Kinetic modeling of multi-component crystallization of industrial-grade oils and fats

Transient crystallization kinetics is investigated for complex, industrial-grade vegetable oils consisting of more than ten triacylglycerols (TAG). The classical nucleation model has been used to describe primary nucleation, while secondary nucleation has been described by a semi-empirical approach. Growth is modeled using a modified Burton-Cabrera-Frank (BCF) model. Surface tensions and growth constants have been determined using focused-beam-reflectance measurements (FBRM). The required adjustable parameters in the model have been fitted to overall crystallization curves obtained by solid-fat content (SFC) measurements for a given oil at different cooling rates and degrees of dilution. The developed model can accommodate more polymorphs simultaneously and performs well with respect to predicting crystallization onset, rate of crystallization and final SFC value. It can also qualitatively describe how higher cooling rates lead to formation of more meta-stable crystals and smaller mean-crystal sizes. The model provides a good starting point for developing more realistic, transient models for TAG crystallization with the ability to accommodate processing conditions and complex chemical compositions. Such a predictive model may provide a powerful tool to screen and optimize oil formulations in industrial processes and allow product developers to evaluate recrystallization events.

General information
State: Published
Organisations: Department of Chemical and Biochemical Engineering, CAPEC-PROCESS, CHEC Research Centre, AAK Denmark A/S
Contributors: Hjorth, J. L., Miller, R. L., Woodley, J. M., Kiil, S.
Pages: 1066-1078
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: European Journal of Lipid Science and Technology
Volume: 117
Issue number: 7
ISSN (Print): 1438-7697
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.22 SJR 0.776 SNIP 1.05
Web of Science (2017): Impact factor 2.2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.06 SJR 0.712 SNIP 1.042
Web of Science (2016): Impact factor 2.145
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.85 SJR 0.643 SNIP 0.878
Web of Science (2015): Impact factor 1.953
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.98 SJR 0.742 SNIP 1.052
Web of Science (2014): Impact factor 1.812
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.16 SJR 0.863 SNIP 1.122
Web of Science (2013): Impact factor 2.033
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.06 SJR 0.864 SNIP 1.221
Web of Science (2012): Impact factor 2.266