Oil Migration in Chocolate

Understanding the mechanism behind the migration of oil through chocolate will help to optimize existing strategies to control deterioration and to develop new ones.

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Oil migration is responsible for the poor keeping qualities of many composite confectionery products with nut-based centers, coated biscuits or nut inclusions. Quality defects arising from oil migration include softening of the coating, hardening of the filling, deterioration in sensory quality and a greater tendency to fat bloom. For this reason, oil migration has been extensively studied, most recently by magnetic resonance imaging (mri). Despite the recent attention paid to the oil migration, confusion regarding its origins and control still exists.

To completely stop oil migration and quality deterioration in nut-chocolate composite products is nearly impossible. The goal of the confectionery technologist is to slow oil migration through proper selection of ingredients, processing conditions and postmanufacture handling so that acceptable quality is maintained during the product’s anticipated shelf life. Until we gain a clear understanding of the mechanism behind the migration of oil through chocolate, the process of optimizing the influential factors will be hit-and-miss, and there will be an eternal quest for the magic bullet to stop this persistent problem.

**BASIC MECHANISM OF MIGRATION**

The flux, or migration, of any substance can be equated to a force driving the movement divided by a resistance opposing it:

\[ \text{Flux} = \frac{\text{Driving Force}}{\text{Resistance}} \]

To eliminate oil migration \((\text{Flux} \approx 0)\) we need to eliminate the driving force or make the resistance so high that migration is effectively stopped. Examples of the latter approach include adding a barrier between the filling and the chocolate (for example a sugar glass) and use of the physical structure of either the filling or the chocolate to impede the progress of the oil. This has been the primary means of addressing the problem over the years, but with only modest success.

Recently, the idea that the driving force for oil migration is capillary pressure has taken root. What began as one potential explanation for an anomalous observation by mri has become an explanation for oil migration through chocolate. However, this would require a chocolate structure of empty interconnected pores, which it does not have (gas permeability analysis of chocolate suggests that pores are either closed or filled with liquid). Capillary pressure has been proposed as another potential mechanism for oil migration in chocolate, in part because of an apparent lack of fit of...