

## **Modulating the crystallization of phytosterols with monoglycerides in the binary mixture systems: mixing behavior and eutectic formation**

### **ABSTRACT**

Phytosterols (PSs) are insoluble in water and poorly soluble in oil, which hampers their potential as cholesterol level regulator in human. To mitigate this problem, monoglycerides (MGs) were used to modulates the crystallization behavior of PSs. Therefore, the understanding on mixing behavior provides the insight into different aspects of crystallization and the resultant effects. The effects on thermal, morphology, diffraction, and spectroscopy behavior were investigated for binary mixtures of 11 different ratios (100:0 to 0:100 MGs:PSs). The phase behavior of binary mixtures of commercial MGs and PSs exhibited complexity with the formation of eutectic mixtures at 90:10 and 80:20 (MGs:PSs) combinations. These combinations revealed a single melting profile and reduced melting enthalpy, though after a month of storage at 5 °C. Conversely, two separate melting regions were observed in others. Furthermore, powder X-ray diffraction (PXRD) analysis of selected combinations revealed a change in crystalline forms with changes in the peaks located between 18-19° (2θ) and 25-26° (2θ). Accordingly, Raman spectroscopy results revealed changes in intensities and peak shape. Therefore, the change in crystalline forms or behavior correlated well to the change in thermal properties. Overall, the characterizations revealed the formation of eutectic mixtures between MGs and PSs at 90:10 and 80:20 (MGs:PSs) in which MGs modified the crystallization of PSs and changed the crystal forms thus, thermal behaviors. This study provides new insight into the mixing behavior of MGs and PSs which supports other research. Therefore, the results of this study are beneficial for the improvement of formulation of phytosterols in food and pharmaceutical products. Nonetheless, this study reveals a simple technique to alter crystal forms of phytosterols through simple complexation with monoglycerides.