

## Crystallization kinetics of palm oil in blends with palm-based diacylglycerol

### Abstract

Crystallization kinetics of palm oil (PO) in the presence of different concentrations (2, 5, 10, 30 and, 50% w/w) of palm-based diacylglycerol (PB-DAG) were investigated over different ranges of crystallization temperatures. Addition of 30 and 50% (w/w) of PB-DAG (high concentrations) increased significantly ( $P < 0.05$ ) the melting point and crystallization onset while addition of 2 and 5% PB-DAG did not have significant ( $P > 0.05$ ) effect. PO and PO blends with 2 and 5% of PB-DAG showed crystal transformation at crystallization temperatures (TCr) of 26, 26, 26.5 °C, respectively as reflected in corresponding changes of the Avrami parameters at below and above these TCr. This was especially evident for the blends containing 2 and 5% of PB-DAG. Individual comparison of induction time ( $T_i$ ), Avrami exponent ( $n$ ), Avrami constant ( $k$ ) and half-time of crystallization ( $t_{1/2}$ ) of blends classified under various supercooling ranges based on the supercooling closeness ( $\pm 0.1$  °C), showed that addition of 5% of PB-DAG in most of the supercooling ranges significantly ( $P < 0.05$ ) reduced nucleation rate as well as crystal growth velocity of PO. This was reflected in the significantly ( $P < 0.05$ ) higher  $T_i$  and  $t_{1/2}$  and lower  $k$ . Although the presence of 2% of PB-DAG was found to have inhibitory effect on PO crystallization, this effect was not significant ( $P > 0.05$ ). Mode of crystal growth attributed to  $n$  was changed significantly only in presence of 5% of PB-DAG. Furthermore, presence of 10% PB-DAG showed  $\beta'$ -stabilizing effect on PO. On the other hand, high concentrations of PB-DAG were found to significantly ( $P < 0.05$ ) reduce  $T_i$  as well as  $t_{1/2}$  and also increase  $k$  suggesting their promoting effects on nucleation and crystallization rate of PO even with the close supercoolings. In addition, they changed crystal growth mode of PO. Amongst the different concentrations of PB-DAG investigated, blend containing 50% of PB-DAG as compared to PO, not only, have healthier benefits but also, may have greater potential applications in plastic fat products due to its unique physical properties.

**Keyword:** Palm oil; Palm-based diacylglycerol; Isothermal crystallization; Avrami model