The quality of a dairy product is largely determined by its microstructure which also affects its optical properties. Consequently, an assessment of the optical properties during production may be part of a feedback system for ensuring the quality of the production process. This paper presents a novel camera-based measurement technique that enables robust quantification of a wide range of reduced scattering coefficients and absorption coefficients. Measurements are based on hyperspectral images of diffuse reflectance in the wavelength range of 470 to 1020 nm. The optical properties of commercially available milk and yogurt products with three different levels of fat content are measured. These constitute a relevant range of products at a dairy plant. The measured reduced scattering properties of the samples are presented and show a clear discrimination between levels of fat contents as well as fermentation. The presented measurement technique and method of analysis is thus suitable for a rapid, noncontact, and non-invasive inspection that can deduce physically interpretable properties.