

WHAT IS MILK?



Milk is defined as the lacteal secretion obtained by the complete milking of one or more mammalian animals. Although in other parts of the world a variety of animals are used as sources for milk, in the United States almost all commercially available milk comes from cows. Milk is valued because it is an important source of many of the nutrients essential for the proper development and maintenance of the human body.

Today, milk appears in American grocery stores in a wide variety of forms designed to appeal to the tastes and needs of individual consumers. The distinguishing characteristics of the most popular types of milk are described below.

Milk is one of the most carefully tested and heavily regulated foods available. One of the most effective instruments for assuring the quality and purity of milk is the Pasteurized Milk Ordinance (PMO), a set of recommendations from the U.S. Public Health Service/Food & Drug Administration (FDA) for voluntary adoption by state and local governments (which often enact even more stringent requirements for milk produced within their jurisdictions). The descriptions below reflect the requirements of the PMO for various types of milk.

MILK VARIETIES

Whole milk is a good choice for children aged 1-2 years and anyone else for whom fat intake is not a consideration. Whole milk must contain not less than 3.25% milkfat and 8.25% “milk solids not fat” (protein, carbohydrate, water-soluble vitamins and minerals). All milks are approximately 87% water. Whole milk contains 150 calories and 8 grams (g) of fat per 8-fluid oz. serving. Although not required, whole milk may be fortified with Vitamin A and/or Vitamin D (see “Fortified milk,” below).

Reduced fat milk is a good choice for those seeking moderate restriction of their fat intake. Reduced fat milk is whole milk in which the milkfat level has been reduced from 3.25% to 2% (hence its popular name, “2% milk”). Reduced fat milk contains about 38% less fat than an equal serving of whole milk. Like whole milk, it must contain not less than 8.25% “milk solids not fat” and is approximately 87% water. Reduced fat milk contains 120 calories and 5g of fat per 8-fluid oz. serving. Vitamins A and D are removed with the milkfat, so they are added back to reduced fat milk (see “Fortified milk,” below).

Low fat milk is a good choice for those seeking somewhat greater restriction of their fat intake. Low fat milk is whole milk in which the milkfat level has been reduced from 3.25% to 1% (hence its popular name, “1% milk”). Low fat milk contains about 69% less fat than an equal serving of whole milk. Like whole milk, it must contain not less than 8.25% “milk solids not fat” and is approximately 87% water. Low fat milk contains 100 calories and 2.5g of fat per 8-fluid oz. serving. Vitamins A and D are removed with the milkfat, so they are added back to low fat milk (see “Fortified milk,” below).

Fat-free milk is a good choice for those seeking to restrict their fat intake considerably. Fat-free milk is whole milk in which the milkfat level has been reduced from 3.5% to essentially none (the PMO allows milkfat residuals of up to .5%). Fat-free milk is often referred to as “skim milk.” Like whole milk, it must contain not less than 8.25% “milk solids not fat” and is approximately 87% water. Fat-free milk contains 80 calories and 0g of fat per 8-fluid oz. serving. Vitamins A and D are removed with the milkfat, so they are added back to fat-free milk (see “Fortified milk,” below).

Flavored milk helps children to get their recommended three servings of dairy each day. Flavored milk is milk to which a flavoring – such as cocoa or cocoa powder, strawberry or vanilla extract – and a sweetener have been added. Some manufacturers of flavored milk also add stabilizers or thickening agents to improve

taste and texture. Flavored milks are available in whole, reduced fat, low fat and fat-free varieties. The addition of sweeteners adds calories to flavored milk; for example, chocolate milk contains about 60 calories more than unflavored milk per 8-fluid oz. serving. Like unflavored milk, flavored milk must contain not less than 8.25% "milk solids not fat" and is approximately 87% water. It may also feature added Vitamins A and/or D. There is no scientific evidence that the sweeteners in flavored milk contribute to hyperactivity in children (Glinsmann, Irausquin and Park, Evaluation of health aspects of sugars contained in carbohydrate sweeteners, *J. Nutr.*, 116(Suppl.), 1, 1986; White and Wolraich, Effect of sugar on behavior and mental performance, *Am. J. Clin. Nutr.*, 62(Suppl.), 242, 1995).

Cultured Buttermilk is valued as a recipe ingredient and digestive aid. Buttermilk is freshly pasteurized or ultra-pasteurized fat-free or low fat milk with added fat-free dry milk solids. It can also be made with whole fluid milk or reconstituted fat-free dry milk. (In the past, buttermilk was a by-product of churning cream into butter.) Buttermilk's pleasantly tart taste and smooth body is produced by adding a safe, lactic acid-producing bacterial culture (usually *Streptococcus lactis*) and incubating it at 68-72 degrees F until its acidity reaches 0.8-0.9% (pH 4.6). Salt in quantities of 0.01-0.15% and citric acid or sodium citrate in amounts up to 0.2% may be added to enhance taste. Buttermilk cultured with *Lactobacillus bulgaricus* for increased tartness is known as Bulgarian buttermilk. Its name does not mean that it was manufactured in Bulgaria.

Evaporated milk will stay fresh for extended periods. Evaporated milk is made by heating homogenized whole milk under vacuum to remove about 60% of its water, fortifying it with Vitamin D, standardizing its nutritive components to required levels, canning and stabilizing. It is heat-treated (at 240-245 degrees F for 15 minutes) to sterilize it for prolonged storage. The addition of Vitamin A is optional. Evaporated milk must contain not less than 7.5% milkfat and 25% "milk solids not fat." Evaporated milk requires no refrigeration until its can is opened.

Evaporated fat-free milk is similar to evaporated whole milk except that it is made with fat-free milk and must contain not more than 0.5% milkfat or less than 20% "milk solids not fat."

Sweetened condensed milk is a valued recipe ingredient. Sweetened condensed milk is whole or fat-free milk with about 60% of its water removed and to which a nutritive sweetener (usually sucrose) has been added. The sweetener – amounting to 40-45% by volume – acts as a preservative. Sweetened condensed milk is typically used in candy and dessert recipes. Since evaporated milk contains no sweetener, it cannot be substituted for sweetened condensed milk. The latter must contain not less than 8% milkfat and not less than 28% "milk solids not fat." **Sweetened condensed fat-free milk** (0.5% milkfat, 24% "milk solids not fat") is also available.

Acidophilus milk is a great digestive aid. Acidophilus milk is pasteurized milk – usually low fat or fat-free – to which a beneficial bacterium, *Lactobacillus acidophilus*, has been added. *L. acidophilus* is bile-resistant and helps to relieve the symptoms of lactose maldigestion. The composition, nutritive characteristics, natural flavor (pH 6.5-6.7) and consistency of the milk is unchanged.

Reduced lactose milks are a great choice for those coping with lactose maldigestion. These milks are treated with the enzyme *lactase* to reduce their lactose content by about 70%. Lactose – the natural sugar in milk – is poorly digested by some people. Reduced lactose milks are sweeter-tasting than conventional milk because the lactose has been broken down (*hydrolyzed*) into *glucose* and *galactose* sugars. Otherwise, the composition, nutritive characteristics and consistency of these milks are unchanged. Reduced-lactose milks are available in reduced fat, low fat and fat-free varieties.

Low sodium milk allows people on salt-restricted diets to include a protein-rich food in their meal plan. Low sodium milk has had 95% or more of the sodium that occurs naturally in milk removed. The sodium content is reduced from about 49mg to about 2.5mg (per 100g of milk) by replacing it with potassium. The milk is then pasteurized and homogenized. The composition, nutritive characteristics and consistency of the milk is otherwise unchanged.

Eggnog is a great treat for the whole family. Eggnog contains milk, egg yoke, egg white and nutritive carbohydrate sweetener. It may also contain salt, flavorings, color additives and stabilizers. Eggnog must contain not less than 6% milkfat and 8.25% “milk solids not fat.” Egg yoke solid content may not be less than 1% by weight of the finished product. Eggnog must be pasteurized and may be homogenized.

Whole dry milk allows milk to be enjoyed when refrigeration is not available. Whole dry milk is pasteurized whole fluid milk from which the water has been removed. On a dry weight basis, whole dry milk contains between 26% and 40% milkfat and not less than 5% moisture on a “milk solids not fat” basis. It has added Vitamin A and may also contain added Vitamin D. Except for some loss of ascorbic acid, Vitamin B-6 and thiamin, drying has no appreciable impact on the nutritive characteristics of the milk. Whole dry milk has limited retail distribution; it is used mainly in processed foods such as infant formula, chocolate and candy.

Low fat dry milk is similar to whole dry milk except that it contains between 5% and 20% milkfat on a dry weight basis.

Fat-free dry milk (or non-fat dry milk) is pasteurized fat-free milk from which the water has been removed. On a dry weight basis, fat-free dry milk contains not more than 1.5% milkfat and not less than 5% by weight of moisture. Fat-free dry milk contains about half of the calories of whole milk. Almost all fat-free dry milk is fortified with Vitamins A and D. “Instant” fat-free dry milk is made of larger particles that dissolve more easily in water. To earn the “U.S. Extra Grade” designation, instant fat-free dry milk must have a sweet, pleasing flavor and a natural color. It must also dissolve immediately upon contact with water. The low moisture content of fat-free dry milk inhibits the multiplication of microorganisms so it can be stored for longer periods.

WHAT DOES THAT MEAN?

Pasteurization. “Raw” milk is pasteurized to destroy potentially harmful bacteria it may contain and to disable certain natural enzymes. It also increases the “shelf life” of milk. Pasteurization involves the heating of “raw” milk to 145 degrees F for 30 minutes; or heating it to 161 degrees F for 15 minutes. The pasteurized milk is then rapidly cooled to 38 degrees F. Pasteurization has negligible effect on the taste and nutritive characteristics of milk.

Ultrapasteurization. Ultrapasteurized milk is heated to at least 212 degrees F for at least two seconds. The higher temperature treatment destroys all natural bacteria that may be present, rendering the milk microbially stable. Ultrapasteurized milk must still be refrigerated, but its “shelf life” is extended to something like two months. Ultrapasteurization is valued for milk destined for certain commercial applications (i.e., fast food restaurants) and for eggnog and other specialty products where spoilage is an issue. Ultrapasteurization has negligible effect on the taste and nutritive characteristics of milk.

Ultra High Temperature (UHT) pasteurization. In UHT pasteurization, milk is heated to 280 degrees F for one-to-two seconds. The use of a very high temperature completely sterilizes all microbes that may be present in the milk, while the short exposure to high temperature minimizes impact on the milk’s taste and nutritive characteristics. UHT milk remains fresh without refrigeration for up to three months provided it remains sealed within its aseptic package. After opening, the package must be refrigerated; the milk will remain fresh about as long as conventionally pasteurized milk.

“Raw” milk. “Raw” milk is milk that has not been pasteurized. Although some people claim that “raw” milk possesses positive nutritional and health-promoting attributes, these claims have not been scientifically substantiated. USDA, FDA, Centers for Disease Control and many other scientific authorities recommend against consumption of “raw” milk. “Raw” milk can contain a variety of microorganisms that can be harmful and even fatal to people – including *bacteria campylobacter*, *Escherichia*, *listeria*, *salmonella*, *yersinia* and *brucella*. Pasteurization, however, destroys any harmful microorganisms and renders milk safe for everyone to consume. (www.fda.gov/fdac/features/2004/504_milk)

Homogenization. Homogenization achieves a more permanent and consistent suspension of milkfat in milk. By breaking up and dispersing milkfat globules, milk enjoys a smoother, more uniform texture. Without homogenization, cream would separate from other components of milk and rise to the top. Homogenization involves reducing the diameter of milkfat globules to no more than 0.001 mm by forcing milk through a small orifice under suitable conditions of temperature and pressure. Homogenization results in a softer curd in the stomach that eases digestion. Homogenization has no effect on the nutritive characteristics of milk. Homogenized milk must be pasteurized to inactivate the enzyme *lipase* which can cause milk to taste rancid.

Fortified milk. Few foods, including milk, naturally contain significant amounts of **Vitamin D** – needed for proper calcification and metabolism of bones and teeth. Approximately 98% of the fluid milk marketed in the U.S. is fortified with Vitamin D to a level of 400 IU per quart. Milk is an excellent vehicle for fortification with Vitamin D because it contains the proportion of calcium and phosphorus required for proper binding to bones and teeth. Vitamin D fortification of milk has been credited with the virtual elimination of rickets in the U.S. **Vitamin A** – essential for the skin, immune system and vision – is naturally present in whole milk in high but variable quantities. Fortification standardizes Vitamin A levels to 126 IU per 100g of milk. Since Vitamin A and Vitamin D are removed in de-fating, they must be added back to reduced fat, low fat and fat-free milks. Some milks may be fortified with added protein and/or calcium. **Protein fortification** involves the addition of nonfat milk solids (proteins, carbohydrates) to create a more nutrient-rich product; when added to fat-free milk, proteins enhance the taste and “mouth feel” of the milk. Fortification of milk must be disclosed on the product label.

Goat’s milk. Although only a relative handful of Americans drink fluid goat’s milk, it is more widely consumed around the world than cow’s milk. Goat’s milk contains many of the same nutrients as cow’s milk. Compared with cow’s milk, one cup of goat’s milk contains more calories (168 vs. 150), more calcium (326g vs. 291g), more phosphorus (270g vs. 228g), more protein (8.69g vs. 8.03g) and more potassium (499g vs. 370g). Perhaps the greatest benefit of goat’s milk is that it can be tolerated by some people who have difficulty digesting cow’s milk. However, goat’s milk contains only slightly less lactose than cow’s milk (4.1% milk solids vs. 4.7%), and so can produce adverse digestive reactions in some people. Goat’s milk is lacking in several nutrients critical for growing infants; when feeding infants a goat’s milk-based formula, dietary supplementation is necessary.

Sheep’s milk. Very little fluid sheep’s milk is consumed in the U.S. Most sheep’s milk produced in North America is used to manufacture cheese and yogurt. Compared with cow’s milk, sheep’s milk is richer in Vitamins A, B and E, calcium, phosphorus, potassium and magnesium. It is denser in protein than cow’s milk, but also contains considerably more calories and more fat. Sheep’s milk is better tolerated by some people with adverse digestive reactions to cow’s milk, even though the two milks contain about the same amount of lactose.

Plant-based beverages. Manufacturers of soy- and rice-based beverages call their products “milk,” although legally that title can only be applied to a lacteal secretion. **Soy beverage** – an emulsion of oil, water and protein – is an aqueous extract of whole soybeans. It contains about the same amount of protein as cow’s milk, 2% fat and 2.9% carbohydrate. It is deficient in calcium and some vitamins and is not suitable for infants. A qualified “Heart Healthy” claim approved for use with soy beverage by FDA is disputed by the American Heart Association and the American Medical Association. **Rice beverage** is derived from brown rice and is sweetened with sugarcane syrup. Compared with cow’s milk, it contains about three times as much carbohydrate (due to sweetening). It contains less than 7% of the calcium found in cow’s milk and very little protein. It contains little lactose and no cholesterol. Plant-based beverages are frequently fortified with additives to compensate for deficiencies in their nutrient profiles.

Hormones. All foods derived from animals contain trace amounts of protein hormones, usually a few parts-per-billion (ppb). All milk naturally contains a few ppb of bovine somatotropin (bST), a cow growth hormone. However, animal growth hormones are non-reactive in human beings and they produce no effect. A man-made

duplicate of bST – called recombinant bovine somatotropin or rbST – is sometimes administered to cows to stimulate them to produce more milk. However, cows do not pass bST into their milk in proportion to the amount in their bloodstream, so milk from rbST-supplemented cows contains the same amount of growth hormone found in milk from unsupplemented cows. Milk from organically raised cows contains the same hormone, in the same amount, as milk from conventionally raised cows. The presence of these hormones in milk should be of no concern to consumers because they are simply proteins that are digested harmlessly in the human stomach. (www.rbSTFacts.org, www.MilkIsMilk.com)

Antibiotics, pesticides. No milk sold in the U.S. contains dangerous antibiotics or pesticides. Milk is repeatedly tested at the farm and the processing plant to ensure that it conforms to rigorous purity standards mandated by government authorities and the dairy industry. All milk that fails to meet these standards is destroyed before it can enter the human or animal food chains. Detection rates are approximately 100%. The most recent report of the FDA's National Milk Drug Residue testing program found that only 0.00067% (less than seven ten-thousandths of 1%) of all milk reaching processing plants in the U.S. failed to meet required antibiotic standards. All of this milk was destroyed before it could enter the human or animal food chains. The same report found that *none* of the milk tested contained any pesticide residues at all. The notion that milk is laced with dangerous antibiotics and pesticides is a myth.

Organic milk. "Organic milk" refers to the process by which it was produced, not to the product itself. Organically-produced and conventionally-produced milks are identical in their composition, nutritive characteristics, taste, purity and safety attributes. Organic production methods aim at recycling resources and promoting biodiversity, and these aims are valued by some consumers. However, all milk – regardless of how it was produced – must meet the same strict standards for content, wholesomeness and product safety. Marketing claims that organic milk is different from, and better than, conventionally produced milk have not been scientifically substantiated. (www.ams.usda.gov/nop/Consumers/brochure, www.eatright.org/cps/rde/xchg/ada/hs.xsl/home_4143_ENU_HTML, www.nationaldairycouncil.org/NationalDairyCouncil/Nutrition/Products/Organic, www.MilkIsMilk.com,).

RESOURCES

www.fda.gov (U.S. Food & Drug Administration)
www.ams.usda.gov (U.S. Dept. of Agriculture)
www.mypyramid.gov (U.S. Dept. of Agriculture, nutrition information)
www.eatright.org (American Dietetic Association)
www.nationaldairycouncil.org (National Dairy Council)
www.aap.org (American Academy of Pediatrics)
www.nmanet.org (National Medical Association)
www.webmd.com (Medical information)
www.rbSTFacts.org (Bovine growth hormone)
www.MilkIsMilk.com (Bovine growth hormone, organic milk)
www.igf-1-and-milk.com (Bovine growth hormone, IGF-1)
www.whymilk.com (National Milk Processor Promotion Board)

www.dairyfarmingtoday.org (Dairy production practices, animal welfare)
www.cgfi.org (Center for Global Food Issues)
www.3aday.org (Dairy products, health attributes, recipes)
www.ilovecheese.com (Dairy products, health attributes, recipes)
www.DairyNews.net (Nutrition science, health attributes)
www.WINForum.org (Nutrition information for athletes)
www.ThinkYourSnacks.org (Nutrition information)
www.havemilk.com (Washington Dairy Products Commission)
www.eatsmart.org (Washington State Dairy Council)
www.gotmilk.com (California Milk Processor Board)
www.actionforhealthykids.org (Nutrition information)
www.nutritionexplorations.org (Nutrition information)

