Phase behaviour of the mixture of triacylglycerol stereo isomers

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Triacylglycerols (TAG) function as depot fat for most animals. Many overwintering livings accumulate TAG before winter and use them for basal metabolism. During winter TAG should not be solidified in order to be easily digested by lipase. Known as the relationship between the transition temperature of TAG and the degree of unsaturation of their fatty acyl chains, organisms living at low temperatures have a mechanism for increasing the degree of unsaturation in the fatty acyl chains. In fact, the cold-tolerant Drosophila flies increase the degree of unsaturation before winter. They may have another strategy to lower the transition temperature of TAG mixtures using the unsaturated fatty acids on hand. They distribute unsaturated fatty acids into at least one of the three fatty acyl chains of TAG, that is, they decrease a number of saturated TAG (the three fatty acyl chains are all saturated) as possible [1]. In the present study, we mixed two TAG stereo isomers, sn-1,2-dioleoyl-3-stearoylglycerol (OOS) and sn-1,3-dioleoyl-2-stearoylglycerol (OSO), as a model fuel of flies and examined the phase behaviour and structural changes. For this purpose, the simultaneous measurements of time-resolved X-ray diffraction and differential scanning calorimetry (DSC) using synchrotron radiation source were operated at the photon factory in Tsukuba [2]. Fig. 1 shows the phase diagram of OOS/OSO mixtures drawn by plotting the peak temperatures of main endothermic transitions observed in the DSC thermograms. Depending on the thermal history, several small DSC peaks and complicated changes of X-ray diffraction patterns were observed in the solid phase temperature region. These suggest the existence of several metastable solid phases. To assign the metastable phases, detailed analyses are now in progress. In any case, the phase diagram of OOS/OSO mixtures exhibits a typical eutectic feature. The present study demonstrates that even if the degree of unsaturation is the same, the melting temperature of TAG mixtures is affected by the composition of TAG molecules, and supports the strategy of overwintering insects found in our former report [1].

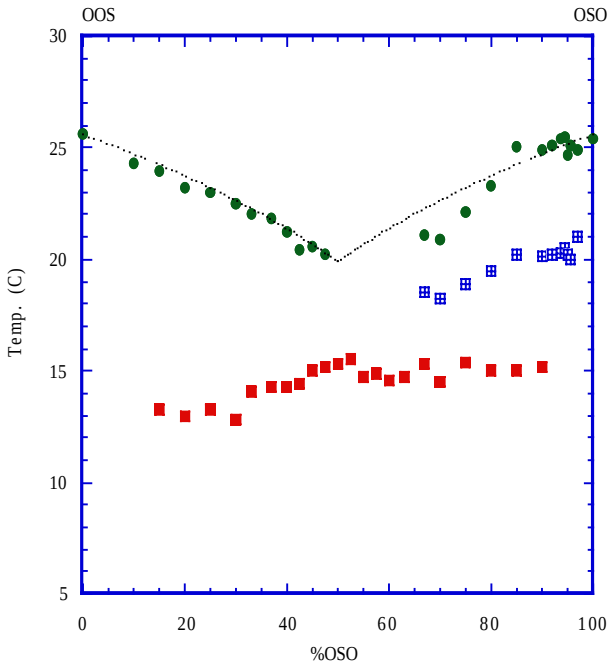

Fig. 1 The phase diagram of OOS/OSO mixtures.
The dotted line curves represent theoretical phase boundaries calculated under the following assumptions: the latent heats are temperature independent and the TAG (OOS and OSO) are phase-separated completely in a solid phase but are mixed ideally in a liquid phase.

References

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