

In the United States, milk is generally purchased in liquid form and milk powder is not regarded as a standalone dietary staple. Rather, powdered milk is primarily used as an ingredient in other products, such as infant formula, candies, and other edible goods. However, for much of the world, powdered milk serves as the primary source of milk product, particularly in developing countries relying on scarce transportation, storage, and refrigeration resources. Its versatility, high level of nutrient concentration, and long shelf-life make it invaluable to the lives of millions around the world, an essential part of food aid supplies, and a key component of the global dairy industry. As markets for milk powder continue to emerge and expand, manufacturers must increasingly engage in highly developed quality assurance practices to guarantee consistency, safety, and palatability.

The Need for Accurate Color Measurement

The color of milk is a prime indicator of quality and can vary depending on animal husbandry practices, processing methods applied to raw milk, and environmental stressors on the final milk product. Dehydrated milk products are particularly vulnerable to color change due to high heat exposure during processing, which may induce browning known as [the Maillard reaction](#), interfering with not only aesthetic appearance but reflecting undesirable chemical changes in the milk powder composition that compromise taste and safety. Prolonged storage periods, elevated temperatures, moisture exposure, and packaging materials can also induce color change and lead to spoilage.¹ As such, close color monitoring is necessary to ensure consistent optical and chemical quality as well as to evaluate how process variables contribute to color change and, by extension, product quality.

Traditionally, color monitoring was done via visual inspection, a time-consuming and laborious process prone to inaccuracy and inconsistency due to the [inherently subjective nature of human sight](#). Today, a growing number of manufacturers are turning to spectrophotometric analysis for a simple and effective way of objectively quantifying milk powder color, allowing operators to quickly identify color changes and analyze their relationship with process variables. Directional 45°/0° reflectance instrumentation is ideal for color measurement of both dehydrated milk in powder form as well as reconstituted milk to allow you to evaluate the product in multiple forms. When used within the milk dehydration production line, spectrophotometers can enhance product consistency and monitor quality with exacting precision throughout the manufacturing process. But spectrophotometers aren't just measuring existing color, they are contributing to the development of superior industry practices as producers seek to improve their products.

Refining Manufacturing Practices

South America is home to several of the largest producers of dehydrated milk products and both people and economies depend on the powdered beverage for sustenance. In order to optimize production and fortify the market, a group of Argentinian researchers set out to determine the impact of heat treatments and manufacturing season on color change.² Using a reflectance spectrophotometer to obtain CIE Lab scale values, the team analyzed color data from milk powder after both direct and indirect heat treatment and found distinct color shifts created by the methods. The results indicated that indirect heat treatment, which requires greater, more sustained heat application, produced more pronounced browning as the result of "the combined action of temperature and time." Meanwhile, direct heat application had a less severe effect on color. However, the exact nature of the color shifts was also dependent on the quality of the raw material; the milk powder produced in the summer had lower L* values along with higher a* and b* values. This may be due to the [fluctuating chemical composition](#) of the raw milk as determined by seasonal animal diet. In particular, variation in carotene levels appears to determine the level of browning reaction each sample displayed when exposed to both direct and indirect heat processing.

These observations could have important implications for milk powder manufacturing practices and product success. As dairy processing research continues to harness the power of spectrophotometry to analyze color change in response to processing variables, farmers and manufacturers alike can tailor their production to satisfy the demands of consumers as well as develop more exact methods to improve product stability and

maximize shelf-life. This may be particularly critical in countries like Argentina, where powdered milk is the primary dairy export and acts as a major economic engine. Moreover, enhanced quality assurance is critical to meeting the needs of populations who rely on milk powder to safely deliver essential nutrients.

Full article with photos available here:

<https://www.hunterlab.com/blog/color-food-industry/how-color-measurement-via-spectrophotometers-is-bringing-milk-powder-production-to-new-heights/>