## Construction of Cold-triggered/Heat-destroyed Emulsions for Use as a Practical Cold-Storage Thermal History Indicator

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To provide a record of the occurrence of a high-temperature event during a cold-chain system in the range from 1°C to 10°C, an indicator material that undergoes an irreversible temperature-related visual change in response to high temperatures is needed. In order to obtain the aimed indicator, we tried to construct highly thermo-sensitive cold-triggering and heat-destructive emulsions that can start monitoring a high temperature event just on-cooling, and after the triggering give irreversible visual change over the upper limitation of the monitoring temperature. Emulsions composed of oil mixtures of triacylglycerols and fatty acid esters gave the 1°C triggering and 10°C destructive emulsion. The effect of the oil phase composition was studied by differential scanning calorimetry (DSC), nuclear magnetic resonance (NMR) and microscope with a cooling/heating system.

The emulsion was triggered by cooling at 1°C, and was immediately destroyed by heating to 10°C with clear visible phase separation. For the cold-triggering, crystalline structures of frozen oils should work to destruct the interfaces of the emulsion droplets. It can be used as the thermal indicator that was triggered in cold-chain distribution systems and that was destroyed out of these systems.



1) K. Nagata, T. Mizoguchi, M. Kitsunai, K. Hirose, A. Hirasawa and K. Chiba, Cold-triggered/Heat-destroyed Emulsions Composed of Phospholipids and Triacylglycerols as Thermal History Indicators for Cold-Chain Distribution Systems, *J. Sci. Food Agric.*, 2008, 88, 1019–1024.

2) T. Mizoguchi, K. Nagata, M. Kitsunai, K. Hirose, A. Hirasawa, and K. Chiba, Construction of Cold-triggered/Heat-destroyed Emulsions for Use as a Practical Cold-Storage Thermal History Indicator, *J. Sci. Food Agric.*, 2009, 89,1453-1461.