

PART ONE

**CHARACTERISTICS OF
DAIRY**

CHAPTER 1

US DAIRY INDUSTRY

HEALTH BENEFITS AND NUTRITION

Milk is highly nutritious and affordable and is valued by consumers for its contribution to health and taste. Consumers have access to a wide variety of dairy products to meet their nutritional needs, from fluid milk and cheese, to milk proteins in sports drinks. Milk and dairy products have an excellent nutritional profile to meet these varied needs.

Raw milk from the cow is roughly 87% water, with the balance being milk solids. These solids represent fat (about 3.9%), protein (about 3.2%), carbohydrates or lactose (about 4.9%), and smaller amounts of vitamins and minerals. The protein in milk includes casein and whey proteins. Proteins are vital for human health and are the major structural components of all cells in the body including hair, fingernails, serum albumin, and a large part of membranes. They help build and repair muscle tissue. Proteins are made up of amino acids which function as enzymes and hormones that are essential for life.¹ While the body has the ability to manufacture some of these amino acids, the balance must come from food. The nine “essential” amino acids that are needed for human health are contained in milk.² The fat in milk is made up of individual fatty acid molecules. According to the USDA, whole milk contains about 65% saturated, 28% monounsaturated, and 7% polyunsaturated fatty acids (see table 1.1). Fat provides energy needed for human sustenance. Milk also contains calcium and vitamin D needed for strong bones, and other important B vitamins.³

Calories

The USDA has created a “MyPlate Plan” that recommends a food

¹ Institute of Medicine, *Dietary Reference Intakes*.

² Histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. See Table 10-1, pg. 593, *Dietary Reference Intakes*.

³ Water soluble vitamins thiamin (B1), riboflavin (B2), niacin (B3), choline (B4), pantothenic acid (B5), pyridoxine (B6), folates (B9), cobalamin (B-12); and fat-soluble vitamins A, D, E, and K. See MilkFacts.com.

TABLE 1.1
COMPOSITION OF WHOLE MILK, 3.25% MILKFAT, WITH ADDED
VITAMIN D, PER 100 GRAM PORTION

	g	mg	kcal
Water	88.13		
Energy			61.1
Protein	3.15		12.6
Carbohydrate	4.80		19.2
Total lipid (fat)	3.25		29.3
Fatty acids:			
saturated	1.865		
monounsaturated	0.812		
polyunsaturated	0.195		
Minerals:			
Calcium, Ca		113	
Iron, Fe		0.03	
Magnesium, Mg		10	
Phosphorus, P		84	
Potassium, K		132	
Sodium, Na		43	
Zinc, Zn		0.37	
Copper, Cu		0.025	
Selenium, Se		3.7	

Note: g = gram; mg = milligram.

Source: USDA, FoodData Central, Milk, Whole, SR Legacy, FDC ID: 171265.

plan based on the calories needed by age, sex, and other physical properties. For example, a 40-year-old male with moderate physical activity would require 2,700 calories each day to maintain current weight. A 40-year-old female with moderate physical activity would require 2,200 calories per day. A calorie is a unit of energy that people get from food and drink. A “large calorie” (or kcal) is the amount of energy required to raise 1 kilogram (kg) of water by 1 degree Celsius. The original method used by the USDA to measure calories in food was to burn the food and measure the energy it produced. One kcal is equal to 1,000 calories (or kilocalorie). The calorie content on food packaging refers to kilocal-

ories. Thus, the USDA daily nutritional needs are for kcal's per day.

The calorie values in food are based on the Atwater system that classified the available energy in food as follows:

- 1 gram of carbohydrates contains 4 kcal.
- 1 gram of protein contains 4 kcal.
- 1 gram of fat contains 9 kcal.

The USDA calculates that retail packaged whole milk contains 3.25 grams (g) of milkfat, 3.15 g of protein, and 4.8 g of carbohydrates and other minerals per 100-g portion (table 1.1). Using the parameters of the Atwater system, whole milk contains 61 kcal of energy per 100-g portion. Whole milk also contains on average 113 milligrams (mg) of calcium and 132 mg of potassium. Fortified whole milk also contains numerous minerals including 1.3 micrograms (μg) of vitamin D, 0.046 mg of thiamin, 0.169 mg of riboflavin, and 0.089 mg of niacin. One cup of fortified whole milk (249 g) contains 8.14 g of protein and 149 kcal of energy.

Protein

The Recommended Dietary Allowance (RDA) for protein is 0.8 g per kilogram (kg) of body weight for males age 15-50 and older, and in females ages 11 and above.⁴ Thus, a 15-year-old female weighing 55 kg (121 pounds) would need to consume 44 g/day of protein. One cup of milk would provide her with 18.5% of the RDA for protein. Surprisingly, there is not an RDA for fat in the diet. According to the National Academy of Sciences, an RDA is not set for fat since there is insufficient data to determine a defined level of fat intake at which inadequacy or prevention of chronic disease occurs. Rather, an acceptable range for total fat in the diet of 20% to 35% of energy has been estimated.⁵

Fat

Fat is a necessary part of a human diet. Fat is in every cell in the body and makes up 60% of the brain. It is essential to the absorption of fat-soluble vitamins A, D, E and K. It also makes up part of the hormones that regulate our body. Fat in food (dietary fat) is also required to provide essential fatty acids such as alpha-linolenic (omega-3) and linoleic (omega-6) fatty acids, which are not produced by

⁴ National Research Council, *Recommended Dietary Allowances*.

⁵ Institute of Medicine, *Dietary Reference Intakes*, pg. 422.

the body. Fat also improves the taste of food and increases peoples feeling of dietary satiety, or feeling of satisfaction. However, given that fat has twice the calorie count per gram as protein or carbohydrates, excess fat consumption could lead to weight gain and health problems.

There are many different kinds of fat:

- **Lipids:** the scientific term that refers to fat, cholesterol and other fat-like substances. Lipids are organic compounds that are insoluble in water but soluble in organic solvents. Lipids consist of fats, phospholipids, and steroids.
- **Triglycerides:** one type of lipid that is made up of three fatty acids and one glycerol molecule. The three fatty acids can be identical or different and are typically 12-18 carbons long. It is the main type of stored fat or energy in the body. Triglycerides are also found in the blood and may trigger the liver to make more cholesterol.
- **Saturated fatty acids (SFA):** primarily from animal food sources such as meat, lard, eggs and dairy products. They are usually solid at room temperature. They range in chain length from 8 to 18 carbon atoms.
- **Monounsaturated fatty acids (MUFA):** primarily in canola oil, olive oils, peanut oil, high oleic safflower and sunflower oils, palm oil, and avocados. This fat is liquid at room temperatures.
- **Polyunsaturated fatty acids:** including omega-6's (vegetable oils such as corn, safflower, sunflower, soybean, cottonseed) and omega-3's (fish oil, flaxseed). They are liquid at room temperatures.
- **Essential fatty acids:** essential for human health, are not produced in the body, and must be provided by food. This includes omega-3 and omega-6 fatty acids.
- **Hydrogenated fats:** fatty acids that have been chemically altered. Unsaturated fats have a double bond between carbon atoms and are therefore liquid at room temperature. Under hydrogenation, the double bonds are replaced with single bonds. If just some of the double bonds are replaced, it's called "partial hydrogenation." If all the double bonds are turned into a single bond, a hydrogenated saturated fat is formed that is stable at room temperature. Hydrogenated fats are found in margarine and vegetable shortening, and other food products like baked goods, pizza, and popcorn.
- **Trans fatty acids:** occurs naturally in foods including dairy fat and