
SUMMARY

In the present study nine mesomorphic homologous series were synthesized and mesomorphic behaviour of their members studied. These series can be broadly classified into three distinct categories :

(i) Mesomorphic Heterocyclic Homologous Series

- A1 7-(4'-n-Alkoxybenzoyloxy)-3-phenylcoumarins
- B1 4'-Cyanophenyl 7-n-alkoxycoumarin-3-carboxylates
- C1 2-Methyl-5-(4'-n-alkoxycinnamoyloxy) pyridines

(ii) Mesomorphic Non-heterocyclic Homologous Series

- E1 4'-Formylphenyl 6-n-alkoxynaphthalene-2-carboxylates
- F1 6-(4'-n-Alkoxybenzoyloxy)-2-acetylnaphthalenes
- G1 4-(4'-n-Alkoxycinnamoyloxy) toluenes

(iii) Laterally Substituted Mesogens

- H1 4-(4'-n-Alkoxycinnamoyloxy)-3-ethoxybenzylidene-4"-anilines.
- J1 4-(4'-n-Alkoxycinnamoyloxy)-3-ethoxybenzylidene-4"-toluidines
- K1 4-(4'-Alkoxycinnamoyloxy)-3-ethoxybenzylidene-2",4"-dimethylanilines.

In addition, the following non-mesomorphic series was also synthesised.

I. 4-(4'-n-Alkoxy-cinnamoyloxy)-3-ethoxybenzaldehydeS

The salient features of the study are summarised in the following text.

In series A1, the first eight members are enantiotropic nematic. The nonyl derivative exhibits monotropic smectic and enantiotropic nematic phases, the decyl and dodecyl derivatives exhibit enantiotropic smectic and nematic phases whereas the remaining members are only enantiotropic smectic. N-I transition points when plotted against the number of carbon atoms in the alkoxy chain show usual odd-even effect. The S-N transitions lie on a rising curve which merges with the falling N-I curves.

In series B1, mesomorphism is observed beyond decyl homolog. The last three members exhibit enantiotropic smectic phase only. The first two members of the series C1 are non-mesomorphic ; mesomorphic properties appear at the propyl derivative which exhibits monotropic nematic. The smectic phase commences from the pentyl derivative which exhibits smectic as monotropic and nematic as enantiotropic phases. The hexyl homolog also exhibits

monotropic smectic and enantiotropic nematic phases while octyl to octadecyl derivatives exhibit only enantiotropic smectic phase.

A few conclusions can be drawn from the study of series A1, B1 and C1.

- (i) Coumarin nucleus is rather broad due to presence of ketone group of lactone moiety but at the same time it also carries a permanent dipole which will increase intermolecular cohesions. Thermal stabilities of mesophases of coumarin derivatives can be explained by the combined effects of these two factors.
- (ii) The smectogenic tendencies of the compounds of series C1, compared to those of carbocyclic analogs can be attributed to the presence of the heterocyclic nitrogen atom.
- (iii) Low molecular weight compounds having ester group as central linkage can often yield low melting mesogens.
- (iv) The presence of the -CN group at the end of the molecule enhances the smectogenic properties.

The first nine members of series E1 show enantiotropic nematic phase. The smectic phase commences with the decyl

derivative which exhibits both smectic and nematic as enantiotropic phases and a reentrant nematic phase. The remaining members are enantiotropic smectic. All the compounds adopt homeotropic texture when heated. In series F1, the first seven members are enantiotropic nematic. The smectic phase commences with octyl derivative which exhibits smectic as monotropic and nematic as enantiotropic phases. All the members adopt homeotropic texture when heated. The N-I points when plotted against the number of carbon atoms in the alkyl group, show descending tendency. In series G1, the first seven derivatives exhibit monotropic nematic phase except the hexyl homolog which shows enantiotropic phase. The smectic phase commences with the octyl derivative as the enantiotropic phase. The heptyl, octyl, nonyl, decyl, hexadecyl and octadecyl derivatives adopt homeotropic texture while heating and cooling the isotropic liquid.

A few conclusions can be drawn from the study of series E1, F1 and G1.

- (i) The molecules of a homologous series having a terminal -CHO group may exhibit a reentrant nematic phase.
- (ii) The nematic properties of the molecules of a homologous series are enhanced due to the presence

of naphthalene nucleus which increases the polarizability of the molecules.

- (iii) The commencement of smectic phase may be delayed due to the increased breadth of the molecules of a homologous series containing naphthalene nucleus which are rather broad.

All the members of the series H1 are enantiotropic nematic. The smectic phase is absent. The N-I transitions lie on two falling curves, the upper one being occupied by even members of the series and the lower one by odd members. In series J1, all the members are enantiotropic nematic except the hexadecyl derivative which exhibits monotropic nematic phase. Smectic phase is absent. The N-I transitions lie on the one falling curve. All the members of the series K1 are enantiotropic nematic. The smectic phase commences at the tetradecyl derivative. The propyl derivative adopts a homeotropic texture during cooling. The N-I transition lie on two falling curves exhibiting normal odd-even effect. The S-N transition curve does not merge with the N-I transition curve.

A few conclusions can be drawn from the study of series H1, J1 and K1.

- (i) Introduction of lateral group in mesomorphic compounds causes reduction in melting points and mesomorphic - isotropic temperatures, the latter being more affected as usual.
- (ii) The increase in the breadth of a molecule by introducing a bulky lateral group may not help to achieve the goal of obtaining room temperature liquid crystals.

It may be concluded from the study of the non-mesomorphic series, 4-(4'-n-alkoxycinnamoyloxy)-3-ethoxybenzaldehydes, that if the breadth of the compound is increased to large extent, it leads to non-liquid crystalline compounds instead of giving low-melting mesogens.

In addition to the synthesis of the above homologous series, three binary systems using compounds synthesized in this investigation were also studied. The binary systems with their constituent homologs are summarized in the following Table :

<u>Binary System No.</u>		<u>Homolog</u>
1.	X	4-(4'-n-Decyloxy-cinnamoyloxy) toluene
	Y	4-(4'-n-Tetradecyloxy-cinnamoyloxy) toluene
2.	X	4-(4'-n-Decyloxy-cinnamoyloxy) toluene
	Y	4-(4'-n-Nonyloxy-cinnamoyloxy)-3- ethoxybenzaldehyde
3.	X	4-(4'-n-Tetradecyloxy-cinnamoyloxy) toluene
	Y	p-Azoxyanisole

The first binary system consists of component X, which exhibits both smectic and nematic phases, and component Y which is a pure smectogen. The component X of binary system 2 is the same as of binary system 1. The component Y is non-mesomorphic. The component X of binary system 3 is a pure smectogen and component Y exhibits only enantiotropic nematic phase.

An attempt to obtain room temperature liquid crystal mixture in binary system 1 was not successful ; however,

eutectic mixture exhibiting enantiotropic smectic phase at 50.5°C is obtained. This mixture consists of 47 mole % of component Y and 53 mole % of component X. The low melting mesomorphic mixture compared to the pure component in binary system 2 can be obtained by the addition of the non-mesomorphic component. The maximum lowering in the case of smectic and nematic transitions compared to pure mesogen X is about 37.0° and 30.0°C respectively. The smectic properties of the component X in binary system 3 is considerably reduced by the addition of more polarizable component Y. This binary system behaves like an ideal nematogenic series.