

What is milk made of?

Milk is one of the most versatile and naturally occurring products we consume. It is not only nutrient dense, but can be made into many different products due to its composition. Because of the different components of milk listed in Figure 1, we are able to take fluid milk and transform it into cheese, yogurt, sour cream, cottage cheese, kefir, lassi, infant formula, whey protein powders, or many other products. Milk is so versatile that in 2017, approximately 10,500 years after cattle domestication, we continue to have major dairy product innovation. Milk composition can vary by breed of animal, feed, and season.

	Sheep	Goat	Rabbit	Rat	Human	Cow
% Water	82.0%	86.7%	67.2%	79.0%	87.1%	87.7%
% Fat	7.2%	4.5%	15.3%	10.3%	4.5%	3.8%
% Casein Protein	3.9%	2.6%	9.3%	6.4%	0.4%	2.6%
% Whey Protein	0.7%	0.6%	4.6%	2.0%	0.5%	0.6%
% Lactose	4.8%	4.3%	2.1%	2.6%	7.1%	4.6%
% Ash	0.9%	0.8%	1.8%	1.3%	0.2%	0.7%

Figure 1. Source: *Fundamentals of Dairy Chemistry, 1988. Wong et al*

How does milk's composition lend itself to the creation of other products? Let's take cheese as an example. Of all the protein in cow's milk (about 3.2% of milk) around 80-85% of that protein is *casein* protein and 15-20% is *whey* protein. When we add a clotting enzyme to milk, called chymosin or rennet, we are able to separate these casein and whey proteins. The casein proteins come together to form our cheese curds, and the liquid whey proteins are pushed out. We can ultimately put those cheese curds into molds to form blocks or wheels of cheese. Depending on any cultures used and the conditions of the aging process, a unique product can be created – just think of how many cheeses you see in the grocery store. Very slight changes during the cheese making will result in a different product. The whey from this process can be filtered and dried, ultimately ending up as dried whey protein concentrate powders that you might find in bulk, or as an ingredient in many other products from candy bars to smoothies. This is just one example of the variety of products and byproducts we can create from milk.



Cheese curd and whey being stirred in a vat at the Cornell University Food Processing and Development Laboratory

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