Milk and Milk Products

INTRODUCTION

Milk is the normal secretion of the mammary glands for the feeding of the young of mammals. In the United States, the primary milk in commerce is cow’s milk. The responsibility for insuring the quality of this food product rests primarily with the individual states rather than with the federal government. Consequently, legal definitions of milk are not uniform within the United States. The U.S. Public Health Service (USPHS) has encouraged the adoption of adequate and uniform state and local control legislation. The following definition from its Grade A Pasteurized Milk Ordinance (1965) has been adopted by a majority of the states: “Milk is hereby defined to be the lacteal secretion, practically free from colostrum, obtained by the complete milking of one or more healthy cows, which contains not less than 8½% milk solids-not-fat and not less than 3½% milk fat.”

The composition of milk is rather complex. Of the major components of milk, the one that most readily distinguishes milk from other foods is lactose, which occurs naturally only in milk. Similarly, casein occurs only in milk. The proteins of milk are of great importance and contribute essential amino acids necessary for normal health and growth. Milk fat is a palatable mixture of glycerides of fatty acids. The components of milk are in complex equilibrium, and much is yet to be learned regarding the forms and combinations in which they exist.
Lactose and some of the mineral salts are in true solution; the milk proteins as well as some of the calcium phosphate exist in colloidal solution; the fat exists in macroscopic dispersion in the milk plasma. Besides these major constituents, milk contains other constituents such as vitamins, enzymes, pigments, and lactic acid.

**COMPOSITION OF MILK**

The average gross composition of cow's milk is as follows: water, 87%; fat, 3.7%; lactose, 4.9%; proteins, 3.5%; and ash, 0.7%. However, the composition of milk from individual cows may vary considerably from these average values. Breed differences, the time of year, the time of day, individual differences, the age of the cow, the period of lactation, the portions of any one milking, feeding, etc., are some of the factors that may contribute to variation in the composition of milk.

Variations in milk composition due to breed are of the greatest magnitude. Jersey, Guernsey, and Ayrshire cows give milk richer in fat than Holstein cows. Usually milk obtained in the fall and early winter is richer than that obtained in the spring and summer. The morning milk is usually richer in fat than evening milk, at times by almost 2%. The first portions (or fore milk) of milk drawn in the milking process are lower in fat than the last portions (or strippings). Milk obtained the first few days after calving is known as colostrum and differs materially from normal milk. During the final stages of lactation, when the daily production of milk is decreasing, there is some increase in the percentages of fat and casein. The differences in milk composition occur mainly in the relative amounts of fat, protein, and water. The percentages of ash and lactose remain fairly constant in normal milk regardless of the amounts of other components.

**Fat**

Fat and associated lipid material are present in milk as an emulsion of small individual globules in an aqueous phase. These fat globules are predominantly in the liquid state at 37° and range in number from 2.5 to $5 \times 10^9$/ml of milk. The fat globules vary in size from about 0.1 to 10 μm in diameter, an average about 3 μm in diameter (1 μm is approximately 1/25,000 in.).

Surrounding each milk fat globule is a membrane composed of cholesterol, phospholipids, proteins, and other surface-active molecules. The fat globule membrane appears to have two layers: an inner layer