MILK FAT SIZE DISTRIBUTION BY LASER DIFFRACTION

INTRODUCTION
The role of milk in nature is to nourish and provide immunological protection. Milk has been a food source for humans since prehistoric times; from human, goat, buffalo, sheep, yak, and domesticated cow milk. Milk is also a very complex food with over 100,000 different molecular species found. There are many factors that can affect milk composition such as breed variations, including management and feed considerations, seasonal variations, and geographic variations.

Milk is an emulsion of fat globules within a water-based fluid. Each fat globule is surrounded by a membrane consisting of phospholipids and proteins; these emulsifiers keep the individual globules from joining together into noticeable grains of fat and also protect the globules from the fat-digesting activity of enzymes found in the fluid portion of the milk. The fat-soluble vitamins A, D, E, and K are found within the milk fat portion of the milk. Not only is the composition important in determining the properties of milk, but the physical structure must also be examined. Due to its role in nature, milk is in a liquid form. This may seem curious if one takes into consideration the fact that milk has less water than most fruits and vegetables. Milk can be described as:

- an oil-in-water emulsion with the fat globules dispersed in the continuous serum phase
- a colloid suspension of casein micelles, globular proteins and lipoprotein particles
- a solution of lactose, soluble proteins, minerals, vitamins other components.

The main structural components of milk, fat globules and casein micelles, are shown in figure 1.
MILK FAT GLOBULES – PARTICLE SIZE

Properties such as flavor, emulsion stability and sensory feel (mouth feel) are related to the particle size of the fat droplets present in milk. More than 95% of the total milk lipid is in the form of globules ranging in size from 0.1 to 15 µm in diameter, with milk fat having size ranging from 1 – 10 µm, depending on cow breed and season. If the droplet size is too large creaming, due to poor stability, could be generated, thus, providing a product with a greasy taste. On the other hand, a size that is too small may cause may lead to flocculation.

PARTICLE SIZE MEASUREMENTS

Four different types of milk, fat free, low fat (1%), reduced fat (2%), and whole milk (3.25%) obtained from a local market, were analyzed with the Beckman Coulter LS 13 320 laser diffraction particle size analyzer. For the determination of the size distribution a refractive index of 1.462 (RI for milk fat) was used. Figure 2 is an overlay of the results obtained.

The graph clearly shows the difference in particle size due to fat content. The smaller size reported on the Fat Free sample is due to the casein micelles which typically have a size from 100 – 300 nm.

Figure 2  Particle size overlay of the different types of milk used in this experiment