Measurement of Energy Release of RBD Palm Oil at different Temperatures by Differential Scanning Calorimetry and Correlation with the Degradation of Glycidyl Esters during Storage

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During storage of RBD palm oil at 5°C, 10°C and 15°C glycidyl esters are degraded with 0.5, 0.4 and 0.2 mg/kg per month, while at a storage temperature of -18°C and 20°C this phenomenon is not observed. This experimental result can lead to the hypothesis that the internal energy of the oil is responsible for its properties of condensed matter phase. Differential Scanning Calorimetry (DSC) can be used to determine the internal energy content.

As an example, the energy of crystallization is shown on a DSC thermogram within the temperature range where a degradation of glycidyl esters was found. From this the hypothesis was defined that crystallization energy released during storage could be sufficient for the degradation of glycidyl esters by cleaving the epoxide binding [1].

In the presented work this hypothesis should be verified by DSC measurement of the released energy. DSC curves of heat flux vs. time of RBD palm oil have been measured isothermal at -18°C, 5°C, 10°C, 15°C and 20°C and the energy released during the measurement was calculated from the integration of the curves.

The results from the DSC measurement show a good agreement with the results from the measurement of the degradation of glycidyl esters during storage at different temperatures. During storage of RBD palm oil at 5°C, 10°C and 15°C an energy release between 30 J/g and 40 J/g was found, storage at -18°C and 20°C, respectively, resulted in no release of energy. When assuming a medium energy content of a C-O binding of 358 KJ/mol and molar mass of glycidyl esters of 340 g/mol it results in an energy demand of 1 J for the cleavage of 1 mg glycidyl ester. Thus the energy released during storage at 5°C, 10°C and 15°C should be sufficient for the degradation of glycidyl esters.

[1] Matthäus, B.; Weitkamp, P.; Vosmann, K.: Behaviour of 3-MCPD Fatty Acid Esters and related Compounds under different Storage Conditions. 11th Euro Fed Lipid Congress, 27. - 30. October 2013, Antalya, Turkey.