

Isomerization and Polymerization of Sunflower Oil Polyenoic Fatty Acids under High Temperatures

Vladimír Filip , Klára Cihelková, Markéta Zárubová, Iveta Hrádková, Jan Šmidrkal

Institute of Chemical Technology Prague, Czech Republic

Isomerization and polymerization reactions of double bonds of essential fatty acids in plant oils occur under high temperatures. Undesirable *cis-trans* isomers of polyenoic fatty acids are formed especially by physical refining and deodorisation, where they influence the final oil quality.

The aim of this study was to investigate heat induced *cis-trans* isomerization and polymerization of standard sunflower oil and high oleic acid sunflower oil depending on temperature, reaction time and original content of linoleic acid in oil.

Plant oils were heated in glass laboratory reactor in argon atmosphere at temperatures from 200 to 250 °C till 170 hours. The content of isomeric fatty acids was determined by CGC and the content of polymers GP HPLC.

The content of *trans* isomers of fatty acids increased with time and with temperature and this interaction is irreversible. The main products of isomerization are *cis-trans* isomers (*9cis,12trans-*, *9trans,12cis-*) and conjugated isomers of octadecadienoic acid. These products take part in the polymerization reactions immediately. The rate of *cis-trans* isomerization and polymerization depends on the temperature according to Arrhenius equation. The degree of isomerization of octadecadienoic acid was significantly higher than the isomerization degree of octadecenoic acid. The decrease of original octadecadienoic acid corresponds with the kinetics of the first-order, but regarding the increase of individual *trans* fatty acid isomers the isomerization reaction is close to the zero-order.

The content of polymers was significantly lower in sunflower oil with high content of oleic acid because of the low concentration of linoleic acid in oil. The content of conjugated linoleic acid (conjugated isomers of octadecadienoic acid) initially increased depending on time and temperature of isomerization in both oils, however after certain time the stationary state occurred, because the forming conjugated isomers were consumed in the polymerization reaction. This is validated by obtained linear correlation between the content of polymers and the content of conjugated linoleic acid.

Polymerization of polyenoic fatty acids takes place in the wake of heat induced *cis-trans* isomerization of fatty acids.