Melting properties of some structured lipids native to high stearic acid soybean oil

By G.R. List*, R.O. Adlof, C.J. Carrierre and R.O. Dunn

Food and Industrial Oil Research, National Center for Agricultural Utilization, ARS, USDA, 1815 N. University Street, Peoria, IL 61604.

Ph. 309-681-6388. Fax 309-681-6340. E-mail: listGR@ncaur.usda.gov

1. INTRODUCTION

During the past decade a number of structurally modified soybean oils high in saturated acids have been introduced (Lui 1999, List et al. 1996, List et al. 1997). In their natural state, these oils exhibit melting points about 15°C lower than hydrogenated oils used in spreads and they lack sufficient solids at temperatures above 10°C (i.e. 21.1-33.3°C). This work was undertaken to characterize the physical properties of some structured lipids native to high stearic acid soybean oil.

2. MATERIAL AND METHODS

Stearic (S), oleic (O), linoleic (L) and linolenic (Ln) acids were purchased from Nu-Chek-Prep, Elysian, MN and were found 100% pure after conversion to methyl esters and analysis by gas chromatography. The symmetrical triacylglycerols, SOS, SLS and SinS, were synthesized from 1,3-distearyl glycerol and the appropriate fatty acid. SOS, SLS and SinS showed purities of 98.4, 100 and 100% respectively as determined by HPLC (Neff et al. 1994). SOS contained 1.6% tristearin as an impurity.

The solid fat content (SFC) was determined by pulsed nuclear magnetic resonance spectroscopy according to the official AOCS method (Anon 1989). A Bruker Minispec instrument was used, Toronto, ON. The temperature range studied was from 10-50°C. Drop melting points were determined according to the official AOCS method and values reported are the means of duplicate determinations (Anon 1989). The agreement between duplicates was equal to or better than the ± 1.4°C variability reported as acceptable for the method.

Heats of fusion (ΔH) were determined by differential scanning calorimetry (DSC) according to...
the official AOCS method (6). A TA instruments model 2910 DSC was used, New Castle, DE. Melting points by DSC were found to have a standard deviation of ±1.3% and were within the ranges reported for the methodology. Heats of fusion (ΔH) were reproducible to within ±5.1%.

3. RESULTS AND DISCUSSION

Although pulsed NMR had found widespread use to estimate solid fat in triacylglycerol oils (List et al., 2001), little or no data have been published for pure, individual triacylglycerols. The solid fat contents of the symmetrical triacylglycerols SOS, SLS and SlnS are given in Table I along with their drop melting points and heats of fusion. Their solid fat content over 10-50°C range shows the interesting functional properties of these triacylglycerols since, at the temperatures used to define the solid fat content of an edible oil, they show high, but sharply melting properties. Triacylglycerols which melt sharply are of particular importance components of food oils since they impart a pleasant, cooling sensation in the mouth and, therefore, affect the sensory properties of spreads (Bessler and Orthoefer, 1983). At temperatures of 10-33°C they all contain high amounts of solids (39-93%) yet are completely melted at 36-44°C. The completely saturated SSS triglyceride melts at 73.5°C, while SOS, which contains 1 double bond/molecule, melts at 44.1°C, 2 double bonds/molecule (SLS) melts at 37.9°C and 3 double bonds/molecule (SlnS) melts at 36.5°C.

Compared to the melting points of fully trisaturated triacylglycerols, including tristearin (SSS), tripalmitin (PPP), trimyristin (MMM) and trilaurin (LaLaLa), the introduction of oleic acid into the two position, forming symmetrical triacylglycerols, lowers the melting point about 30°C. For example, SSS melts at 73.5°C compared to 44.1°C for SOS, tripalmitin melts at 65.5°C compared to 35.2°C for POP, trimyristin melts at 57°C compared to 26.3°C for MOM and LaLaLa melts at 46.4°C compared to 16.5°C for LaOLa (Bailey, 1950). The heat of fusion data (ΔH form) for SSS, SOS and SLS are in agreement with Sato (2001) while the heat of fusion for SlnS has not been reported. Heats of fusion were also calculated from Mettler dropping point determinations as admixtures with soybean oil and the results, with the exception of SSS, showed consistent agreement with the DSC data.

ACKNOWLEDGMENTS

K.R. Steidley conducted the experimental work.

REFERENCES


Recibido: Enero 2003
Aceptado: Agosto 2003