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Zeev B. Alfassi [a] & Liviu Feldman [a]
[a] Department of Nuclear Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel
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THE EFFECT OF ADDITION OF CHOLESTERYL ALKANOYL ESTERS TO CHOLESTERYL NONANOATE AND DECANOATE - A COMPATIBILITY EFFECT

ZEEV B. ALFASSI and LIVIU FELDMAN
Department of Nuclear Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel

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ABSTRACT: It was found that the closer the number of carbon atoms in the cholesteryl alkanoyl ester impurity to that of the solvent the lower is the reduction in the red-green transition temperature.

The composition dependence of optical and electrical properties of a binary or ternary mixture of cholesteric liquid crystals has been studied by many authors.[1-5] However, most of these studies were concerned with the dependence on the concentration of the constituents and less were done about the dependence on the structure of the additives. Fergason et al.[4] found that using cholesteryl nonanoate (CN) as a standard material, the addition of 20% of other alkanoyl ester of cholesterol (C_2-C_4) leads to a decrease in the color play temperature, which is decreasing going from C_4 to C_2. This finding does not agree with the melting points of the pure esters, which generally decrease with increasing the number of the carbon atoms and where the odd-even effect was observed ($C_2 > C_4 > C_3$).[6]

A possible explanation for this effect is that the larger the difference between the solvent (CN-C_9) and the solute, the larger is the decrease in the color-play temperature.

This explanation will mean that from C_1 to C_8 the temperature decrease will be a monotonously decreasing function of the number of the carbon atoms of the acidic side chain in the minor component, whereas from C_{10} and up the larger the number of the carbon atoms, the larger will be the temperature decrease. This is in contrast to the always monotonously character of the melting points for either even or odd-numbered carbon atoms.[6]

This work was done in order to check this explanation. Mixtures of 10% (molar percentage) cholesterol esters of varying acidic chain length (C_1 to C_{18}) with 90% CN or cholesteryl decanoate (CD) were prepared by mixing appropriate volumes of 0.1 M solutions in petrol ether. The red-green transition temperature was measured as described previously[7] with accuracy of $\pm$ 0.2°C. Tables 1 and 2 show that the decrease of the red-green transition temperature as a function of the number of carbon atoms is a function with a maximum.

Figure 1 shows that below the number of carbon atoms of the solvent itself, the decrease in the transition temperature is monotonous and no odd-even effect is found both for odd numbered ester - (CN-C_9) and even numbered ester - (CD-C_{10}).

These results seem to indicate that the transition temperature is influenced mainly by the structural compatibility of the impurity and the main cholesteric liquid crystal and not by the melting point of the impurity itself.

No of carbon atoms in the acidic residue	1	2	3	4	6	7	8	10	16	18
T (°C)	-19.0	-15.2	-10.6	-6.8	-2.8	-1.8	-1.0	+0.2	-5.5	-4.8

Table 1. The change in the red-green transition temperature of cholesteryl nonanoate due to 10% of cholesterol esters of differing chain length.

No of carbon atoms in the acidic residue	1	2	3	4	6	7	8	9	16	18
T (°C)	-20.5	-15.1	-10.4	-7.1	-3.8	-3.2	-1.6	-0.8	-3.3	-2.6

Table 2. The change in the red-green transition temperature of cholesteryl decanoate due to 10% of other cholesteryl esters.

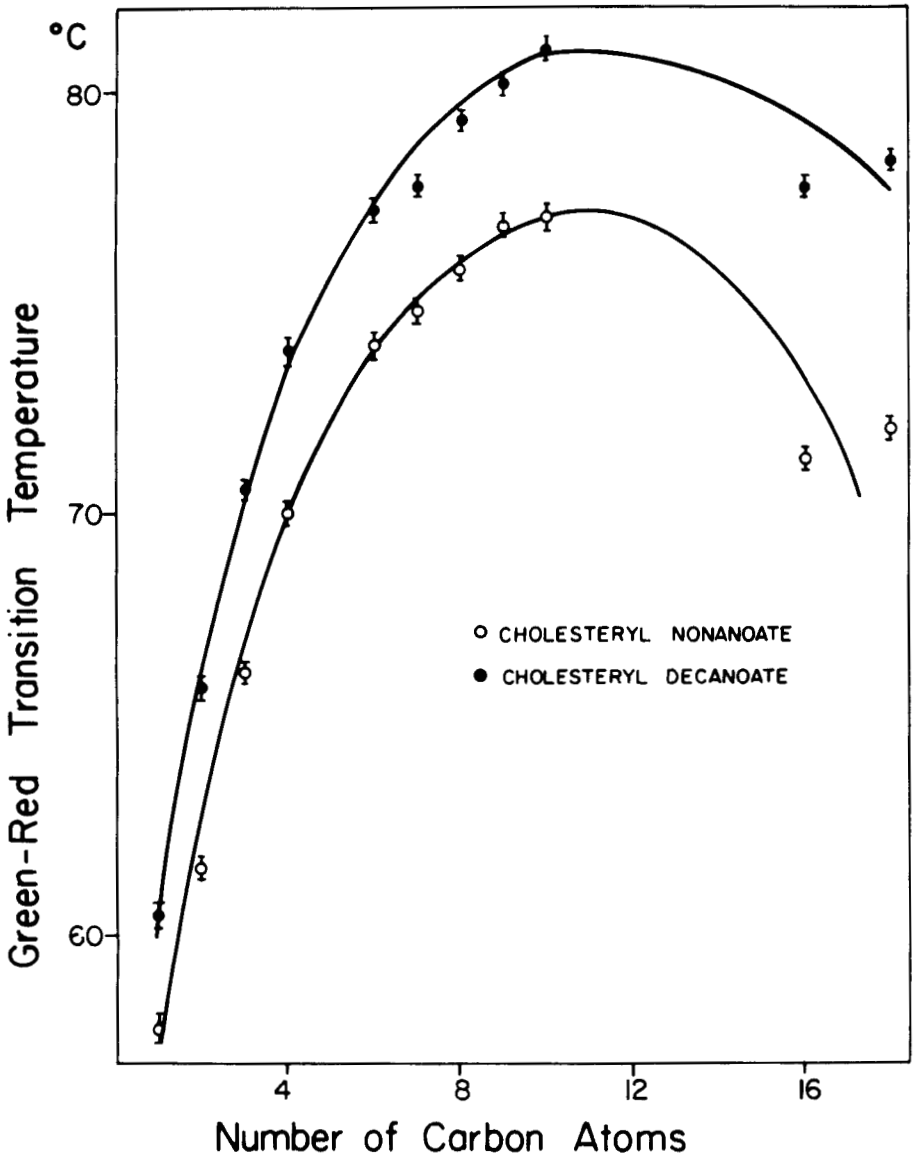

Figure 1: The green-red transition temperature for mixtures of 10% cholesteryl alkanoate and 90% cholesteryl nonanoate and decanoate as a function of the number of the carbon atoms in the alkanoyl residue.

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