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Synthesis and Characterization of Liquid Crystalline Property of a New Thermotropic Liquid Crystalline Molecules with Terminal End Group and DSC Study

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Abstract
We synthesized and studied a novel homologous series of esters with a lateral methoxy group and a terminal n-heptyl benzoate group to study how mesomorphic behavior correlates with structure. The twelve-membered series comprises non-mesomorphic methoxy to heptyloxy derivatives, while the remaining homologs are smectegenically mesomorphic without expressing any nematic characteristics. On a heating-stage-equipped optical polarizing microscope, we observed transition temperatures and textures. IR, ^{1}H NMR, mass spectra, and elemental analysis characterized some representative members. Analytical data confirm the molecular structures of the homologs. The mesomorphic characteristics of the current novel series are compared with those of recognized structurally comparable series. The average thermal stability of the current series is 72 °C.
Keywords: *Liquid Crystals, Smectogenic, Mesomorphism, Ester, DSC*

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I. INTRODUCTION

The state of matter known as the liquid crystal state possesses characteristics of both liquids and crystals; hence, it is referred to as an anisotropic liquid state, a mesomorphic state, or simply a liquid crystal (LC) state [1]. The combination of flow properties, such as liquids and optical properties associated with crystals, makes it applicable in various fields [2-4]. This study aimed to investigate and establish the correlation between the crystalline properties and molecular structures by synthesizing new liquid crystal substances through homologous series. Will modify molecular structures by altering the central groups that connect the phenyl rings, the terminal end groups, the groups with different polarities, or the position (o, m, p) of the same polar group in the isomeric series [5-8]. Consequently, thermotropic and lyotropic LC materials have great potential to benefit humanity [9-12]. The synthesis of ester homologs, which involves the incorporation of a lateral -OCH_3 group at the ortho position, a -CH=CH-COO- group as a central bridge and right-handed terminal end group of -$COOC_7H_{15}$(n), was influenced by a review of the literature on thermotropic liquid crystals [13-16]. Following the characterization of the newly synthesized compounds, we analyze the obtained data in terms of the molecular rigidity and flexibility of their molecular structures [17-20].

II. MATERIAL AND METHODS

Thin layer chromatography was performed on the precoated silica gel 60 F254 (Merck), and the compounds were visualized with UV light at 254 nm and 365 nm or with iodine steam. IR spectrometers were recorded using the ATR technique on the Shimadzu FT-IR spectrometer. The ^{1}H spectra were recorded with a Bruker AVANCE III spectrometer (400 MHz) in DMSO-d_6. As an internal standard, chemical changes are expressed in ppm from Tetramethylsilane (TMS). The mass spectrometers were recorded using direct input probes on the Shimadzu GCMS QP2010 Ultra mass spectrometer. All reactions were carried out under an ambient atmosphere. All chemicals were purchased from Loba, Molychem, SRL, and CDH and used without further purification. Transition temperatures for synthesized compounds and phases were identified through a polarizing optical microscope attached to a Mettler FP82HT heating plate. Enthalpies and transition temperatures were determined using differential scanning calorimetry (DSC) on the PerkinElmer thermal analyzer at 10 °C min^{-1}.