

Periodic Graphics

A collaboration between C&EN and
Andy Brunning, author of the popular
graphics blog *Compound Interest*

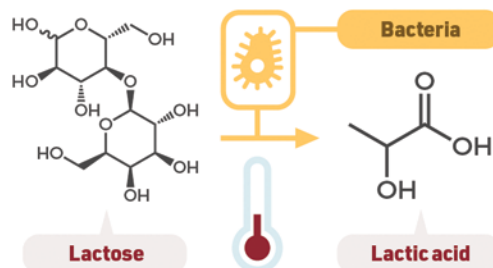
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To see more of
Brunning's work, go to
compoundchem.com.
To see all of C&EN's
Periodic Graphics,
visit [cenm.ag/
periodicgraphics](http://cenm.ag/periodicgraphics).

THE SCIENCE OF MAKING CHEESE

Hundreds of types of cheeses exist, but despite this variety, their manufacture follows some common steps. Here we take a look at the biochemical processes that turn milk into cheese.

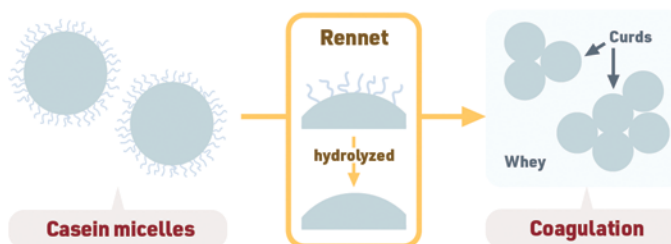
1 ACIDIFICATION



First, manufacturers add beneficial bacteria to milk and warm the liquid. The bacteria turn lactose, one of milk's sugars, into lactic acid, lowering the milk's pH.

2 COAGULATION

Coagulation occurs when the casein proteins in milk clump together to form curds. For soft cheeses, such as cottage cheese, acidification alone triggers coagulation. For harder cheeses, rennet is added. Rennet contains enzymes that speed up coagulation by hydrolyzing casein.



3 REDUCING MOISTURE CONTENT

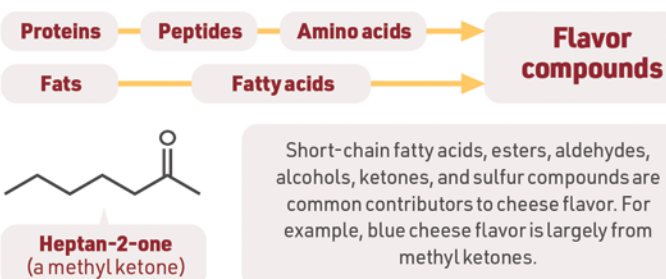
The coagulated casein network traps water and fats. The subsequent production steps promote the loss of whey, the liquid remaining after coagulation.



Cooking time and temperature affect the properties of the resulting cheese. Some cheeses are salted, either by immersion in brine or by rubbing salt on the cheese surface, forming a rind that slows water loss.

4 MATURATION

Fresh cheeses such as mozzarella and feta aren't aged. Maturation of other cheeses allows flavors and textures to develop. As the cheese ages, sugars, proteins, and fats slowly break down and produce flavor compounds.



Short-chain fatty acids, esters, aldehydes, alcohols, ketones, and sulfur compounds are common contributors to cheese flavor. For example, blue cheese flavor is largely from methyl ketones.