Nut Oil Migration Through Chocolate

Gregory R. Ziegler, PhD, A. Shetty and R.C. Anantheswaran
Pennsylvania State University

Oil migration is responsible for the poor keeping qualities of composite confectionery products like those with nut-containing centers, coated biscuits and 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 formation. For this reason, oil migration has been extensively studied. Even with all the recent attention paid to the topic, confusion regarding its source and control still exists.

To completely stop oil migration in nut-chocolate composite products is impossible; the goal of the confectionery technologist is to slow oil migration through proper selection of ingredients, processing conditions and postmanufacture handling. But until we gain a clear understanding of the mechanism behind the migration of oil through chocolate, the process of optimizing these influencing factors will be hit-and-miss, and there will be an eternal quest for the magic bullet to stop this persistent problem. Therefore, the objective of this paper is to explain in the most straightforward way possible the mechanism of oil migration through chocolate as it affects the shelf life of composite nut-chocolate confections. This poses a significant challenge since the mechanism of oil migration involves the coupling of two complex phenomena — molecular diffusion and phase behavior — and diffusion in particular is difficult to explain without the use of mathematical concepts.

BASIC MECHANISM OF MIGRATION

Within any homogeneous material or phase, molecules will diffuse by random molecular motion so as to eliminate any differences in concentration between two points (i.e., a concentration gradient). In the case of oil migration, this concentration gradient is the difference in the triacylglycerol composition between the oil and the cocoa butter (or cocoa butter-milk fat mixture) of the chocolate. Picture yourself at the Tuesday evening Production Conference reception. You are hungry and those cheese-filled peppers are calling to you. However, between you and the food stand about 200 conference attendees. You can’t necessarily walk in a straight line to the food table, but must negotiate your way through the crowd taking advantage of momentary openings here and there to move past people. In a similar...