

## **Evaluation of vacuum packaging on the physical properties, solubility, and storage space of dairy powders**

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Dry dairy ingredients can have a long shelf life if packaged and stored properly. Vacuum packaging can be an attractive method for keeping quality and provides added value; because of the inherent compactness of the products. Vacuum packaged dry dairy ingredients may also have added ease of handling for end users. However little is known about the impact of vacuum packaging on the properties of dry dairy ingredients. The objective of this study was to determine the effects of vacuum packaging on particle size, (particle, bulk, and tapped) densities, flowability, compressibility, color, and solubility of six types of dry dairy ingredients. Commercial samples of nonfat dry milk powder, whole milk powder, buttermilk powder, milk protein isolate, whey protein concentrate 80, and sweet whey powder were repackaged in duplicate using multi-wall foil side gusseted bags under varying degrees of vacuum (1, 0.7, 0.4 bar) and a control with no vacuum, and then stored for 3, 6, and 12 months at 25°C and 60% relative humidity. Each powder was sampled and analyzed in duplicate for all the quality attributes mentioned above upon receiving and after 3, 6, and 12 month storage. At  $\alpha = 0.01$ : particle size, (particle, bulk and tapped) densities, and flowability of the powders increased (all p-values = 0.000), while the compressibility decreased ( $p = 0.004$ ) due to the significant effect of storage time. Powders packaged under vacuum showed a higher mean of L- color value ( $p = 0.003$ ), but significantly lower means of (a- and b-) color values, (p-values = 0.005, and 0.001 respectively) due to the significant effect of vacuum pressure. This change in color values was more dramatic in high fat containing powders such as whole milk powder. No significant change was observed in solubility of the powders. The storage space calculations showed that vacuum packaging saved 15 % storage space per bag/ pallet. The data suggest that the proposed vacuum packaging method may be beneficial to maintain the quality of the powders studied while it results in improved space savings per unit of dairy powder.