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Synthesis and spectral studies (ir, ¹H nmr, ms) of 1- and 3-substituted arylthiobenzof[quinolines (IIIa-IIIc, IVa-IVc) obtained through nucleophilic displacement of the corresponding halobenzof[quinoline by various thiols (a-c) were done.

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The derivatives of benzo[quinoline are known as medicinally important agents (2-6b). Nucleophilic displacement of 1- and 3-chlorobenzof[quinolines by hydrazines have earlier been studied in this laboratory (7,8). In the present communication the replacement of chlorine by various thiols (a-c) have been discussed and the structures of such arylthiobenzof[quinoline derivatives have been established by ir, ¹H nmr and mass spectral studies.

Results and Discussion.

It was found that chlorine *ortho* to nitrogen (III) was comparatively more active than to that situated *para* to nitrogen (IV). The nature of the substituent in thiols (a-c) also effect the substitution and the reactivity order of thiophenols was $b > a > c$.

EXPERIMENTAL

All melting points are uncorrected. Purity of the compounds was checked by tlc using silica gel 'C' as an adsorbent and benzene-ethanol:ammonia (7:2:1; V/V; upper layer) as mobile phase. The ir spectra were recorded on Perkin-Elmer Infracord in potassium bromide pellets. The Nmr spectra were recorded on varian A-60 MH₃ spectrophotometer in deuteriochloroform using TMS as an internal reference. The chemical shifts were expressed in δ ppm. The mass spectra were recorded on Varian Mat-CH-7 mass spectrophotometer at 70 ev.

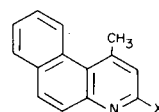
3-Chloro-1-methylbenzo[quinolin (III) and 1-Chloro-3-methylbenzo[quinolin (IV).

Compounds III and IV were prepared by the method of Connard and Limpach (9a,b) by condensing ethyl acetoacetate and 3-naphthylamine to obtain 3-hydroxy-1-methyl- and 1-hydroxy-3-methylbenzo[quinoline separately followed by subsequent chlorination with a mixture of phosphorus oxychloride and phosphorus pentachloride (10) whereupon corresponding chloro derivatives III and IV were obtained.

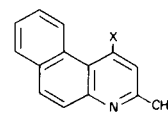
Sodium Salts of Thiophenols (a-c).

One half mole of mercaptan dissolved in alcohol (ca. 10-15 ml) to which 2 ml of 10% sodium hydroxide solution was added. The mixture was refluxed for 30 minutes when a solid salt of the mercaptan obtained was filtered and dried.

Chart I



III ~ IIIc

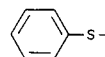


IV ~ IVc

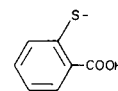


a, Y = H
b, Y = COOH
c, Y = NH₂

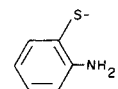
X - Comp. No.
Cl - III, IV



IIIa, IVa



IIIb, IVb



IIIc, IVc

Table I

| No. | Molecular Formula | Mp °C | Rf | Yield % | Reaction time (hours) | Analysis % | | | |
|------|---|-------|------|---------|-----------------------|------------|-------|--------|-------|
| | | | | | | S | N | Calcd. | Found |
| IIIa | C ₂₀ H ₁₅ NS | 156 | 0.50 | 74 | 11 | 10.63 | 10.40 | 4.65 | 4.61 |
| IIIb | C ₂₁ H ₁₅ NO ₂ S | 172 | 0.58 | 75 | 10 | 9.27 | 9.15 | 4.34 | 4.22 |
| IIIc | C ₂₀ H ₁₆ N ₂ S | 215 | 0.52 | 68 | 13 | 10.12 | 10.01 | 8.79 | 8.66 |
| IVa | C ₂₀ H ₁₅ NS | 166 | 0.65 | 67 | 18 | 10.63 | 10.54 | 4.65 | 4.55 |
| IVb | C ₂₁ H ₁₅ NO ₂ S | 186 | 0.63 | 68 | 18 | 9.27 | 9.02 | 4.34 | 4.30 |
| IVc | C ₂₀ H ₁₆ N ₂ S | 207 | 0.40 | 64 | 19 | 10.12 | 9.98 | 8.79 | 8.69 |

Chart II

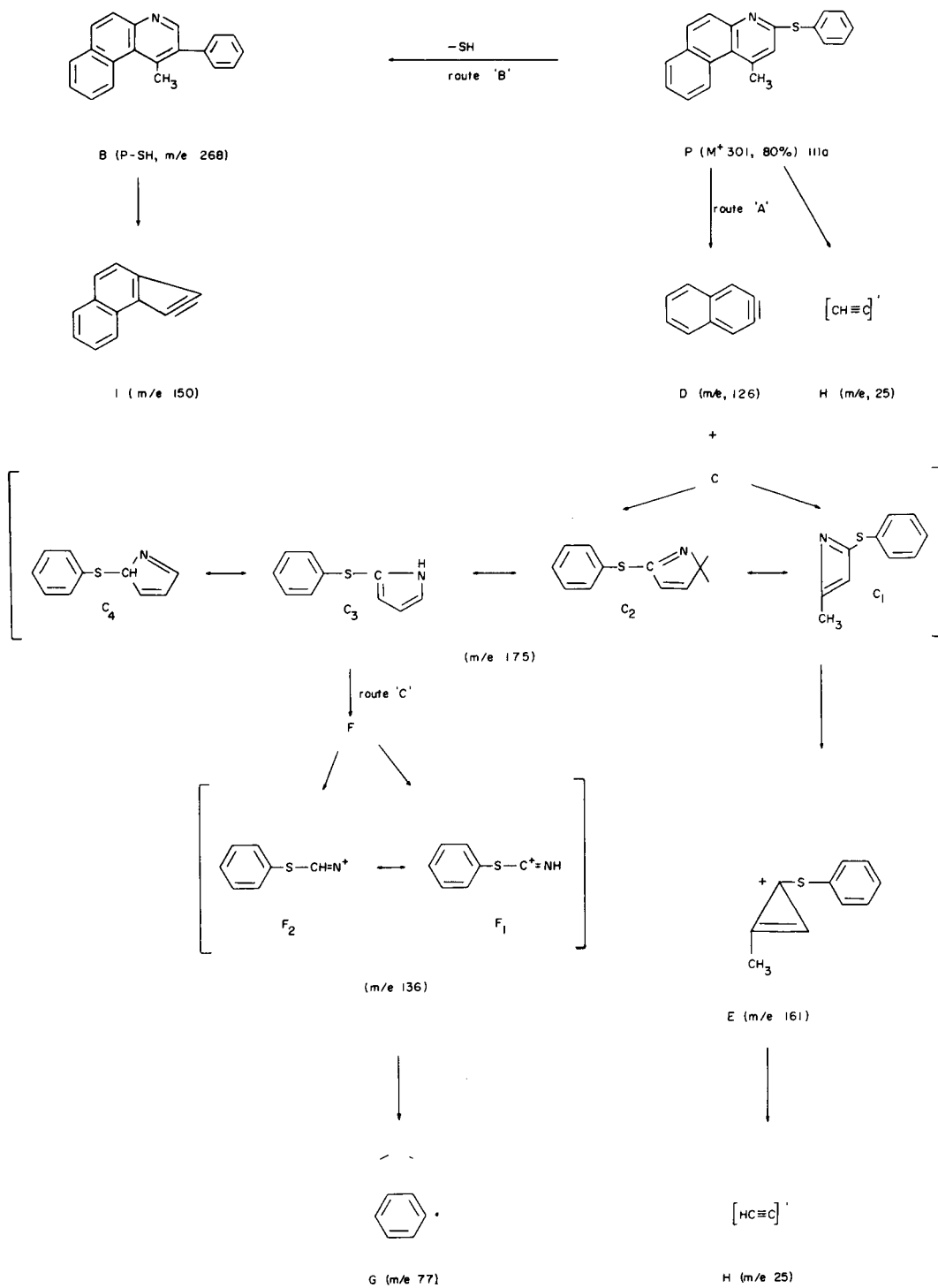


Chart II (continued)

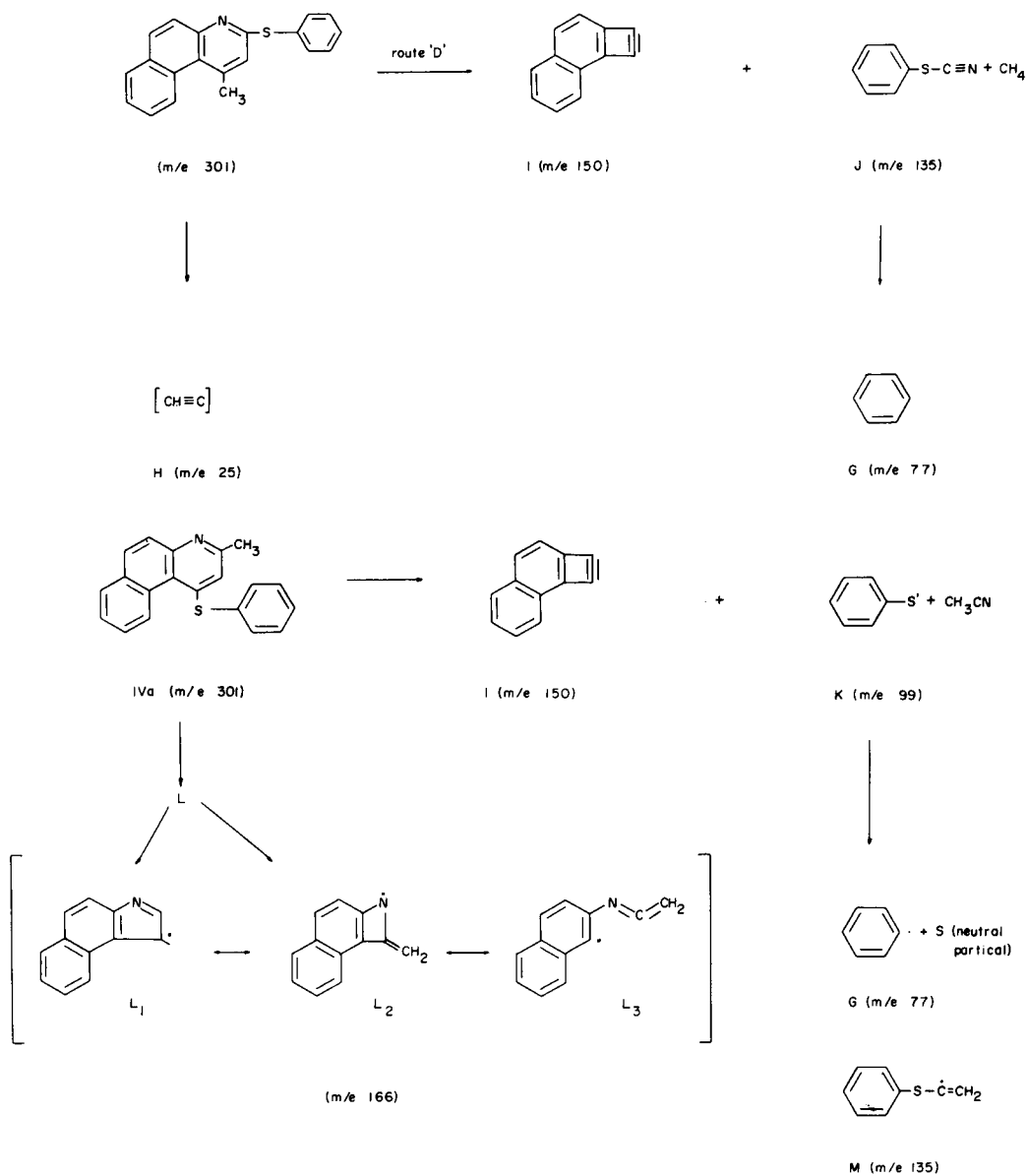


Table II

| No. | Aromatic region | >C=S stretching | -OH of COOH | >C=O of -COOH | -NH ₂ | Substituted aryl ring | C-H (out plane vibrations) |
|------|-----------------|-----------------|-------------|---------------|------------------|--|----------------------------|
| IIIa | 1600-1450 | 635, 600 | — | — | — | 1200, 1160, 1130, 1070, 1020, 750 | 860 |
| IIIb | 1600-1450 | 640, 600 | 3200-2950 | 1725-1718 | — | 1200, 1188, 1170, 1085, 1020, 795, 770 | 862 |
| IIIc | 1600-1450 | 650, 610 | — | — | 3410-3250 | 1190, 1160, 1070, 1020, 790, 760 | 860 |
| IVa | 1600-1450 | 635, 600 | — | — | — | 1200, 1170, 1085, 1020, 795, 700 | 862 |
| IVb | 1600-1450 | 640, 600 | 3200-2950 | 1725-1718 | — | 1200, 1110, 1085, 1020, 790, 760 | 860 |
| IVc | 1600-1450 | 650, 510 | — | — | 3400-3250 | 1190, 1160, 1070, 1020, 790, 760 | 865 |

Table III

NMR Deuteriochloroform Chemical Shifts in δ ppm

| No. | Aromatic protons | \rightarrow C-CH ₃ | Ar-NH ₂ |
|------|------------------|---------------------------------|--------------------|
| IIIa | 6.7-8.2 (m) 12H | 2.75 (s) 3H | — |
| IIIb | 6.85-8.3 (m) 11H | 2.75 (s) 3H | — |
| IIIc | 6.6-8.1 (m) 11H | 2.70 (s) 3H | 4-4.7 (s) 2H |
| IVa | 6.7-8.2 (m) 12H | 2.75 (s) 3H | — |
| IVb | 6.85-8.3 (m) 11H | 2.75 (s) 3H | — |
| IVc | 6.6-8.1 (m) 11H | 2.70 (s) 3H | 4-4.7 (s) 2H |

Condensation of 3-Chloro-1-methylbenzo[*f*]quinoline (III) With Sodium Salt of Thiophenol (a) (IIIa).

Compound III (1.137 g, 0.05 mole) in DMF (ca. 15-20 ml) and the sodium salt of thiophenol (a, 0.06 mole) was refluxed for 11 hours. The reaction mixture was checked by tlc for completion, then poured on crushed ice and the solid compound was filtered and dried. It was crystallised from a petroleum ether-acetone mixture (1:9) to give prismatic yellow crystals of IIIa (Yield 74%, mp 156°; Rf 0.50).

Similarly IIIb, IIIc and IVa-IVc were also synthesized.

The melting points, Rf values, solubility and the values of elemental analysis (S and N) are summarized in Table I. The structures of compounds IIIa-IIIc and IVa-IVc were established on the basis of elemental analysis, ir, ¹H nmr and ms studies. Characteristic absorption bands in ir spectra of compounds IIIa-IIIc and IVa-IVc are given in Table II.

The nmr spectra of IIIa and IVa showed singlets for 3H at δ 2.75 ppm and that of IIIb and IVb at δ 2.7 ppm. These singlets of the C-Me group (in the vicinity of δ 2.70-2.75 ppm) moved to downfield as compared to that observed in quinoline (at δ 2.4 to 2.55 ppm) probably due to deshielding caused by conjugation with the benzene ring. The presence of electron donating groups (-NH₂ in IIIc and IVc) shifted this signal to a higher field (δ 2.70 ppm). The signals for aromatic protons in IIIb and IVb (11H, δ 6.85-8.3) moved downfield as compared to that of IIIa and IVa (12H, δ 6.7-8.2) due to the deshielding of the aromatic protons by the -COOH group and the sulphide linkage but an upfield movement was observed in IIIc and IVc due to shielding of these protons by the amino group, the presence of which was confirmed by a broad singlet at δ 4.0-4.7. The proton attached to the -COOH group (in IIIb and IVb) could not be detected as the spectra were scanned only upto δ 10 ppm.

Mass spectral studies of heteryl aryl sulphides have not been studied in much detail at present.

An electron impact study of compound IIIa showed that the parent ion (P) peak intensity was much larger (80%, R.A.) and the base peak was

observed at m/e 268 P-SH or ion (B). The absence of a P-H₂S ion characterised the compound as a thioether (R-S-R). The presence of the ion at m/e 175 and 126 indicated the fragmentation (through route 'A') of the parent ion in two parts C (C₁ or C₂ or C₃ or C₄) and (D). The loss of nitrogen from the ion C₁ gave an ion (E), m/e 161. The further disintegration of ion (C) and subsequent rearrangement resulted into an ion (F) m/e 136 (F₁ or F₂). The ions (G) at m/e 77 (phenyl ring), (H) at m/e 25 (-C = CH) were obtained as a result of fission either at the 'b' or the 'c' positions. The presence of ions (I) and (J) at m/e 150 and at m/e 135, respectively, were a result of disintegration of the heterocyclic ring through route (D). These ions can also result with the simultaneous fragmentation of the ion 'P'.

The mass spectrum of IVa was more or less similar to that of IIIa, as the formation of ions at m/e 175, 150, 136, 126, 77 and 25 were observed. Fragmentation of the parent ion with subsequent elimination of CH₃CN gave ions (I) and (K) at m/e 150 and m/e 99, respectively. The formation of ions 'L' (L₁ or L₂ or L₃) at m/e 166 in IVa was, however, not observed in IIIa. It was as a result of fission of the heterocyclic ring at b or c.

Acknowledgement.

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