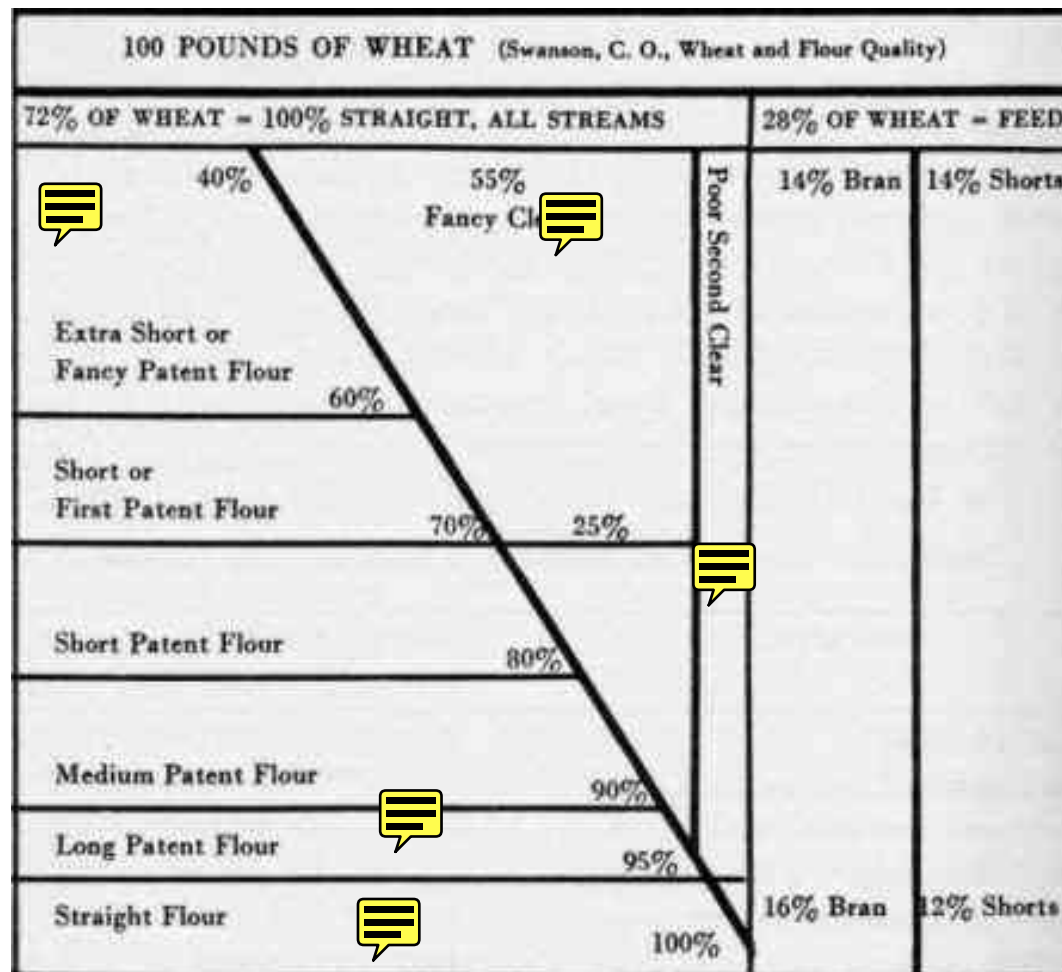
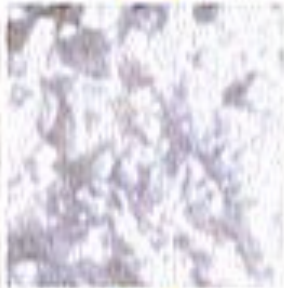


Figure 7.13. - Proportional yields of various milled products obtained from cleaned wheat.



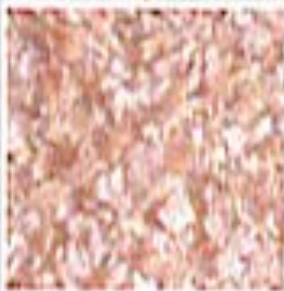
Flours

Different flour separations may be combined to produce many different types of flour, including household flour, bakers' flour and noodle flour. Flour can be produced either by blending wheats at the milling stage, or by milling wheats separately and blending the resulting flours to meet customer specifications.



Flour Treatment

In some mills, flour is bleached immediately after it is milled. Flour may also be enriched to put back vitamins and minerals removed in the refining process. The flour is now ready to be packaged and sent to the bakery, store or warehouse.



By-products

Most of the endosperm is recovered as flour. Germ, bran and unrecoverable endosperm are sold as by-products, usually for animal feed.



Flour

- Soft Wheat (vs hard wheat)
 - Lower protein
 - Weaker protein
 - Weaker mixing properties
 - Lower flour water viscosity
 - Lower water absorption
 - Less starch damage

Flour Composition


- Protein
 - Gliadin and glutenin - form gluten
 - Albumins and globulins
- Carbohydrates
 - Starch, dextrins, fibre, pentosans
- Fat
- Enzymes
 - Amylase, protease, lipase, lipoxygenase
- Minerals
- Moisture
 - ~14%

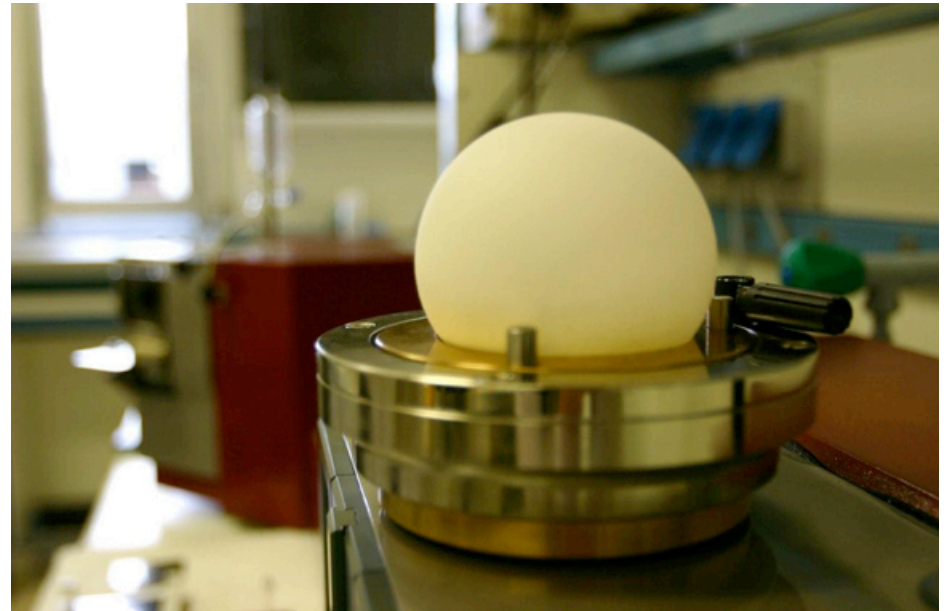
Flour Functional Tests



- Flour Strength
 - Alveograph
- Mixing Strength
 - Farinograph
 - Mixograph
- Dough Characteristics
 - Extensograph
- Pasting Characteristics
 - Viscoamylograph

Alveograph

- Dough testing
- Measures resistance to deformation and extensibility 
- Clamped disc shaped piece of dough
- Form a bubble by applying air pressure from below
- Assess bread making quality of flour



Mixograph

- Instrument to evaluate dough mixing properties of a wheat flour
- Part of breadmaking quality evaluation
- Measures and records the resistance that the dough offers to the pins of the mixer while dough is being mixed



Extensograph



- Instrument for measuring physical properties of doughs
- Stretches a cylinder of dough 4-15 centimeters
- Held by the two ends and hook engages the dough in the middle
- Measures the resistance of the dough to extension

Viscoamylograph



- Instrument that measures the consistency or viscosity of a slurry of starch or flour and water
- Heated through a predetermined cycle
- Viscosity measured by the resistance that the slurry offers to a mixing paddle
- Cold paste viscosity, hot paste viscosity, gelatinization temperature


Wheat Proteins

- Albumen and globulins
 - Water soluble
- Gluten
 - Gliadin and glutenin
 - Water insoluble



Gluten

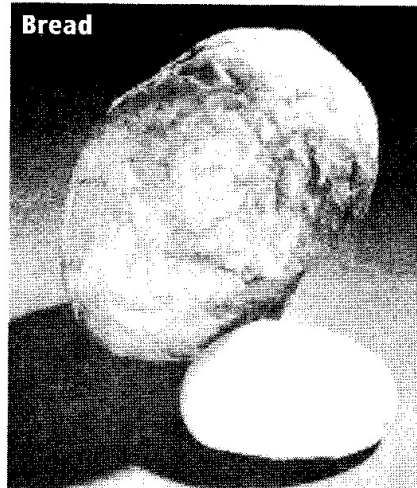
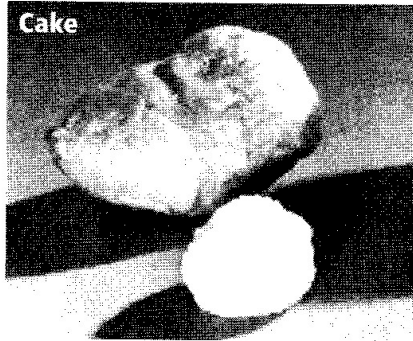


- Flour and water mixed or kneaded to make a dough
- Insoluble proteins wetted and interact with each other
- Soluble protein strands contact and connect to form microscopic films 
- Film envelops the starch granules in the mixture
- Gluten sheets form cells to hold the incorporated air and carbon dioxide
- Air in cells expand
- In the oven, protein denatures and gelatinizes to give firm product structure



Extracting Gluten

- Vigorously knead a flour and water dough
- Thoroughly wash the dough with water to remove starch
- Moist gluten has elastic and cohesive properties
- Gliadin and gluten fractions can be separated from each other



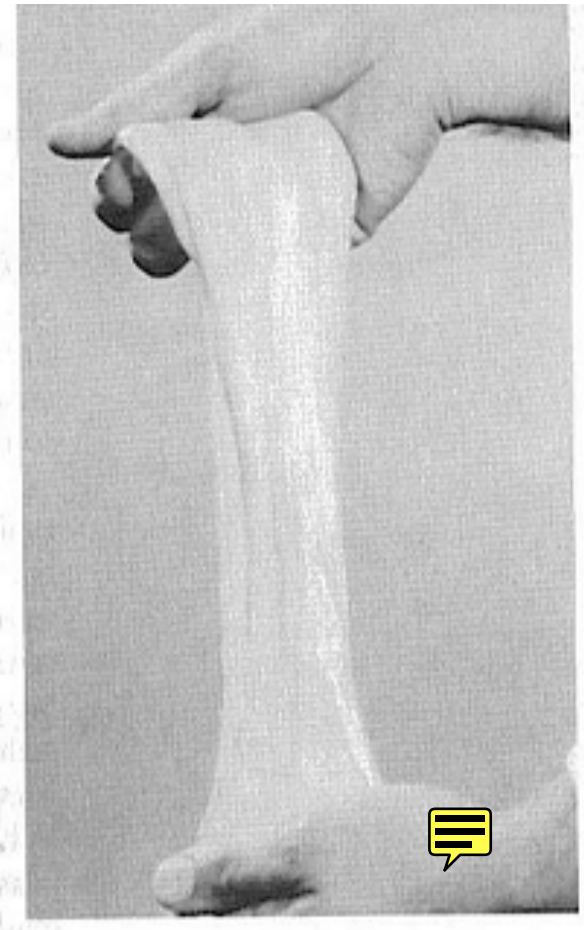
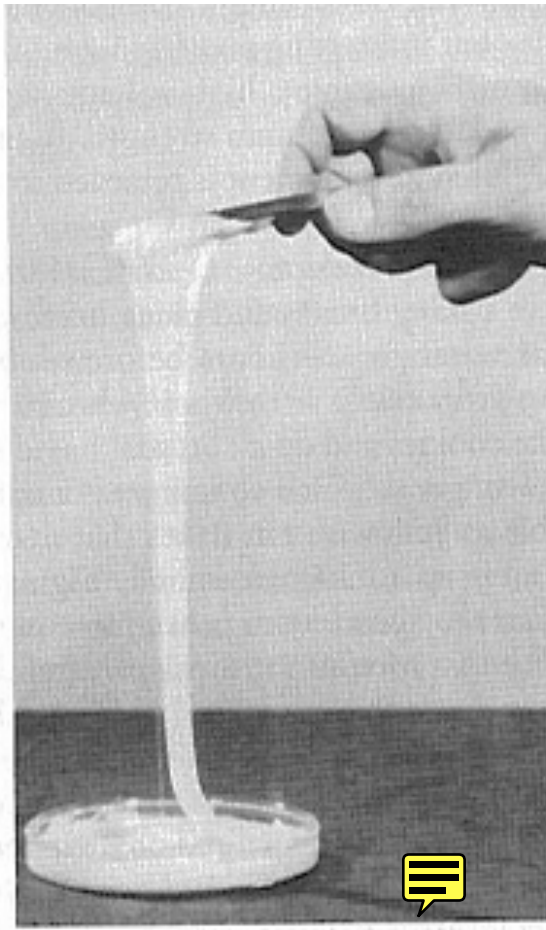
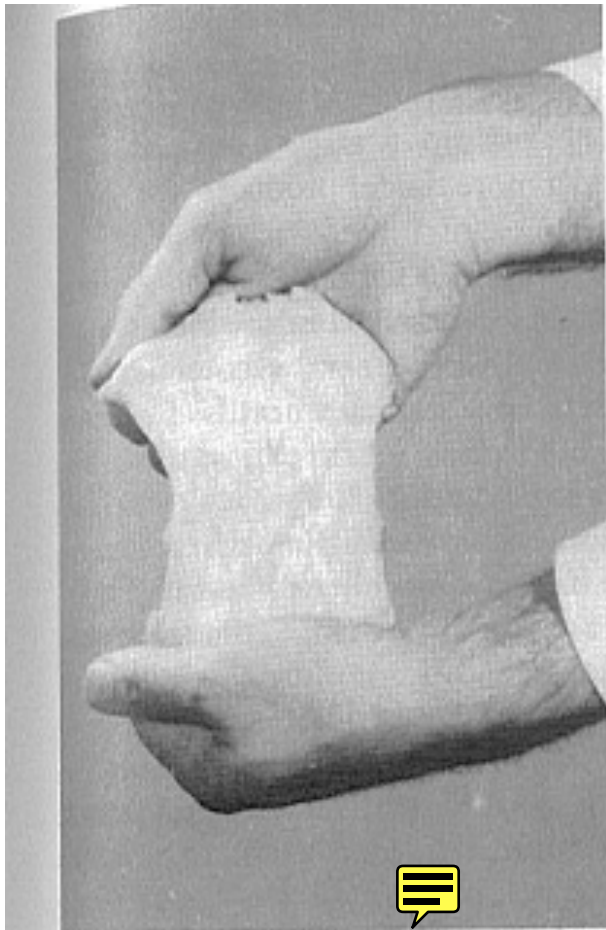


Figure 15-5
The different properties of the glutenin fraction (left), the gliadin fraction (center), and gluten (right). (Courtesy of Baker's Digest and R. J. Dimler)

Bennion and Scheule, 2004



Leavening Agents

■ Biological

- Yeast, bacteria
- Produce **carbon dioxide** and **ethanol**

■ Chemical

- Baking powder, baking soda + acid
- Produce **carbon dioxide** and **ammonia**

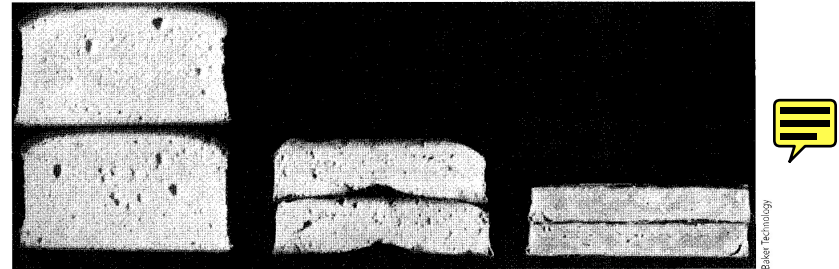
■ Mechanical

- Water, atmosphere
- Produces **air, steam, nitrogen** and **ethanol**



Leavening Agents

FIGURE 17-12 The role of air as a leavening agent. Shown here are three pound cakes made without baking powder and subjected to three different degrees of air incorporation.



■ Biological

- Slow leavening action
- Considerable gluten development and structure

■ Chemical

- Intermediate in structure

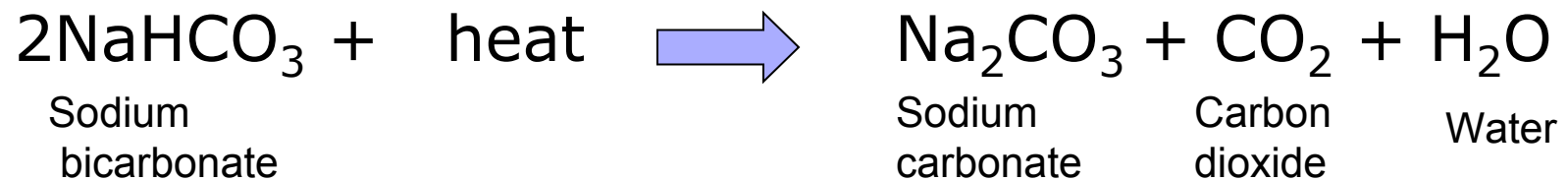
■ Mechanical

- Develop structure at the same time as the steam evolves in a baked product

Leavening Agents



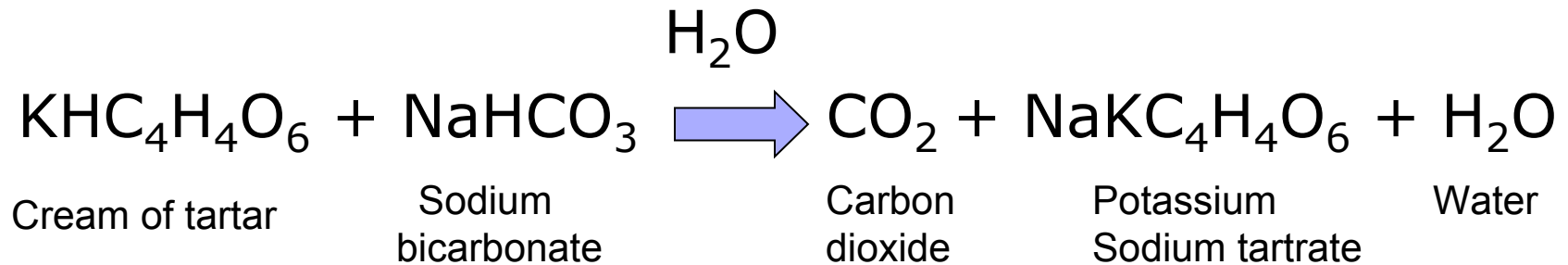
- Chemical production of carbon dioxide



Leavening Agents



- General reaction for most leavening



Baking Powders





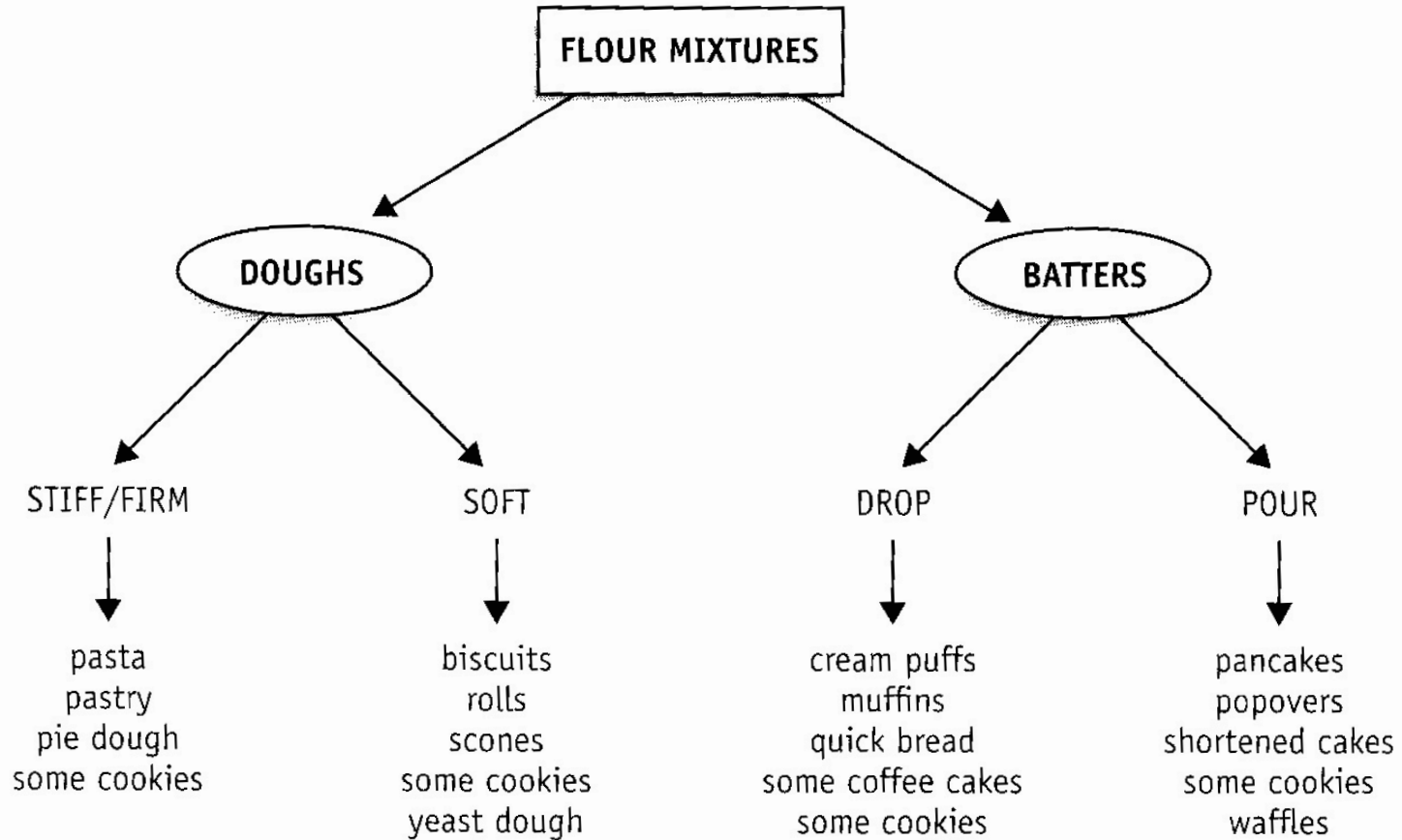
- Contain mixtures of **dry acid or acid salts** and **baking soda**
- **Starch** is added to standardize the mixture
 - **Stabilize components** so they do not react prematurely 
- SAS-phosphate baking powder
 - **Double acting** 
 - Contains two acids
 - Phosphate (calcium acid phosphate)
 - Sodium aluminum sulfate





FIGURE 17-27 Doughs and batters are flour mixtures that differ in their liquid content and general use.




Brown, 2011



Batters and Doughs

■ Influenced by

- **Proportion** of liquid to flour
- **Concentration** of other ingredients
- Type and kind of **ingredients**
- Kind and method of **manipulation** 





Batters

- Relatively **high water content** to flour
- **Water** is continuous
- **Structure** more dependent on **gelatinization of starch** than gluten development
- Pour and drop batters





Doughs

- Continuous phase is **gluten matrix**
 - Matrix consists of membranes surrounding the gas cells
 - Cells are in contact with each other
- Soft and stiff doughs

Mixing

- Distributes ingredients uniformly
- Minimum loss of leavening agent
- Optimum blending
- Optimum gluten development



Mixing

- Blade type influences
 - Viscosity
 - Degree of dispersion
 - Air incorporation
 - Quality characteristics





Mixing

- Optimum amount of manipulation varies with
 - Type of **product**
 - Type and amount of **ingredients**
 - **Temperature** of the ingredients
 - Mixing **method**



Methods for Mixing Batters and Doughs

- Muffin method
- Pastry or biscuit method
- Conventional or creaming method
 - Two stage or blending method
- Sponge or whipping
- Angel Food method
 - Chiffon Method
- Straight Dough
- Sponge and Dough