

Generation of 3-monochloro-1,2-propanediol-related Materials from tri-, di-, and monoolein at Deodorization Temperature

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The mitigation of 3-monochloro-1,2-propanediol-related materials (3-MCPD-RM) is a big challenge because of possibly adverse effects of the compounds to human health. For the development of appropriate mitigation strategies it is necessary to know more about the mechanism and the contribution of the precursors to the formation of these compounds.

In this study, we conducted heating tests of pure tri-, di-, and monoolein (TO, DO, and MO, respectively) with and without adding tetrabutylammonium chloride as a chloride source at 240 °C to clarify the contribution of each acylglycerols. The results revealed the characteristic reactions that generate 3-MCPD-RM. 3-MCPD-RM were formed mainly from DO and MO, with only a small amount from TO. GE was the predominant class of 3-MCPD-RM generated from both DO and MO, and was increased continuously throughout the heating period with comparable rates in both DO and MO. However, 3-MCPD esters were also generated mainly from DO and MO in the presence of a chloride source, which seemed to feature a reaction that was completed in the early stages of the heating period, and required only minimal amounts of heating. TO generated only a negligible amount of 3-MCPD-RM. TO seemed stable at a deodorization temperature. This result supports the demand for raw material low in DO and MO for the production of 3-MCPD-RM reduced edible oils. Additionally it becomes clear that the heating history is important to control the GE levels. On the contrary, the chloride source should be removed to decrease the level of 3-MCPD esters. Although free 3-MCPD and glycidol were confirmed only in MO heated in the gastight heating system, and were not confirmed in DO and TO. Their presence was never confirmed in oils heated with a gas-stream, which simulated manufacturing conditions. Since an interesterification reaction, which produces free-form glycerol, was observed only for heated MO, free glycidol might be a precursor for free-form 3-MCPD.