

Physical Properties of Rice Bran Wax in Bulk and Organogels

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Abstract

Differential scanning calorimetry (DSC), optical microscopy, and X-ray diffraction (XRD) were used to examine the thermal behavior, crystal structure, and crystal morphology of rice bran wax (RBX) in bulk and oil-wax mixtures, and to compare them with those of carnauba wax (CRX) and candellila wax (CLX). The RBX employed in the present study was separated from rice bran oil by winterization, filtration, refinement, bleaching, and deodorization. The RBX crystals melted in bulk state at 76°C with $H_{\text{melting}} = 190.5\text{J/g}$, which is quite large compared with CLX (129J/g) and CRX (137.6J/g). XRD data of the RBX crystals revealed O_{\perp} subcell packing and a long spacing value of 6.9nm. Tiny needle-shaped crystals were observed in the mixtures of RBX and liquid oils (olive oil, salad oil, and liquid paraffin); therefore, the dispersion of RBX crystals in these liquid oils was much finer than that of CRX and CLX crystals. Organogels formed when the mixture of every plant wax and liquid oil was melted at elevated temperature and cooled to ambient temperature. However, the mixture of RBX and olive oil at a concentration ratio of 1:99wt% formed organogel at 20°C, whereas the lowest concentration necessary for CRX to form organogel in olive oil was 4wt% and that for CLX was 2wt%. Observation of the rate of gel formation using DSC and viscosity measurements indicated that the gel structure formed soon after RBX crystallized, whereas a time delay was observed between the organogel formation and wax crystallization of CRX and CLX. These results demonstrate RBX's good organogel-forming properties, mostly because of its fine dispersion of tiny crystals in liquid oil phases.