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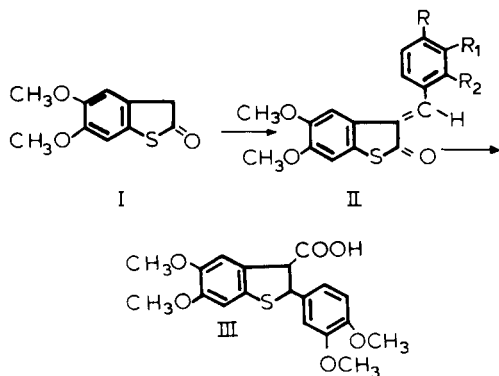
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Substituted-3-benzylidenebenzo[*b*]thiophen-2-ones have been synthesized. 5,6-Dimethoxybenzo[*b*]thiophen-2-(3*H*)one with aniline and triethyl orthoformate gives the 3-anilinomethylene compound, which can be hydrolysed to give the corresponding 3-hydroxymethylene derivative. Dimethoxybenzo[*b*]thieno[2,3-*b*]quinoline has been synthesized.

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In continuation of our studies on thiazio heterocyclic compounds (1-3), it was found of interest to effect the reaction of aromatic aldehydes with an acidic methylene group of the 5,6-dimethoxybenzo[*b*]thiophen-2-(3*H*)one.

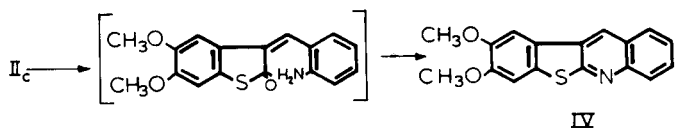


Conley and Heindel (4) have investigated the reaction of 2,3-dibenzo[*b*]thiophen-2-one with aromatic aldehydes and have shown to lead to the more thermodynamically *trans*-configuration.

Hydrolysis of II*d* with ethanolic potassium hydroxide, followed by acidification, gives the 2-(3,4-dimethoxyphenyl)-5,6-dimethoxy-2,3-dihydrobenzo[*b*]thiophene-3-carboxylic acid (III) (4).

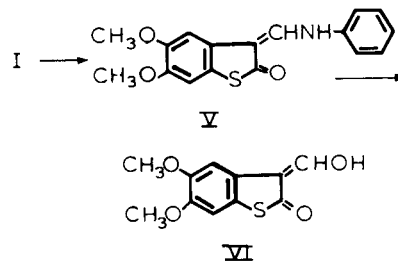
When compound II*c* was treated with zinc chloride in acetic acid or with stannous chloride in glacial acetic acid containing dry hydrogen chloride, compound IV was produced in good yield.

It is suggested that the reaction medium was responsible for the isomerisation of the *trans*-II*c* to the less stable *cis* isomer which on formation cyclised to IV (5).



The ir spectrum of IV shows the absence of the C=O at 1690  $\text{cm}^{-1}$ , the C=CH at 1610  $\text{cm}^{-1}$  and the absorptions of  $\text{NO}_2$  at 1565 and 1345  $\text{cm}^{-1}$ , which correspond to II*c*, while the mass spectrum gives  $M^+$  295 ( $\text{C}_{17}\text{H}_{13}\text{NO}_2\text{S}$ ) corresponding to IV. The nmr spectrum of compound IV gave signals for the two methoxy protons at  $\delta$  3.95 and 4.0. The aromatic protons C6-H to C9-H appeared at  $\delta$  6.8-8.32, while the C5-H appeared as a singlet at  $\delta$  9.20 and the C1-H, C4-H as singlets at  $\delta$  8.10 and 7.10, respectively.

The active methylene group of dimethoxythiophen-2-one (I) condensing with aniline and triethyl orthoformate produces anilinomethylene-5,6-dimethoxybenzothiothiophen-2-(3*H*)one (V), which can be hydrolysed with aqueous potassium hydroxide to give 3-hydroxymethylene-5,6-dimethoxybenzenethiophen-2-(3*H*)one (VI).



Compound II*c* crystallizes in space group  $\text{PI}$  with 2 molecules per unit cell. The cell parameters are:  $a = 7.706(4)\text{\AA}$ ,  $b = 9.785(6)\text{\AA}$ ,  $c = 11.470(8)\text{\AA}$ ,  $\alpha = 66.34(6)^\circ$ ,  $\beta = 78.04(6)^\circ$ ,  $\gamma = 84.44(5)^\circ$ ,  $V = 774.9\text{\AA}^3$ ,  $d_{\text{cal}} = 1.458 \text{ gm}^{-3}$ ,  $d_{\text{obs}} = 1.45 \text{ gm}^{-3}$ ,  $F(000) = 356e$ .

Intensity data was collected on a SYNTEX P2<sub>1</sub> diffractometer with a graphite monochromator. The structure was solved by direct methods using MULTAN, and was refined to an  $R = 0.030$ .

The torsion angles around the C9-C10 and C15-N bonds are  $61.9^\circ$  and  $27.4^\circ$  respectively.

The bonds C3-O3 and C4-O4 are  $1.360(4)$  and  $1.370(4)\text{\AA}$ ,

Table I

Compound	R	R <sub>1</sub>	R <sub>2</sub>	Mp °C	Formula	Yield	Solvent of Recrystallization	3-Benzylidenebenzo[b]thiophen-2-ones						
								Calcd. %	Found %	N	IR bands (cm <sup>-1</sup> )			
IIa	N(CH <sub>3</sub> ) <sub>2</sub>	H	H	169-171	C <sub>19</sub> H <sub>19</sub> NO <sub>3</sub> S	67	Methanol	C	5.57	4.10	66.71	5.56	4.10	1640 (CO)
IIb	OCH <sub>3</sub>	OCH <sub>3</sub>	OCH <sub>3</sub>	154-155	C <sub>20</sub> H <sub>20</sub> O <sub>4</sub> S	90	Methanol-Chloroform	C	5.15	-	61.43	4.84	-	1665 (CO)
IIc	H	H	NO <sub>2</sub>	175-176	C <sub>17</sub> H <sub>13</sub> NO <sub>3</sub> S	80	Methanol-Chloroform	C	3.79	4.08	59.32	4.05	4.10	1685 (CO)
IIe	OCH <sub>3</sub>	OCH <sub>3</sub>	H	154-155	C <sub>19</sub> H <sub>19</sub> SO <sub>4</sub>	75	Methanol-Chloroform	C	5.02	-	63.97	5.43	-	1665 (CO)
IIe	N(CH <sub>2</sub> CH <sub>2</sub> Cl) <sub>2</sub>	H	H	121-123	C <sub>21</sub> H <sub>21</sub> NO <sub>3</sub> SCl	45	Ethyl acetate- <i>n</i> -Hexane	C	4.79	3.19	57.41	5.10	2.98	1665 (CO)

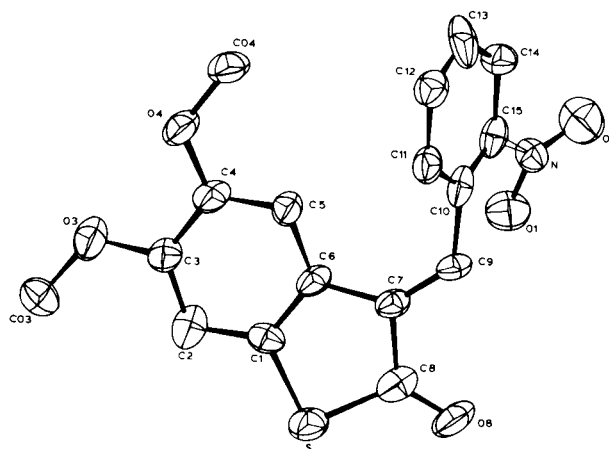
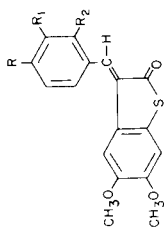


Figure. Diagram of the molecular structure of IIc.

respectively, indicating a partial double bond character while the bonds O4-CO4 and O3-CO3 are 1.426(5) and 1.440(5) Å respectively, normal single bonds.

## Figure and Table

## EXPERIMENTAL

Melting points were determined on a Gallenkamp melting point apparatus and are uncorrected. The ir spectra were recorded with a Perkin-Elmer 521 in solid phase potassium bromide. The nmr spectra were determined with a Varian XL-100 instrument using DMSO as a solvent and tetramethylsilane as the internal standard. Elemental analysis were performed by the Analytical laboratory of the Chemistry Department of the N. R. C. "Demokritos".

General Procedure for the Preparation of 3-Benzylidenebenzo[b]thiophen-2-(3*H*)ones (II).

A solution of 5 mmoles of 5,6-dimethoxybenzo[b]thiophen-2-(3*H*)one (I) and the aromatic aldehyde (5 mmoles) in 5 ml of absolute ethanol was cooled in an ice bath. Piperidine (10 drops) was added and the mixture was stirred for 6 hours at 0° and refrigerated overnight. The precipitate which formed was collected by filtration. The compounds prepared are reported in Table I.

2-(3,4-Dimethoxyphenyl)-5,6-dimethoxy-2,3-dihydrobenzo[b]thiophene-3-carboxylic Acid (III).

A solution of 21 g of the benzylidene IIb in 150 ml of absolute ethanol was added to 65 ml of ethanolic potassium hydroxide (11.3 g/65 ml). The mixture was stirred at room temperature until the solid was solubilized. After that time the solvent was removed under reduced pressure and the residue was dissolved in 100 ml of cold distilled water and acidified with concentrated hydrochloric acid. The resulted solid was obtained by filtration. Recrystallization from methanol-chloroform gave 90% yield of III, mp 208-210°;  $\nu$  max 1668 (CO).

*Anal.* Calcd. for C<sub>19</sub>H<sub>20</sub>SO<sub>6</sub>: C, 60.63; H, 5.32. Found: C, 60.30; H, 5.09.

5,6-Dimethoxybenzo[b]thiopheno[2,3-*b*]quinoline (IV).

## Method A.

Benzylidene IIc (3 mmoles, 1.029 g) was added to boiling acetic acid (30 ml). To this solution 3 g of zinc chloride was added in small portions and the mixture was stirred and heated on a steam bath for one hour.

The cooled mixture was diluted with water and extracted several times with chloroform. The organic layer was washed with water, dried over sodium sulfate and the solvent was evaporated under reduced pressure. The residue was crystallized from methanol to give 0.88 g (90% yield) mp 179-181°.

*Anal.* Calcd. for C<sub>17</sub>H<sub>13</sub>NO<sub>2</sub>S: C, 69.15; H, 4.40; N, 4.74. Found: C, 69.55; H, 4.71; N, 4.78.

#### Method B.

A suspension of stannous chloride dihydrate in glacial acetic acid (15 ml) was saturated with dry hydrogen chloride. The resultant solution was cooled to below 10°. In small portion 0.515 g of the nitrobenzylidene IIc was added. The mixture was allowed to stand at room temperature for 20 hours. The red precipitate was collected by filtration, suspended in water and neutralized with 10% sodium hydroxide. The precipitate was filtered off, washed with water and dried to give 68% yield of IV mp 178-180°, identical to the compound prepared before by infrared spectra and mixed melting point.

#### 3-Anilinomethylene-5,6-dimethoxybenzo[*b*]thiophen-2-(3*H*)one (V).

To 0.630 g (3 mmoles) of thiolactone in 15 ml of glacial acetic acid, 0.279 g (3 mmoles) of aniline and 0.444 g (3 mmoles) of triethyl orthoformate was added. The mixture was heated in an oil bath at 140° for 20 minutes, which after cooling and addition of ethanol gave a solid. This solid was dissolved in chloroform and chromatographed on a silica gel

column. Elution with chloroform-methanol (9.5:0.5) gave compound V in 66% yield, mp 167-168° (chloroform-ethanol); ir:  $\nu$  max 1640 (CO), 1610<sup>-1</sup> (C=C).

*Anal.* Calcd. for C<sub>17</sub>H<sub>15</sub>NO<sub>3</sub>S: C, 65.17; H, 4.79; N, 4.47. Found: C, 64.95; H, 4.75; N, 4.52.

#### 3-Hydroxymethylene-5,6-dimethoxybenzo[*b*]thiophen-2-(3*H*)one (VI).

Compound V (0.65 g) was dissolved in 30 ml of water containing 1.3 g of potassium hydroxide. The mixture was heated under reflux for 1 hour. The cooled solution was filtered and acidified with concentrated hydrochloric acid. The precipitate was collected by filtration and recrystallized from ethanol, mp 115-116°; ir:  $\nu$  max 3160 (OH), 1680 (CO), 1640 cm<sup>-1</sup> (C=C).

*Anal.* Calcd. for C<sub>11</sub>H<sub>10</sub>O<sub>4</sub>S: C, 55.46; H, 4.20. Found: C, 55.79; H, 4.46.

#### REFERENCES AND NOTES

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