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Synthesis, characterization and liquid crystalline behaviour of 4'-bromo-4-alkanoyloxy chalcone

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Abstract

This study investigates the occurrence of liquid crystalline properties in chalcone esters with different hydrocarbon chain lengths. These compounds with the general formula [Br-Ph-CO-CH=CH-Ph-O-CO-C_nH_{2n+1}] were synthesized by the reaction of 4-bromoacetophenone with 4-hydroxybenzaldehyde, and then the product was reacted with carboxylic acid halides in the presence of suitable catalysts. The compounds were characterized by FT-IR, ^{1}H-NMR and ^{13}C-NMR. The occurrence of liquid crystalline properties was confirmed by differential scanning calorimetry (DSC), and the texture morphology was confirmed by polarized light microscopy (POM). Compounds A_1, A_7, and A_9 were monomorphic, while compounds A_8 and A_{10} were dimorphic, and the remaining compounds did not exhibit liquid crystalline properties.

Introduction:

Chalcone's structural makeup is 1,3-diphenyl-2-propen-1-one, or two aromatic rings divided by an α, β unsaturated ketone group (–C (O)CH=CH–). Numerous chalcones are either naturally occurring or manufactured, and they serve as building blocks for a variety of chemicals, including flavonoids. According to biology, chalcones are a class of substances that are produced during the biosynthesis of flavonoids and are members of the family of phytoalexins. Chalcone molecules have been synthesized via a few techniques, including Wittig and Friedel Crafts acylation and Claisen-Schmidt aldol condensation [1]. Both aromatic rings and α, β-unsaturation contribute to the pharmacological characteristics of chalcones [2]. According to reports, they are anti-inflammatory [3,4], antibacterial [5,6], antitubercular1 [7], antiviral [8], anticancer [9,10], antidiabetic [11], antioxidants [12], antimalarial [13], and antibacterial [14]. Chalcones are also utilized in industry as spectrometric reagents [15], light stabilizing agents [16], sweetening agents [5], analytical reagents in amperometry [17], and synthetic reagents for the manufacture of heterocyclic compounds with pharmacological activity [18]. Omar Jamal and his group studied the liquid crystalline properties of chalcone compounds, where he prepared chalcone ester compounds and followed the appearance of the properties or not by changing the length of the alkoxy chains (n=1-9) and that the compounds (n=4-9) showed liquid crystalline properties only in the heating process, except for (4) which showed liquid crystalline properties in the heating and cooling process [19]. The aim of the study is to follow the change in the mesomorphic in chalcone compounds with different ester chain lengths in the compounds.

Experimental Section

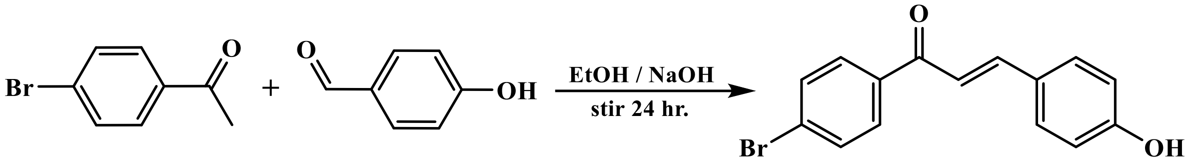
Materials

Starting materials were sourced from Sigma-Aldrich. A Bruker-Tensor 27 spectrophotometer was used for IR spectra. Bruker-400 MHz spectrometer and DMSO-d_6 as the solvent to record the ^{1}H-NMR and ^{13}C-NMR spectra. A P.O.M. equipped with a hot stage and a DSC at a heating rate of 5 °C/min were used to study the thermal phase transitions.

Synthesis:

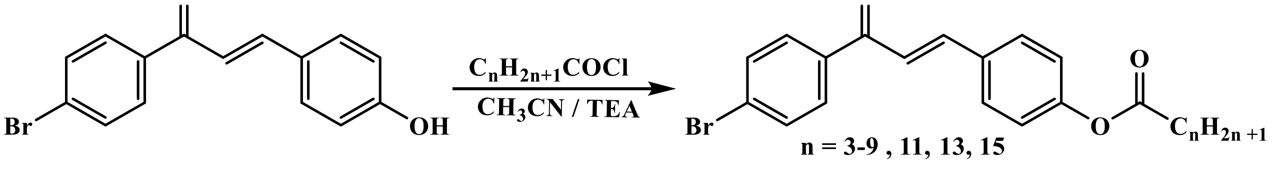
Synthesis of 1-(4-bromophenyl)-3-(4-hydroxyphenyl) prop-2-en-1-one(A)

In an RBF 50 mL containing 20 mL of ethanol, dissolve (2.46 g, 0.0123 mol) of 4-bromoacetophenone and (1.5 g, 0.0123 mol) of 4-hydroxybenzaldehyde. Then, add to the reaction flask in drops (1.47 g, 0.0369 mol) of sodium hydroxide dissolved in (10 mL) of distilled water. Leave the reaction mixture to stir for (24 hours) at room temperature with the reaction being monitored using thin layer chromatography (TLC). Then, the acidity of the medium was titrated by adding concentrated hydrochloric acid to the reaction flask until reaching (pH = 3). Then, a yellow precipitate was observed. Then, the mixture poured into a beaker charging with crushed ice. The precipitate was filtered, dried, and recrystallized with benzene [19].



Synthesis of 4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl alkanoate (A_1-A_{10})

In a round-bottomed flask (50 mL) containing 15 mL of acetonitrile, dissolve (0.3 g, 0.00099 mol) of chalcone (A), then add (0.1 g, 0.00099 mol) of (Triethylamine) with stirring for (10 min), then place the flask in an ice bath, and add to it in drops (0.00099 mol) of carboxylic acid chloride, then leave the reaction stirring for (24 hr.) at R.T with the reaction being monitored using thin layer chromatography (TLC) , after the stirring period is over, pour the reaction mixture into a beaker containing crushed ice with stirring, filter the precipitate, dry it and recrystallize it with methanol[20].



1-(4-bromophenyl)-3-(4-hydroxyphenyl) prop-2-en-1-one (A): Yellow solid, yield 83.8 %; m.p. 167–169 °C, R_f = 0.47 (EtOAc: Hex.) (3:7); IR (ATR) cm^{-1} ν 3237 (O-H), 3101 (CH=CH vin.), 3026 (C-H ar.), 1642 (C=O$_{\text{ketone}}$), 1573, 1513 ar., 1272 (C-O$_{\text{ketone}}$). ^{1}H-NMR (400 MHz, DMF) δ

8.47 (d, J = 8.3 Hz, 2H), 8.26 (d, 1H), 8.21 – 8.06 (m, 2H), 7.49 (d, 2H), 7.29 (d, 1H), 7.05 (d, 2H), 6.16 (s, 1H). ^{13}C-NMR (100 MHz, DMF) δ 188.92, 161.28, 156.56, 146.00, 137.80, 136.54, 134.88, 132.62, 132.05, 131.25, 130.82, 129.32, 128.20, 127.82, 126.54, 118.89, 116.78, 115.85, 45.52, 36.84.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl butyrate (A_1): White solid, yield 81.1 %; m.p. 130–132 °C, R_f = 0.49 (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3081 (C-H ar.), 2964, 2874 (C-Hal.),1753(C=O$_{ester}$) 1657 (C=O$_{ketone}$), 1580, 1503 ar., 1291 (C-O$_{ketone}$), 739 (γ CH_2). ^{1}H-NMR: δ 8.11 (d, 2H), 7.97 (d, 1H), 7.93 (d, 2H), 7.80 (d, 2H), 7.77 (d, 1H), 7.23 (d, 2H), 2.59 (t, 2H), 1.68 (h, 2H), 0.98 (t, 3H). ^{13}C-NMR: δ 188.69, 171.97, 152.72, 144.04, 136.98, 132.72, 132.34, 131.06, 130.78, 127.85, 122.88, 122.19, 35.77, 18.29, 13.87]

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl pentanoate (A_2): White solid, yield 68.4 %; m.p. 107–109 °C; R_f = 0.51 (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3065 (C-H ar.), 2959, 2871 (C-Hal.), 1750 (C=O$_{ester}$)1656 (C=O$_{ketone}$), 1582, 1503 ar., 1288 (C-O$_{ketone}$), 736 (γ CH_2). ^{1}H-NMR: δ 8.15 (d, 2H), 8.00 (d, 1H), 7.96 (d, 2H), 7.84 (d, 2H), 7.81 (d, 1H), 7.27 (d, 2H), 2.65 (t, 2H), 1.68 (p, 2H), 1.44 (h, 2H), 0.97 (t, 3H).^{13}C-NMR : δ 188.67, 172.11, 152.73, 144.04, 136.97, 132.71, 132.33, 131.05, 130.77, 127.84, 122.86, 122.17, 33.67, 26.84, 22.06, 14.12.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl hexanoate (A_3): White solid, yield 83.1 %; m.p. 119–121 °C, R_f = 0.68 (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3079 (C-H ar.), 2963, 2869 (C-Hal.), 1753 (C=O$_{ester}$)1657 (C=O$_{ketone}$), 1579, 1505 ar., 1291 (C-O$_{ketone}$), 724 (γ CH_2). ^{1}H-NMR : δ 8.11 (d, 2H), 7.97 (d,1H), 7.93 (d, 2H), 7.80 (d, 2H), 7.77 (d,1H), 7.23 (d, 2H), 2.60 (t, 3H), 1.65 (p, 2H), 1.41 – 1.19 (m, 4H), 0.90 (t, 3H).^{13}C-NMR : δ 188.68, 172.10, 152.74, 144.04, 136.98, 132.71, 132.33, 131.05, 130.77, 127.84, 122.86, 122.19, 33.91, 31.08, 24.43, 22.29,14.30.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl heptanoate (A_4): White solid, yield 73.2 %; m.p. 105–107 °C, R_f = 0.52 (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3080 (C-H ar.), 2954, 2870 (C-Hal.), 1749 (C=O$_{ester}$)1655 (C=O$_{ketone}$), 1579, 1504 ar., 1289 (C-O$_{ketone}$), 731 (γ CH_2). ^{1}H-NMR : δ 8.11 (d, 2H), 7.97 (d, 1H), 7.93 (d, 2H), 7.80 (d, 2H), 7.77 (d, 1H), 7.23 (d, 2H), 2.60 (t, 2H), 1.65 (p, 2H), 1.43 – 1.21 (m, 6H), 0.89 (t,3H).^{13}C-NMR : δ 188.68, 172.11, 152.74, 144.05, 136.97, 132.72, 132.34, 131.06, 130.78, 127.85, 122.87, 122.18, 33.95, 31.39, 28.54, 24.70, 22.43, 14.39.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl octanoate (A_5): White solid, yield 90.7 %; m.p. 123–125 °C, R_f = 0.59 (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3080 (C-H ar.), 2965, 2868 (C-Hal.), 1751 (C=O$_{ester}$)1654 (C=O$_{ketone}$), 1576, 1502 ar., 1288 (C-O$_{ketone}$), 730 (γ CH_2). ^{1}H-NMR : δ 8.12 (d, 2H), 7.97 (d, 1H), 7.92 (s, 2H), 7.80 (d, 2H), 7.76 (s, 1H), 7.23 (d, 2H), 2.60 (t, 2H), 1.65 (s, 2H), 1.37 – 1.21 (m, 8H), 0.88 (s, 3H).^{13}C-NMR : δ 188.69, 172.39, 152.73, 144.04, 136.98, 132.71, 132.34, 131.06, 130.78, 127.85, 122.86, 122.19, 33.95, 31.59, 28.83, 24.75, 22.53, 14.43.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl nonanoate (A_6): White solid, yield 93.2 %; m.p. 102–104 °C, R_f = 0.56 (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3040 (C-H ar.), 2954, 2870 (C-Hal.), 1748 (C=O$_{ester}$)1655 (C=O$_{ketone}$), 1578, 1502 ar., 1289 (C-O$_{ketone}$), 738 (γ CH_2). ^{1}H-NMR : δ 8.17 (d, 1H), 8.02 (d,1H), 7.99 (d, 1H), 7.85 (d, 1H), 7.82 (d, 1H), 7.28 (d, 1H), 2.65 (t, 1H), 1.70 (p, 1H), 1.46 – 1.25 (m, 8H), 0.92 (t, 2H).^{13}C-NMR : δ 188.68, 172.11, 152.74, 144.04, 136.98, 132.72, 132.34, 131.06, 130.78, 127.85, 122.86, 122.19, 33.95, 31.71, 29.14, 29.03, 28.87, 24.74, 22.57, 14.45.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl decanoate (A_7): White solid, yield 77.8 %; m.p. 120–122 °C, $R_f = 0.51$ (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3081 (C-H ar.), 2952, 2868 (C-Hal.), 1750 (C=O$_{ester}$)1654 (C=O$_{ketone}$), 1582, 1503 ar., 1289 (C-O$_{ketone}$), 738 (γ CH_2). ^{1}H-NMR: δ 8.11 (d, 2H), 7.96 (d, 1H), 7.92 (d, 2H), 7.80 (d, 2H), 7.77 (d, 1H), 7.22 (d, 2H), 2.59 (t, 2H), 1.65 (p, 2H), 1.40 – 1.20 (m, 10H), 0.86 (t, 3H). ^{13}C-NMR: δ 188.68, 172.11, 152.74, 144.04, 136.97, 132.72, 132.34, 131.06, 130.78, 127.85, 122.86, 122.18, 33.95, 31.76, 29.51, 29.33, 29.18, 29.14, 28.86, 24.74, 22.59, 14.45.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl dodecanoate (A_8): White solid, yield 77.1 %; m.p. 98–100 °C, $R_f = 0.53$ (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3080 (C-H ar.), 2954, 2848 (C-H al.), 1749 (C=O$_{ester}$)1655 (C=O$_{ketone}$), 1583, 1503 ar., 1291 (C-O$_{ketone}$), 730 (γ CH_2). ^{1}H-NMR: δ 8.11 (d, 2H), 7.96 (d, 1H), 7.90 (d, 2H), 7.79 (d, 2H), 7.75 (s, 1H), 7.22 (d, 2H), 2.59 (t, 2H), 1.65 (p, 2H), 1.43 – 1.18 (m, 16H), 0.85 (t, 3H). ^{13}C-NMR: δ 189.70, 168.87, 157.20, 137.48, 135.91, 128.93, 126.22, 119.35, 113.10, 31.77, 29.48, 29.18, 22.57, 14.44.

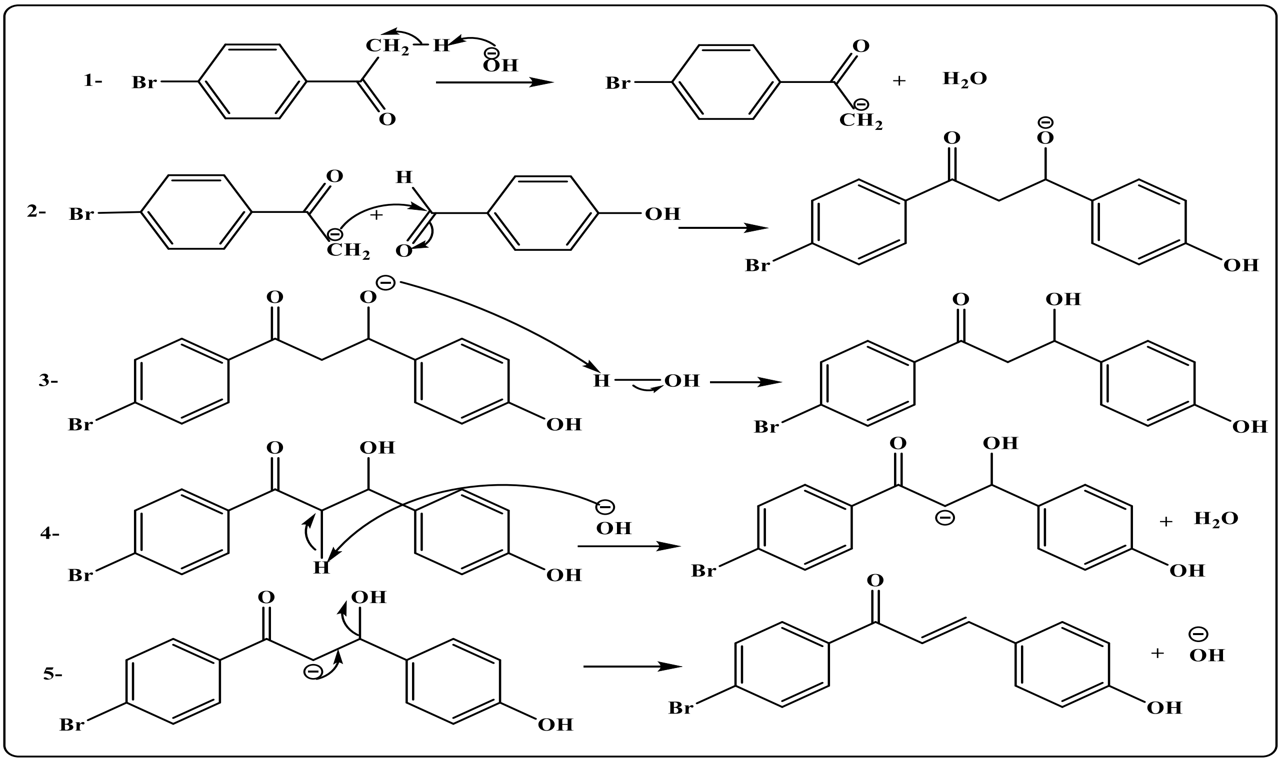
4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl tetradecanoate (A_9): White solid, yield 80 %; m.p. 118–120 °C, R_f 0.53 (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3081 (C-H ar.), 2953, 2848 (C-Hal.), 1749 (C=O$_{ester}$)1655 (C=O$_{ketone}$), 1583, 1503 ar., 1291 (C-O$_{ketone}$), 738 (γ CH_2). ^{1}H -NMR: δ 8.09 (s, 2H), 7.98 – 7.93 (m, 3H), 7.88 (s, 2H), 7.79 (s, 1H), 7.29 (d, 2H), 2.60 (s, 2H), 1.65 (s, 2H), 1.25 (s, 20H), 0.86 (s, 3H). ^{13}C-NMR: δ 190.25, 174.74, 159.48, 154.48, 142.18, 138.08, 132.50, 122.67, 116.39, 111.89, 33.74, 31.77, 29.49, 12.26.

4-(3-(4-bromophenyl)-3-oxoprop-1-en-1-yl) phenyl palmitate (A_{10}): White solid, yield 81.5 %; m.p. 103–105 °C, $R_f = 0.54$ (THF: Hex.) (1:9); IR (ATR) cm^{-1} ν 3080 (C-H ar.), 2953, 2847 (C-Hal.), 1750 (C=O$_{ester}$)1655 (C=O$_{ketone}$), 1584, 1504 ar., 1288 (C-O$_{ketone}$), 720 (γ CH_2). ^{1}H-NMR: δ 8.09 (d, 2H), 7.95 (d, 1H), 7.87 (s, 2H), 7.79 (d, 2H), 7.74 (s, 1H), 7.22 (d, 2H), 2.59 (s, 2H), 1.53 – 1.45 (m, 4H), 1.25 (s, 22H), 0.86 (t, 3H). ^{13}C-NMR: δ 186.06, 174.98, 157.54, 155.58, 150.59, 139.66, 136.45, 126.37, 109.22, 34.12, 31.77, 29.51, 29.38, 29.20, 29.02, 24.96, 22.57, 14.44, 12.39.

Results and Discussion

Synthesis

The chalcone compound (A) was synthesized by a base-catalyzed Claisen-Schmidt reaction of 4-bromoacetophenone and 4-hydroxybenzaldehyde, utilizing NaOH as the catalyst and ethanol as the solvent; Scheme 1 depicts the synthesis mechanism[21].



Scheme 1: *Proposed mechanism for the preparation of chalcone A*

Esters (A1-A10),

The synthesized chalcone A served as the backbone, which was esterified by reactions with carboxylic acid chlorides C_nH_{2n+1}-COOH, (n=3-9, 11,13,15), utilizing acetonitrile as the solvent and triethylamine as the catalyst.

Characterization

FT-IR spectrum of compounds (A, A_1-A_{10}) We note the disappearance of the C-H and C=O stretching bands of the aldehyde for compound (A) as well as the disappearance of the O-H stretching band of the phenolic compounds (A_1-A_{10}). In the FT-IR spectrum of compound (A), we show the appearance of a band at 3237 cm^{-1} attributable to the phenolic (O-H), a weak band at 3101 cm^{-1} due to the vinyl C-H, a band at 3026 cm^{-1} attributable to the aromatic C-H, a band at 1642 cm^{-1} attributable to the $C{=}O_{ketone}$, strong bands at 1573-1513 cm^{-1} attributable the aromatic C=C, and a band at 1272 cm^{-1} due to the ketone (C-O).

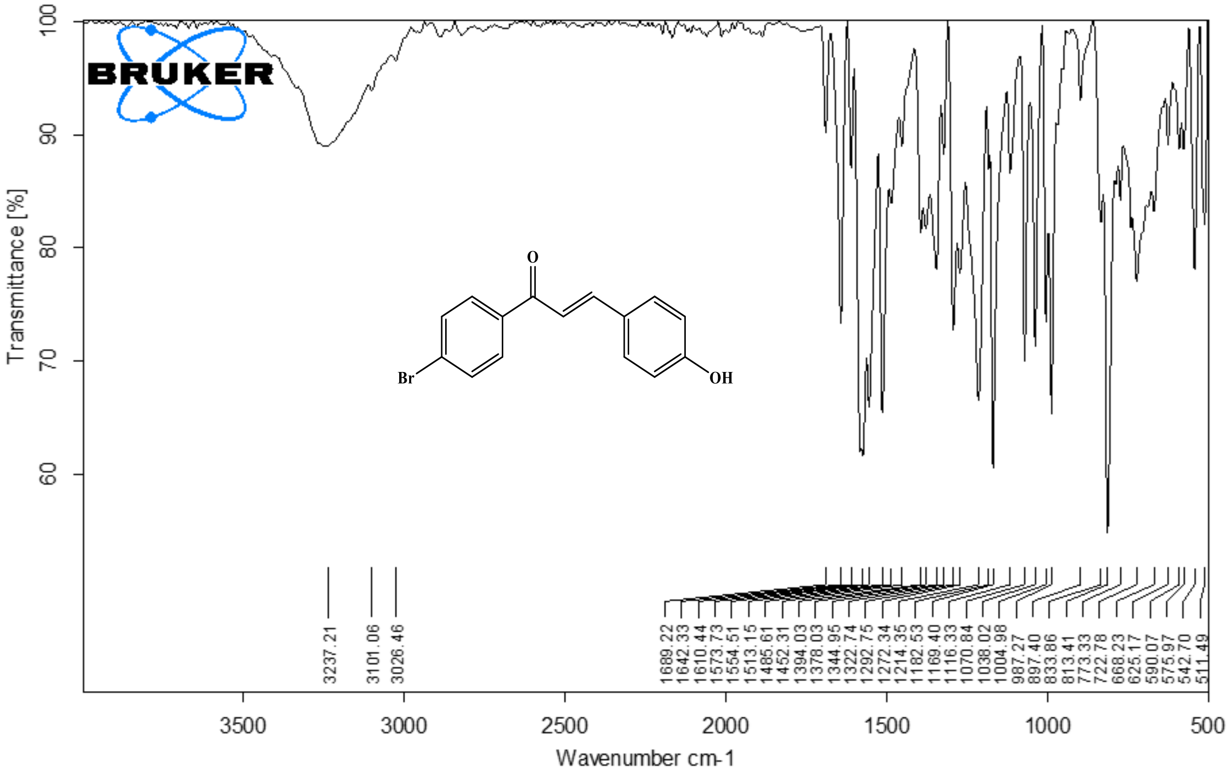


Fig. 1. *FT-IR spectrum of compound A*

In the FT-IR spectra of compounds (A_1-A_{10}), we show the appearance of a medium band at 3081-3040 cm^{-1} attributable to the C-H aromatic, a band at 2965-2847 cm^{-1} due to the C-H aliphatic, a band at 1753-1748 cm^{-1} attributed to the esterified (C=O), and a medium band at 1657-1654 cm^{-1} it is attributed to the ketone C=O, a bands at 1584-1505 cm^{-1}are attributed to the (C=C) aromatic rings, bands at 1291-1288 cm^{-1} are attributed to the C-O of ketone and a band at 739-720 cm^{-1} is attributed to (γ CH_2) [22].

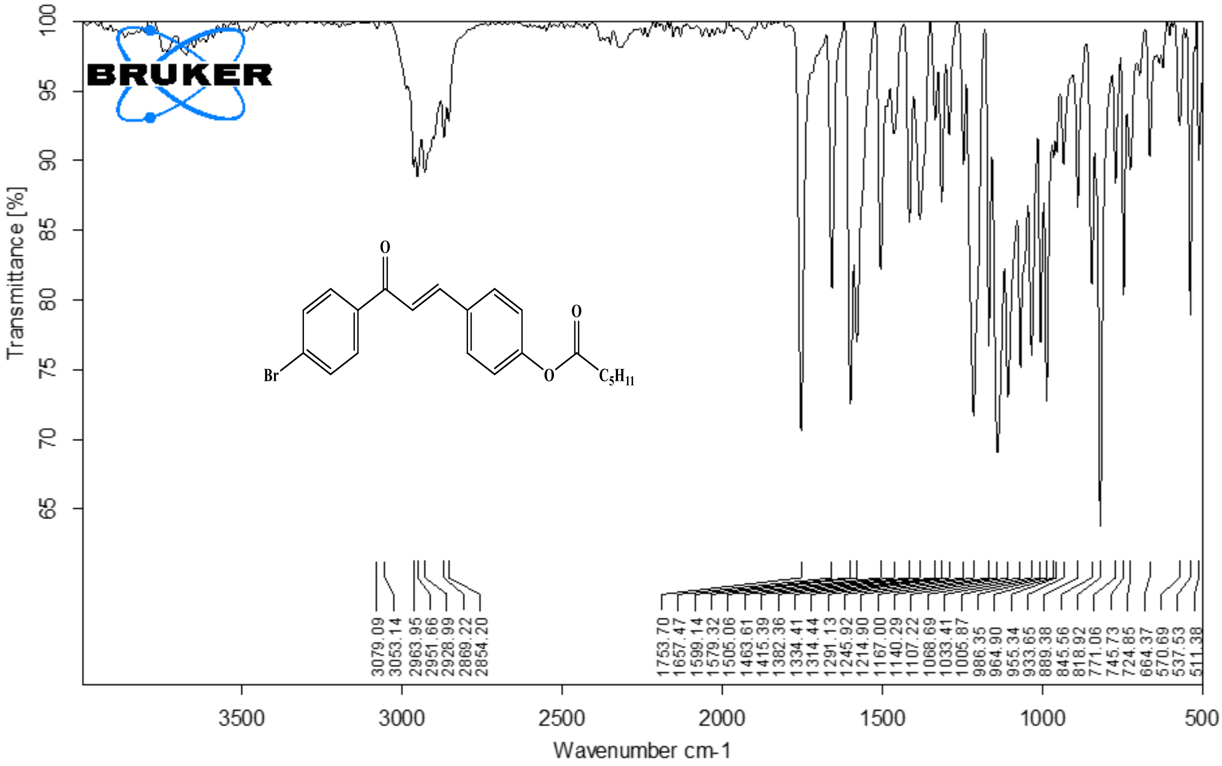


Fig. 2. *FT-IR spectrum of compound A_3*

Further characterization of the prepared compounds was carried out by examining the ^{1}H-NMR spectrum. The spectrum of the compound (A) consisted of a double signal at 8.26 ppm due to one of the protons of the chalcone bond (CH=C), while the second proton of the chalcone (C=CH-C=O) showed a double signal at 7.29 ppm. It also showed several signals at the range 7.05-8.47 ppm due to the protons of the aromatic rings (Ar-H), and a single signal at 6.16 ppm due to the proton of the hydroxyl group. The spectra of compounds (A_1-A_{10}) showed a double signal in the range 7.93-8.02 ppm due to the proton of the chalcone bond (CH=C-C=O), and the second proton of the chalcone bond (C=CH-C=O) showed a signal in the range 7.74-7.82 ppm, and also showed several signals at the range 7.22-8.17 ppm are due to the protons of the aromatic rings (Ar-H), a triple signal in the range 2.59-2.65 ppm is attributed to the proton of the methylene group ($-CH_2-C=O$), various signals in the range 1.18-1.70 ppm are due to the protons of (CH_2) groups in the hydrocarbon chains ($C-CH_2-C$), and a triple signal in the range 0.85-0.98 ppm is due to the protons of (CH_2) in the hydrocarbon chain ($-C-CH_3$) [23]. The structural features of the prepared compounds (A, A_1-A_{10}) were confirmed using ^{13}C-NMR spectroscopy. All compounds showed a band at 186-190 ppm, which is due to the carbonyl group carbon atom in the chalcone bond (C=C-C=O), a signal at the range of 168-174 ppm for compounds (A_1-A_2), a signal at the range of 142-146 ppm for the carbon atom in the chalcone bond (Ar-C=), and multiple signals at the range of 109-159 ppm for the carbon atoms in the aromatic rings (Ar-C), and multiple signals at the range of 12-35 ppm for the carbon atoms in the hydrocarbon chains in compounds (A_1-A_{10}).

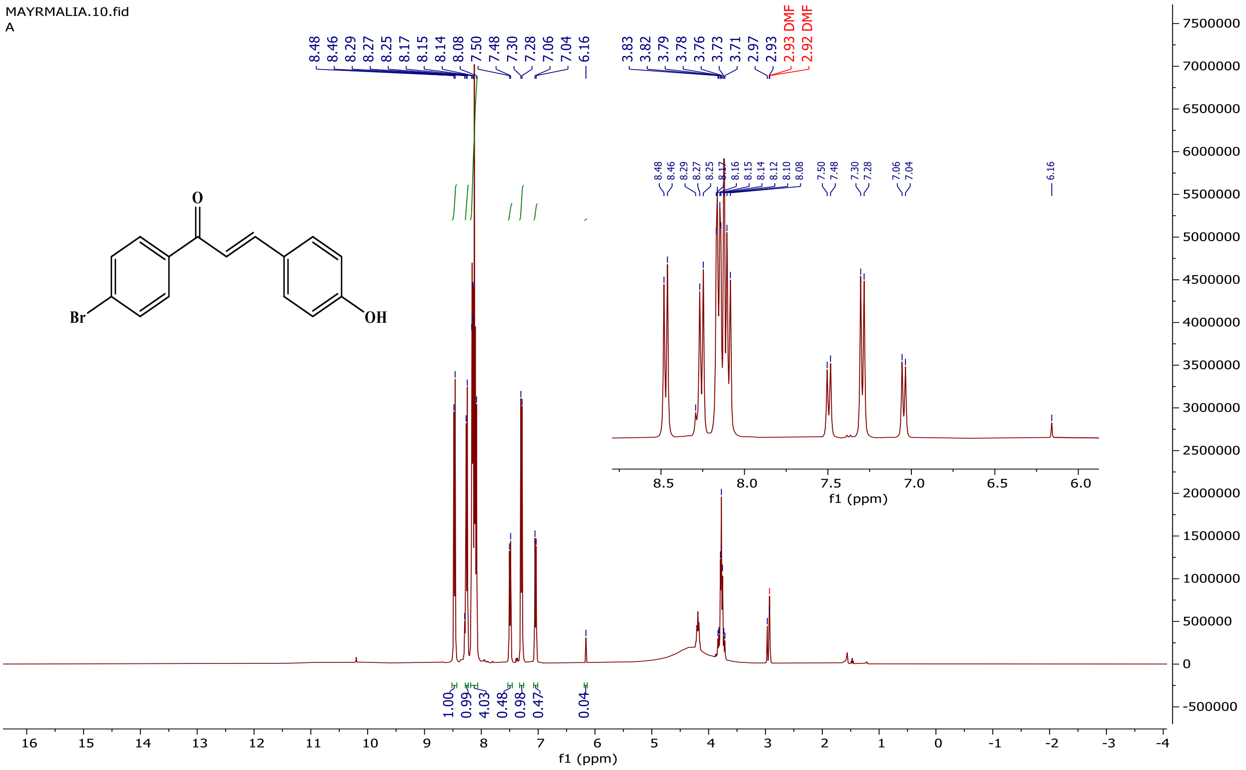


Fig 3. *^{1}H-NMR spectrum of compound A.*

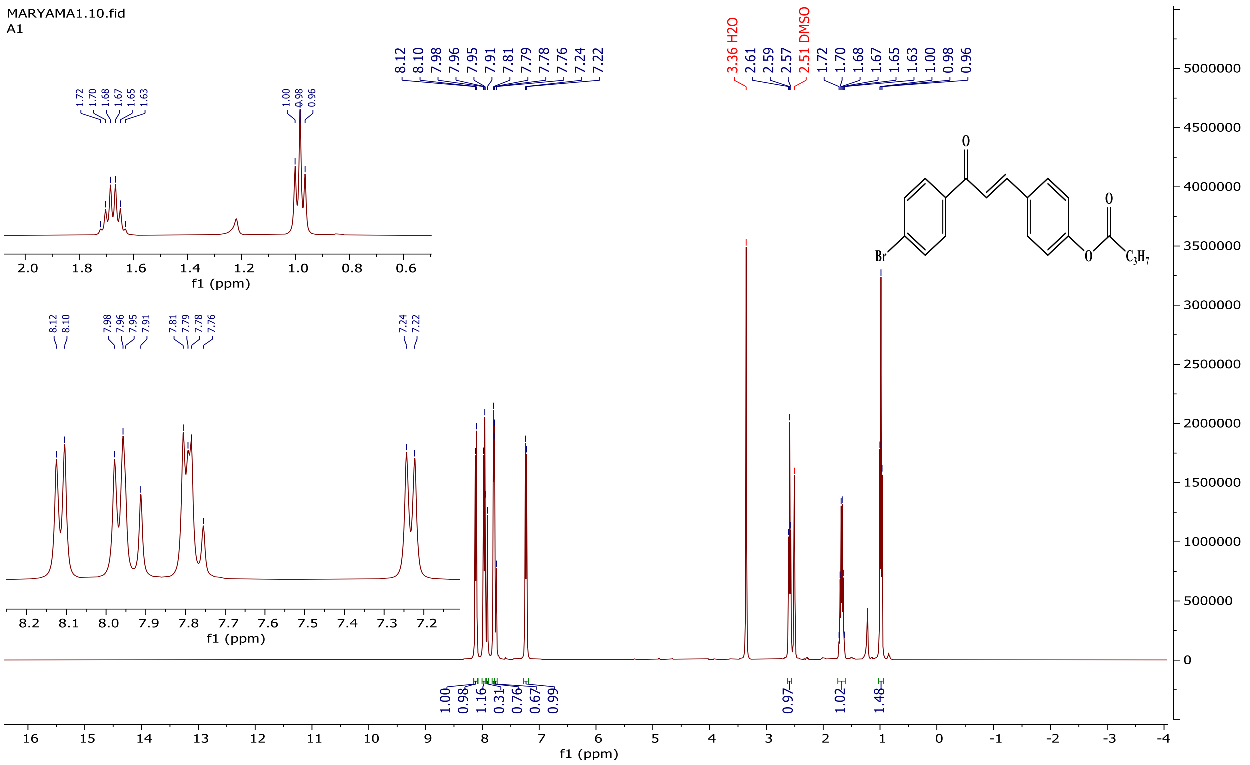


Fig. 4. *¹H-NMR spectrum of compound A₁.*

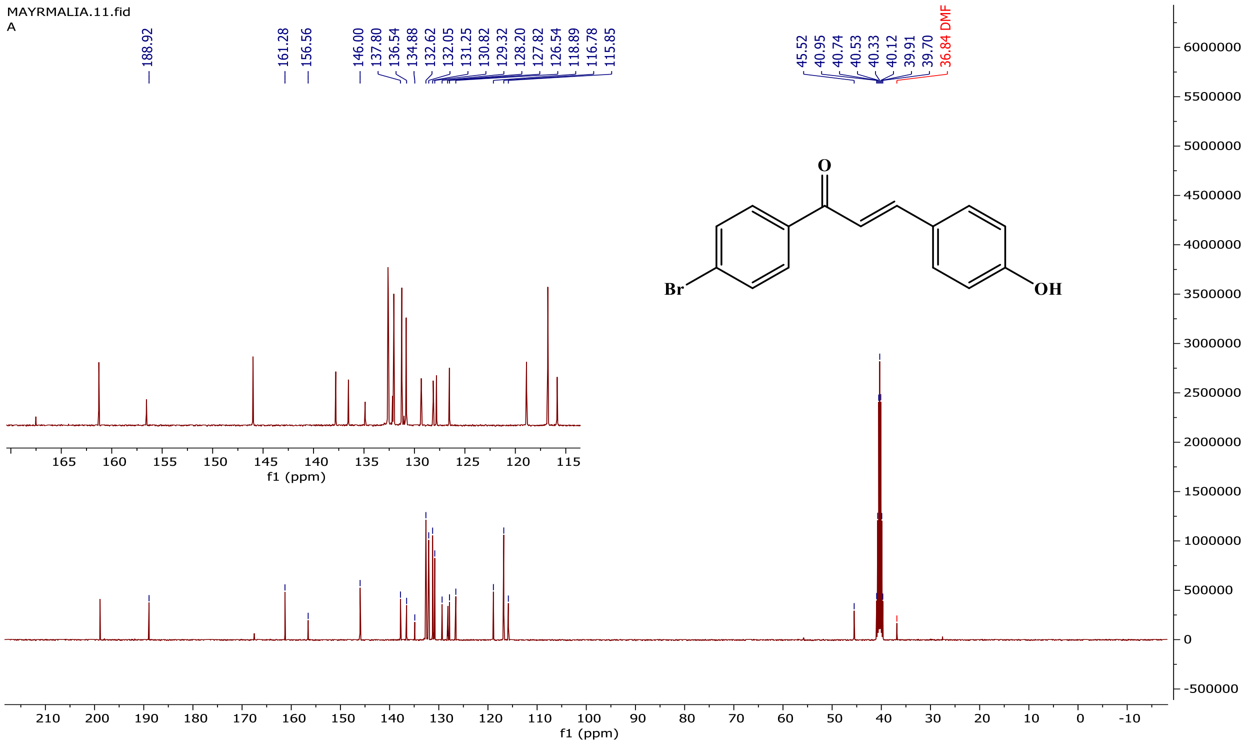


Fig. 5. *¹³C-NMR spectrum of compound A.*

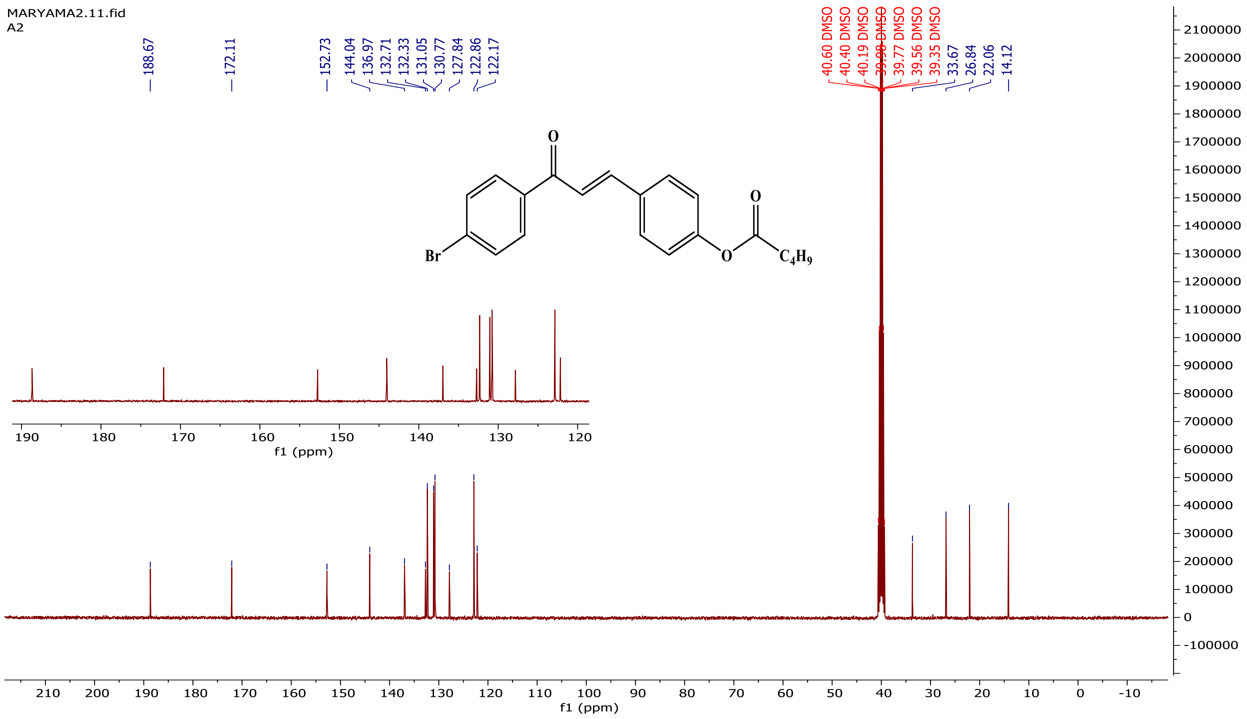


Fig. 6. *^{13}C-NMR spectrum of compound A_2.*

A Study of the Synthesized Compounds of Mesomorphic Properties

The presence of liquid crystalline properties was confirmed by examining the formed compounds using differential scanning calorimetry, and then the type of the formed tissue was confirmed by examining it using a polarized light microscope. The results of the tests indicated that compounds A_1, A_7- A_{10} exhibited liquid crystalline properties, while compounds A_1, A_7, and A_9 were monomorphic, while compounds A_8, A_{10} were dimorphic upon heating. Compounds A_1 and A_7 showed a nematic phase (marble texture), while compound A_9 showed a smectic phase, compound A_8 showed a transition from a crystal phase to a crystal phase and also showed a smectic phase, and compound A_{10} showed both nematic (marble texture) and smectic phases. The rest of the compounds did not show liquid crystalline phases, and the reason may be that the length of the hydrocarbon chains is not sufficient to form van der Waals interactions between neighbouring atoms, and this will reduce the molecular stacking between the molecules. The heat transfer values of the prepared compounds, as well as the entropy and enthalpy data, are given in Table 1.

Table 1. Information and Mesomorphic structures of compounds (A_1, A_7-A_{10})

Comp.	Transition	Peak temp. C°	ΔT_{Sm} C°	ΔT_N C°	ΔH $KJ.mol^{-1}$	ΔS $J.mol^{-1}. K^{-1}$
A_1	Cr-N	105.63	-	-	2.202175	5.817703
	N-I	127.88	-	22.25	32.267463	80.491575
A_7	Cr-N	101.39	-	-	2.726164	7.281615
	N-I	116.29	-	14.9	54.719954	140.563482
A_8	Cr_1-Cr_2	96.07	-	-	5.650754	15.310792
	Cr_2-S_m	98.95	2.88	-	0.864119	2.323212
	S_m-I	102.45	-	3.5	4.869164	12.968875
A_9	Cr- S_m	106.99	-	-	1.489208	3.919072
	S_m -I	117.79	-	10.8	55.906922	143.061291
A_{10}	Cr-S_m	54.44	-	-	1.332262	4.068721
	S_m-N	62.34	7.9	-	42.215382	125.888298
	N-I	103.20	-	40	19.973102	53.091711

The DSC thermograms of compound A_{10} are shown in Figure 7 and the phases observed to be formed by POM are shown in Figure 8.

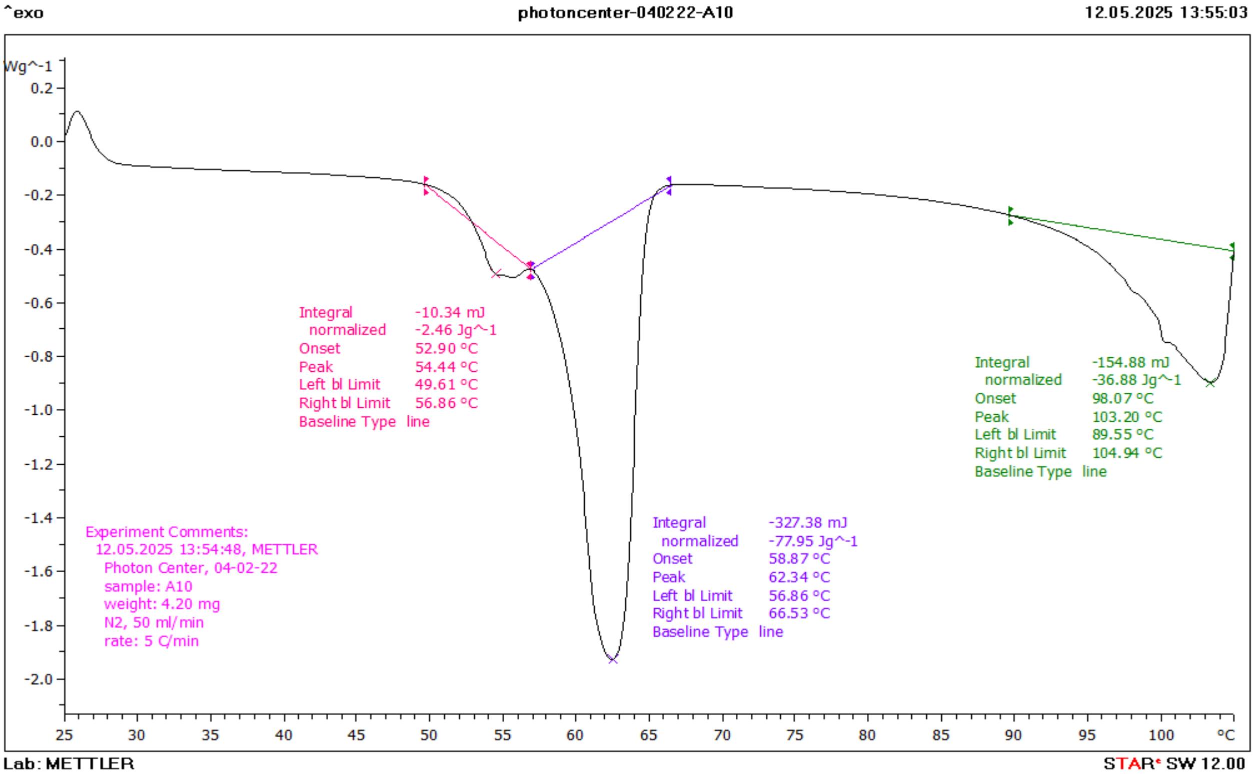


Fig. 7.*DSC thermograms of the compound A_{10}*

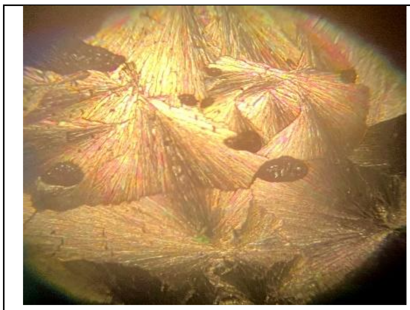
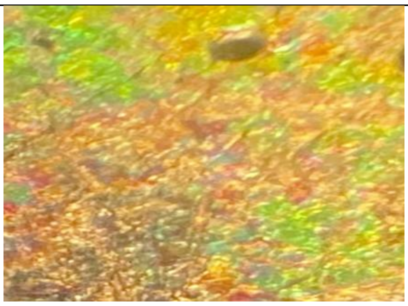
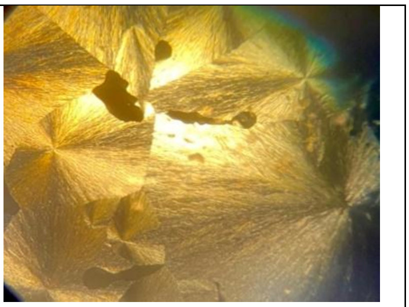
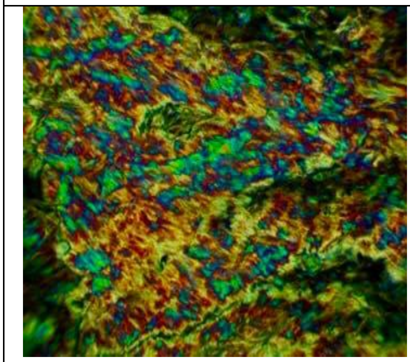
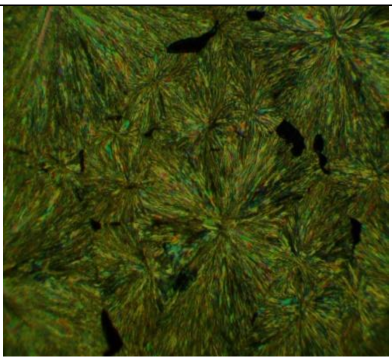
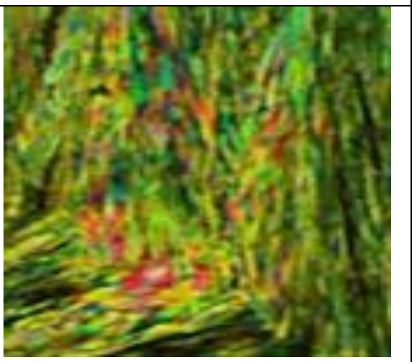
		
smectic phases at 96 °C for A_8	nematic (marble texture) at 105 °C for A_1	smectic phases at 106 °C for A_9
		
nematic- marble at 54 C° for A_{10}	Smectic phase at 62 C° for A_{10}	nematic- marble at 101 C° for A_7

Fig. 8. *polarization optical Microscopy for compounds*

Conclusion

Chalcone esters were synthesized and characterized. The study showed that the change in the hydrocarbon chain length and the type of phase formed, as compounds A_2-A_6 did not show liquid crystalline properties, while the rest of the compounds showed liquid crystalline properties. Compounds A_1, A_7, A_9 were monomorphic nematic to A_1, A_7 and sematic to A_9, while compound A_8 showed Cr_1-Cr_2 transition and smectic phase, compound A_{10} showed two phases: nematic and smectic.

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تخليق وتوصيف وسلوك البلورات السائلة لـ 4'-bromo-4-alkanoyloxy chalcone

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الكلمات المفتاحية:
جالكون، بلورة سائلة، استرة، و4-برومو أسيتوفينون

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الخلاصة:

تبحث هذه الدراسة في وجود خصائص بلورية سائلة في إسترات الجالكون ذات أطوال سلاسل هيدروكربونية مختلفة. صُنعت هذه المركبات، ذات الصيغة العامة [Br-Ph-CO-CH=CH-Ph-O-CO-CnH2n+1]، بتفاعل 4-برومو أسيتوفينون مع 4-هيدروكسي بنزالدهيد، ثم تفاعل الناتج مع هاليدات الحامض الكربوكسيلي في وجود محفزات مناسبة. وُشخصت المركبات باستخدام تقنيات تحويل فورييه للأشعة تحت الحمراء (FTIR)، والرنين المغناطيسي النووي أحادي الهيدروجين (^{1}H-NMR)، والرنين المغناطيسي النووي أحادي الكربون (^{13}C-NMR). تم تأكيد وجود خصائص بلورية سائلة باستخدام جهاز المسعر المسح التفاضلي (DSC)، وتم التأكد من شكل النسيج المتكون باستخدام المجهر الضوئي المستقطب (POM). كانت المركبات A_1 وA_7 وA_9 أحادية الشكل، بينما كانت المركبات A_8 وA_{10} ثنائية الشكل، ولم تُظهر المركبات المتبقية خصائص بلورية سائلة.