Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl19

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Version of record first published: 04 Oct 2006

To cite this article: Leonorina Cada, Arnold Tamayo, Zenaida Domingo, Ellen Lug & Almira Cruz (1997): Liquid-Crystalline Properties of Cholesteryl Esters Derived from Coconut Oil, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 304:1, 403-407

To link to this article: http://dx.doi.org/10.1080/10587259708046988

Mol. Cryst. Liq. Cryst., 1997, Vol. 304, pp. 403–407
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LIQUID-CRYSTALLINE PROPERTIES OF CHOLESTERYL ESTERS DERIVED FROM COCONUT OIL

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Abstract Cholesteryl esters derived from coco-fatty acids were prepared and were found to exhibit the cholesteric and smectic mesophases. Mixtures consisting of these esters and commercial nematic liquid crystals were characterized using DSC and polarizing microscopy. Polymer-dispersed formulations were also studied.

INTRODUCTION

Since fatty acid esters of cholesterol are among those cholesterol derivatives that have been found to exhibit liquid crystalline properties,[1] it is then the objective of this study to prepare them from locally available materials like fatty acids derived from coconut oil and to determine their liquid crystalline properties when prepared as such.

Coconut oil was chosen as the source of fatty acids because of its abundance in the Philippines making it not just readily available but also relatively cheap. Typical composition of coconut oil includes about 48% of lauric acid, 19% myristic, 8% caprylic, 7% capric, 7% palmitic, 6% oleic, 4% stearic and 1% linoleic acid. [2]

SYNTHESIS

Extraction of fatty acids from commercial coconut oil (cooking oil) was done via the cold saponification process.[3]

The mixture of fatty acids was reacted with cholesterol using DCC and DMAP. The crude product was passed through a silica gel column using hexane:dichloromethane (1:4) as eluent. Fractions with similar Rf values were pooled together and characterized.

Mesomorphic Properties of Cholesteryl Esters

The coco-cholesteryl esters were found to be liquid-crystalline, with the following phase transition temperatures (see Figure 1): a solid to smectic phase transition at 44.5℃, a smectic to cholesteric phase change at 66.5℃, and isotropization at 78.2℃. The cholesteric and smectic phases have been verified using the polarizing microscope.

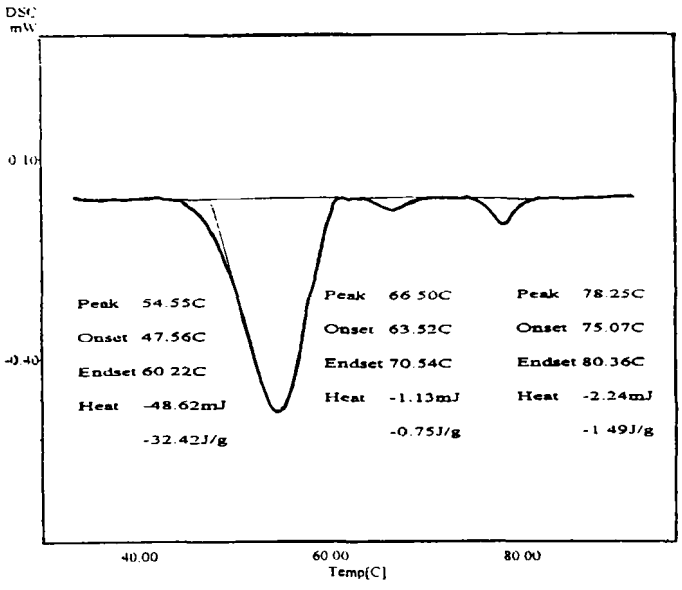

FIGURE 1 The DSC scan for the coco-cholesteryl esters.

MIXTURE FORMULATION

The effects of the prepared coco-cholesteryl esters on nematic E7 and E48 mixtures were examined. DSC studies reveal an increase in the isotropization temperature of the E7 mixture upon addition of coco- cholesteryl esters, and a decrease in the mesomorphic range for E48 mixtures.

E7 mixtures with low percent weight of cholesteryl esters (not more than 20%) are turbid and exhibit the planar texture at room temperature. Higher concentrations have yielded waxy formulations at room temperature, and were observed to change colors upon cooling from the isotropic state. The coco-cholesteryl ester mixtures with the nematic E48 and with varying amounts of cholesteryl iodide have yielded a striated fan-shaped texture as shown in Figure 2.

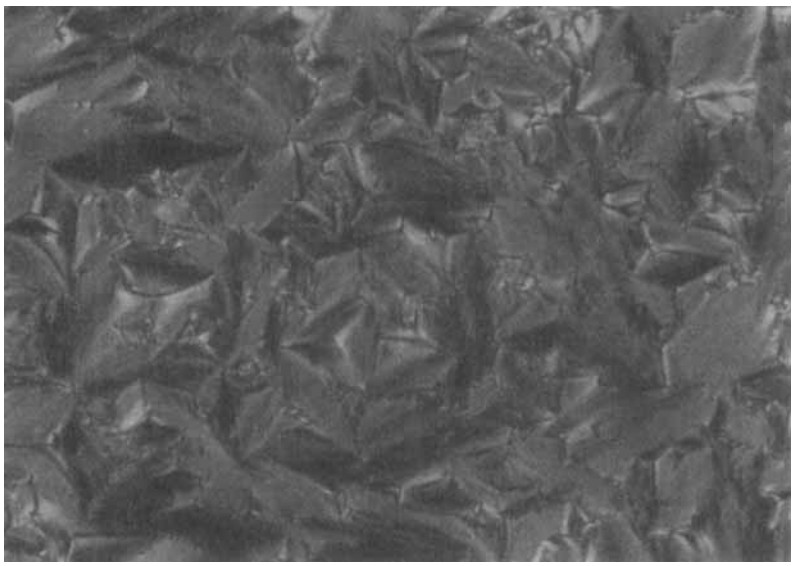

FIGURE 2 Focal conic texture of cholesteryl esters/cholesteryl iodide/E48 (10/10/80) mixture. (See Color Plate XIV).

LIQUID CRYSTAL DISPERSIONS

Study of phase separation of polymethylmethacrylate (PMMA) with the cholesteryl ester/E7 formulations was performed using the polarizing microscope. Using the solvent-induced phase separation (SIPS)[4], polymer dispersed liquid crystal (PDLC) films containing 70% cholesteryl ester/E7 mixture (5:95) and 30% PMMA yielded droplets with a configuration as shown in Figure 3.

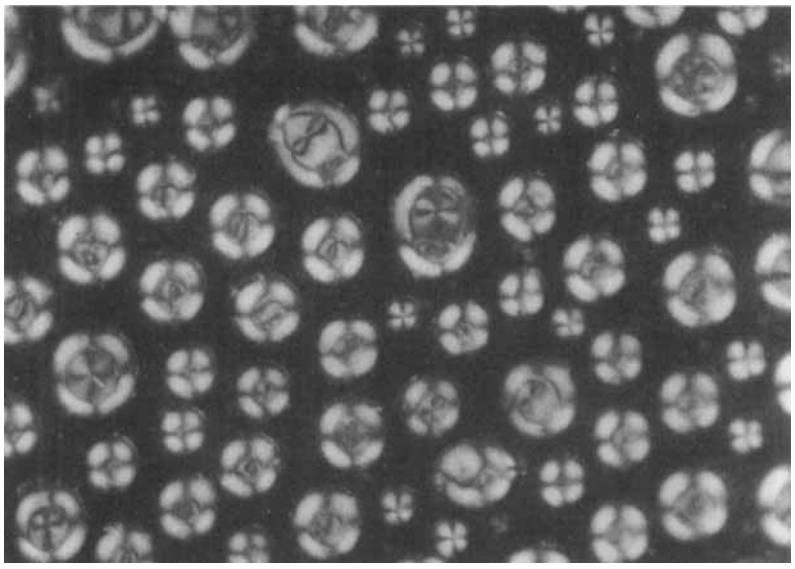

FIGURE 3 Phase separation in PMMA/cholesteric dispersion. (See Color Plate XV).

SUMMARY

Cholesteryl esters from fatty acids of coconut oil exhibit the cholesteric and smectic phases. At low weight percentage of this material with nematic mixtures, a cholesteric system is obtained which phase separates from the polymer PMMA. The switching property of the resulting PDLC is currently being investigated. Dispersions in side-chain liquid crystalline polymers are also being studied.

ACKNOWLEDGEMENT

This project was made possible by the joint support of the University of the Philippines and the Philippine Department of Science and Technology.

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