Chapter 5
Cheese, Yogurt & Sour Cream

Curdled and processed m… ac… er… make milk products

Portions of Annotated PPT

Cheese

A durable form of milk! - 5 -10 times milk concentrate

- Likely first prepared from soured milk and as milk was stored in stomach pouches
- Lactose (sugar) allows this to happen as it serves as a source of food for microbes

The Process of Cheese Making

- Curdling – separation of milkfat and protein from whey
  - Acid, heat, enzyme (rennet) or combinations all cause curdling
- Curd setting – finishing
  - pH, salt content, bacteria culture, cooking times
- Ripening - aging – (react with oxygen) and allow molds and or other bacteria to alter fresh curd to hard aged cheese

Curding — *Denaturation and aggregation of proteins and coagulation of fat globules – requires physical changes to proteins whose job is to keep micelles and globules separate*

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Draining & Pressing — *Removal of water and water soluble components like lactose and setting protein – fat structure*

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Aging & Ripening — *Chemical changes brought about by reactions with oxygen and fats/ proteins/organic molecules and reactions catalyzed by enzymes from bacteria or other microbes*

Types of Cheese

Acid Coagulated Fresh Cheese (lactic acid from bacteria)

- no enzyme is used to finish the curd
- Cottage and Cream Cheese

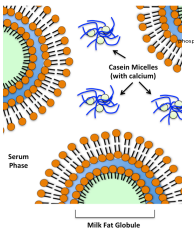
Heat-Acid Precipitated Cheese (acid and heat precipitate/coagulate the protein and cause milk fat to curdle)

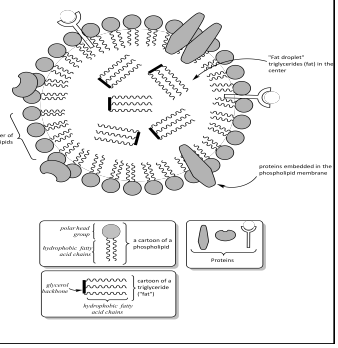
- Add low amounts of acid to 75-100°C temp milk
- High moisture and protein
- Ricotta (Italy) Channa and Paneer (India)

Milk

Milk Fat Globule

Proteins and Fat Globules

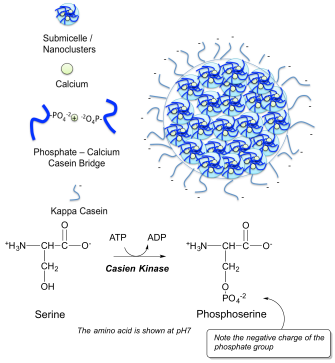




Casein – key for cheese

Sub micelles are held together by phosphorylated casein – calcium ion interactions

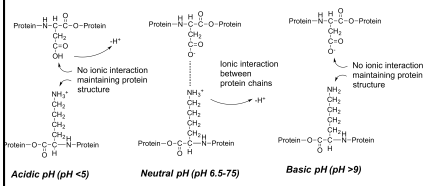
- k-casein caps the growing micelle, binds water and repels interactions with other casein micelles



Curd Formation

Acidifying milk, increasing temperature and action of rennet lead to curd formation. i.e. disruption of casein micelles…

- acid formation (adding acid – acetic or citric) or production of lactic acid from metabolizing bacteria limit protein interaction

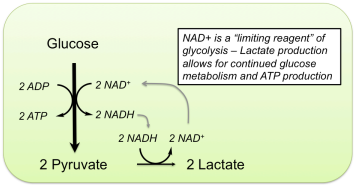


Loss of charged glutamates and aspartic acids diminishes ability of casein to bind to calcium and neutral charged k-casein stop repulsion and form weak aggregated precipitates (curd)

Metabolism – lactic acid production

Fermentation is a way for bacteria to replace limited amounts of NAD^+

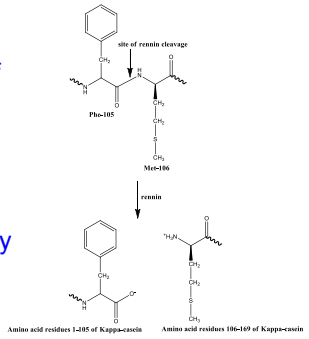
- Lactate is side product
- Typically used for aged cheeses



Rennet attacks kappa-casein

The negative tail of k-casein is cleaved by specific recognition by rennet

- Forms stronger curds than acid only precipitation



Next step – Removing Moisture

Fresh cheeses retain moisture and sugars

Aged pressed cheeses are pressed to dry and have less lactose

Drying the cheese curd

Gravity – through mold and drained – used for soft cheeses (camembert…)

Cutting curd – smaller the dryer, creates a more firm cheese due to increased surface area/mass ratio

Heating and stirring curds continues denaturation of proteins to release water from curd

- exposed hydrophobic protein amino acid side groups will not interact with water reducing "holding" capacity
- Activates bacteria and enzymes for more acid and creation of new flavor compounds

Temps impact final dryness of cheese
- Cheddar 100°F
- Gruyere 120°F
- Parmesan 130°F

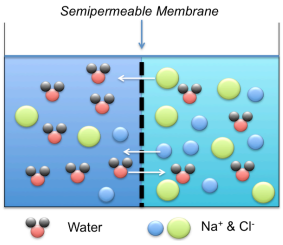
Brining the Cheese

Osmosis – removal of water from the cheese

- net movement of dissolved particles from a region of higl concentration to a lower concentration

Water and salt move in opposite directions in a high salt brine

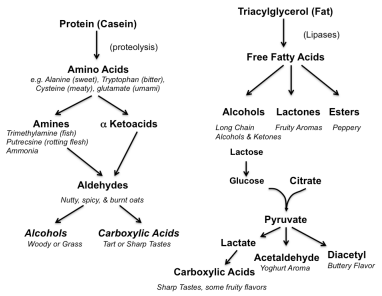
- water is removed from cheese by salt brine and salt is driven into cheese



Higher salt inhibits pathogenic bacteria growth and alters enzyme function to create flavor compounds

Chemistry of ripening

Enzymes breakdown fat, protein and carbohydrates to new flavor compounds



Cheese Flavoring

Protein, fat and metabolites (know this word!)

- Proteins – mostly degredation products of casein
  - Amines – the amino portion of amino acids
    - Fish smell – trimethylamine
    - Putrescine – polymer of amines
    - Sulfur – from cysteine- amino acid side group
    - Ammonia – nitrogen from amino acids
    - Amino acids themselves have tastes
- Fats – different sized and modified fatty acids add different flavors and textures – molds typically alter fats
  - Short chain fatty acids – buttery or peppery taste
  - Smaller break down products – ketones – highly fragrant

The more finished the more flavors – why?

Finishing Microbes

Smear Bacteria – smelly cheeses like munster and limburger cheese

- Live in high salt (most bacteria won't do well)
- Grow on surface of cheese – need oxygen and can't grow in acidic conditions from starter culture
- The cultures are swiped or smeared

on surface of pressed cheeses

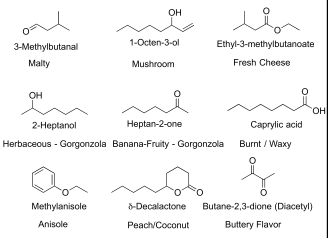
- Responsible for protein breakdown

into… stinky molecules

Sulfur containing compounds – methanethiol

And methylthioacetate

Mold actively modifies fats producing short modified fatty acids



P. Camemberti - Lactic acid is further degraded by surface smear – higher pH results in precipitation of calcium phosphates of casein forming a hard shell and produces lactones, ketones and sulfur from fats and proteins

Cooking with cheese

Melting cheese – process of changing state of matter from solid to liquid

- Melting requires adding energy to defeat chemical bonds holding molecules in place (solid)
  - The more and stronger the bonds the higher the heat/ energy it takes to break the bonds
- Cheese is a complex of many types of solids with different interactions
- Water, fat and protein content and type all alter ability of cheese to melt or cook well

Processed Cheese

Velveeta & Cheez Whiz – made from mixtures of young and old scraps of cheese

- Phosphate salts – highly charged molecules bind well to water and casein keeping proteins in a loose protein form – soft cheese
- The reduction in protein interaction and low stringy cheese makes this great for melting

MILK, WATER, MILKFAT, WHEY, WHEY PROTEIN CONCENTRATE, SODIUM PHOSPHATE, MILK PROTEIN CONCENTRATE, ALGINATE (algae cell wall polysaccharide- emulsifier), SODIUM CITRATE, APOCAROTENAL (COLOR), ANNATTO (COLOR), ENZYMES, CHEESE CULTURE.