Synthesis of Quaternary Salts from 3,3'-Bipyridine and Dibromoalkanes

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There has been considerable interest in the products of the reaction between bipyridines and dibromoalkanes [1]. 2,2'-Bipyridine reacts with 1,2-dibromoethane to give the bridged diquaternary salt (1), which is the well-known herbicide diquat dibromide [2] and similar bridged salts are formed with 1,3-dibromopropane and 1,4-dibromobutane but with 1,5-dibromopentane the product is instead the diquaternary salt (2) where two bipyridine moieties are connected by a pentamethylene group [3]. 2,3'-Bipyridine reacts with several dibromoalkanes to give a mixture of the corresponding 1',l'-bromoalkyl-2,3'-bipyridinium monoquaternary salts such as 3 and the 1',1''-(alkanediy1)-bis-2,3'-bipyridinium diquaternary salts such as 4 containing two bipyridine moieties connected by polymethylene groups [4]. Attempts to obtain bridged diquaternary salts akin to diquat dibromide were not successful. Reaction of 4,4'-bipyridine with 1,2-dibromoethane can result in the formation of polyviologens [1, 5], the diquaternary salt (5) containing two 4,4'-bipyridine moieties [6], the monoquaternary salt (6) [7, 8] or the diquaternary salt (7) [8] depending on reaction conditions and similar results have been obtained with other dibromoalkanes [1, 2, 6, 8]. We now report the results of our study of the reaction of 3,3'-bipyridine with dibromoalkanes. Parts of the work have been the subject of a preliminary communication [9].

Reaction of 3,3'-bipyridine with equimolar amounts of 1,3-dibromopropane, 1,4-dibromobutane, 1,5-dibromopentane, 1,6-dibromohexane, 1,7-dibromheptane and 1,8-dibromooctane in boiling ethanol afforded the bridged diquaternary salts (8, n = 3), (8, n = 4), (8, n = 5), (8, n = 6), (8, n = 7) and (8, n = 8), named in the Experimental section, respectively in about 50—60% yield. Each of these bridged salts represents the first derivative of a new heterocyclic ring system. The structure of the salts followed from their elemental analyses (all bromine ionic) and their NMR spectra. The structures were further confirmed by examination of the fast atom bombardment (FAB) mass spectra of the salts. The spectra were obtained by mixing the solid salts with 3-nitrobenzyl alcohol on a standard FAB target. 3-Nitrobenzyl alcohol has recently been recommended as a matrix suitable for obtaining FAB spectra [10]. Each spectrum showed ions corresponding to (C—H)+ and (C+Br)− as indicated in Table I, where C represents the appropriate dication. There were no significant ions at higher mass values. These
ions are readily accounted for in terms of the mechanism of the formation of ions in FAB mass spectrometry [11]. The spectra also showed ions corresponding to \((C + NO_2 - H)^+\) species presumably arising by reaction of the dications with the 3-nitrobenzyl alcohol matrix. The FAB spectrum of the salt \((8, n = 7)\) in the mass range 170—370 is given in Fig. 1 by way of illustration.

It was ascertained that the salts \((8, n = 3)\) and \((8, n = 4)\) were also obtained, although in lower yield, by heating 3,3'-bipyridine with excess of the appropriate dibromoalkane at 150 °C. The salt \((8, n = 3)\) was also obtained in the following way. Reaction of excess 3,3'-bipyridine with 3-bromopropanol afforded the monoquaternary salt, 1-(3-hydroxypropyl)-3,3'-bipyridinium bromide \((9, X = Br)\), which was analysed as the perchlorate \((9, X = ClO_4)\). On refluxing the salt \((9, X = Br)\) with concentrated aqueous hydrobromic acid there was obtained the hydrobromide of 1-(3-bromopropyl)-3,3'-bipyridinium bromide which, without purification, afforded the bridged diquaternary salt \((8, n = 3)\) on treatment with sodium hydrogen carbonate.

The benzo derivative \((10)\) of the bridged diquaternary salt \((8, n = 4)\) was obtained from reaction of equimolar amounts of 3,3'-bipyridine with \(\alpha,\alpha'\)-dibromo-o-xylene in boiling ethanol followed by conversion of the bromide anions to perchlorate. Its structure too was confirmed by FAB mass spectrometry although, in this case, since it was in the form of the diperchlorate no \((C + Br)^+\) ion was observed (see Table I).

As expected, reaction of equimolar amounts of 3,3'-bipyridine and 1,2-dibromoethane in boiling ethanol did not afford the corresponding bridged diquaternary salt since the length of the chain is too short. Instead the product obtained was the diquaternary salt containing two 3,3'-bipyridine moieties, namely 1,1''-(1,2-ethanediyl)-bis-3,3'-bipyridinium
dibromide \((11; \text{X} = \text{Br})\) which was purified as the di perchlorate \((11; \text{X} = \text{ClO}_4)\). Its structure was confirmed by elemental analysis and by its NMR spectrum. The structure of \((11; \text{X} = \text{Br})\) was further confirmed by its conversion to the bis-diquaternary salt \(1,1''-(1,2\text{-ethanediyl})\text{-bis-}(1'\text{-methyl-3,3'}\text{-bipyridinium})\text{tetraperchlorate} \ (12)\) with dimethyl sulfate followed by reaction with lithium perchlorate to convert all the anions to perchlorate. Reaction of 3,3'-bipyridine with excess 1,2-dibromoethane at 125–128 °C afforded a mixture of \((11; \text{X} = \text{Br})\) and the hydrobromide of the monoquaternary salt, 1-(2-bromoethyl)-3,3'-bipyridinium bromide \((13)\).

In view of our interest in the one electron reduction of diquaternary \([1, 2, 4, 6, 8, 12]\) and bis-diquaternary \([4, 6, 8]\) salts of bipyridines we investigated the polarographic behaviour of the bis-diquaternary salt \((12)\) and the bridged diquaternary salts \((8; n = 3), (8; n = 4), (8; n = 5), (8; n = 6), (8; n = 7)\) and \(10\) in aqueous solution by direct current polarography at the dropping mercury electrode with diquat dibromide \((1)\) as reference. We included for comparison 1,1'-dimethyl-3,3'-bipyridinium bis(methyl sulfate) \((14)\) which was obtained by reaction of 3,3'-bipyridine with excess dimethyl sulfate. The 1,1'-dimethyl-3,3'-bipyridinium dication has been prepared before but as the dichloride \([13]\), diiodide \([13, 14]\) or bis(tetrafluoroborate) \([15]\).

In the pH range 8.2–11.1 1,1'-dimethyl-3,3'-bipyridinium bis(methyl sulfate) \((14)\) gave a reduction wave which corresponded approximately to the uptake of one electron with a half-wave potential \((E_0)\) of approximately 0.0 V independent of pH attributed to the formation of the radical cation of which structure \((15)\) is one canonical form. At lower pH values no clear wave was observed, the current increasing steadily as the applied voltage decreased. The result at low pH values is similar to that reported in a previous study conducted with 1,1'-dimethyl-3,3'-bipyridinium bis(tetrafluoroborate) at pH 6.0 only \([15]\). The 1,1'-dimethyl-3,3'-bipyridinium dication is thus less easily reduced than diquat dibromide \((1)\), 1,1'-dimethyl-4,4'-bipyridinium (paraquat) salts \([2]\), 1,1'-dimethyl-2,2'-bipyridinium diiodide \([2]\) and 1,1'-dimethyl-2,3'-bipyridinium diperchlorate \([4]\) which are reduced by a one electron transfer to radical cations at potentials \((E_0)\) of 0.35 V, 0.45 V, 0.70 V and 0.80 V respectively.

The bridged diquaternary salts \((8; n = 3), (8; n = 4), (8; n = 5), (8; n = 6), (8; n = 7)\) and \(10\) were examined polarographically in the pH range 6.0–9.7. The polarograms were difficult to interpret. In most cases there were indications of a one-electron reduction wave with a half-wave potential \((E_0)\) of about 0.75 V independent of pH presumably due to the formation of radical cations analogous to \(15\) but the waves were not always distinct and the polarograms frequently had wave maxima which were not able to be suppressed by the addition of Triton X-100. This result may be due to surface effects related to the large size of the bridged salts.

The bis-diquaternary salt 1,1''-(1,2-ethanediyl)-bis-(1'-'methyl-3,3'-bipyridinium)tetrap erchlorate \((12)\) was also examined polarographically in the pH range 2.9–7.1. At higher pH values it decomposed. It gave
a symmetrical reduction wave which corresponded to the uptake of two electrons at a half-wave potential ($E_0$) of $-0.57$ V independent of pH and concentration attributed to the formation of the diradical dication of which structure 16 is one canonical form. It is interesting to recall that the corresponding bis-diquaternary salts in the 4,4',bipyridine series namely 1,1''-(1,2-ethanediyl)-bis-(1'-methyl-4,4'-bipyridinium)tetraperchlorate [6], and in the 2,3'-bipyridine series, namely 1',1'''-1,2-ethanediyl)-bis-(1-methyl-2,3'-bipyridinium)tetraperchlorate [4] are reduced to the corresponding diradical dications at potentials ($E_0$) of $-0.27$ V and $-0.47$ V respectively.

The bis-diquaternary salt in the 3,3'-bipyridine series like the 1,1'-dimethyl-3,3'-bipyridinium dication is thus less easily reduced than the corresponding salts in the 2,3'-bipyridine and 4,4'bipyridine series. The diquaternary salts (14), (8; n = 3), (8; n = 4), (8; n = 5), (8; n = 6), (8; n = 7), (8; n = 8) and 10 and the bis-diquaternary salt (12) all gave yellow-brown colourations in aqueous solution on treatment with zinc powder. None of the colours, however, was formed as quickly or was as intense as those obtained likewise from diquat and paraquat salts [2] on treatment with zinc dust presumably because the radical cations formed from the 3,3'-bipyridine salts are less stable than the radical cations formed from diquat and paraquat.

**Experimental**

The fast atom bombardment (FAB) mass spectra were obtained using a VG Analytical MM 12-12 quadrupole mass spectrometer. The beam of fast xenon atoms was produced by charge exchange in a saddle field ion gun (2 mA and 8 kv) and focussed on the FAB target containing the diquaternary salt (100 μg) mixed in 3-nitrobenzyl alcohol (2 μl). The ions produced were mass analysed from m/z 100 to 800 to enable the detection of dimer ions but none was found.

Britton and Robinson buffers were used in the polarography experiments which were conducted at 20 °C with a standard calomel electrode and 3×10⁻⁴ and 2×10⁻⁴ solutions. The solutions sometimes contained 0.2% Triton X-100 to suppress wave maxima. The half-wave potentials are given as $E_0$ values and were calculated by adding 0.25 V to the $E_{1/2}$ values. Experimental error in the half-wave potentials was ±0.02 V. Microanalyses were performed by the Australian Microanalytical Service. UV absorption measurements were taken with 2×10⁻⁵ M solutions. NMR spectra (60 MHz) were determined in deuteriated dimethyl sulfoxide or trifluoroacetic acid.

1-(3-Hydroxypropyl)-3,3'-bipyridinium perchlorate (9, X = C10₄)

3,3'-Bipyridine (1 g) and 3-bromopropanol (0.28 ml) in ethanol (5 ml) were refluxed for 3 h and the solvent was then removed. The oily residue was treated with acetone to afford the salt (9, X = Br) as a white hygroscopic solid. For analysis the salt was dissolved in aqueous ethanol and lithium perchlorate was added. An almost colorless solid precipitated which was crystallized from n-butanol to afford 1-(3-hydroxypropyl)-3,3'-bipyridinium perchlorate, m.p. 103—104 °C (yield 77%).

$$\text{C}_{18}\text{H}_{15}\text{CIN}_{2}\text{O}_3$$

Calcd C 49.6 H 4.8 N 8.9,  
Found C 49.3 H 4.7 N 8.8.

NMR spectrum (CF₃COOD): δ = 2.25—2.75 (m, 2H, central CH₂); 3.8—5.2 (t, 2H, N—CH₂); 4.70—5.10 (poorly resolved m, 2H, central CH₂); 7.2—8.5 (m, 11H, aromatic) [ppm].

UV spectrum (H₂O, pH 8.2): $\lambda_{max}$ 274 (log ε 4.13) [nm].

6,10-Diazoniatricyclo[8.3.1.1²⁶]pentadeca-1(14),2,4,6(15),10,12-hexaene dibromide (8, n = 3)

a) 3,3'-Bipyridine (2 g) and 1,3-dibromopropane (1.3 ml) in ethanol (10 ml) were refluxed for 7 h and allowed to stand overnight at ambient temperature. The white precipitate which formed was washed with acetone and then crystallized from aqueous ethanol to afford white crystals of the hemihydrate, m.p. 310—312 °C (with decomposition) (yield 48%).

$$\text{C}_{18}\text{H}_{24}\text{Br}_2\text{N}_2$$, 0.5 H₂O

Calcd C 42.5 H 4.1 N 7.6 Br(total)43.6 Br(ionic)43.6,  
Found C 42.8 H 3.8 N 7.5 Br(total)43.95 Br(ionic)43.95.

The dibromide was dissolved in water and lithium perchlorate added. A white precipitate of the diperchlorate formed which was crystallized from aqueous ethanol to afford white crystals, m.p. 290—295 °C (with decomposition).

$$\text{C}_{18}\text{H}_{14}\text{Cl}_2\text{N}_2\text{O}_8$$

Calcd C 39.3 H 3.5 N 7.05,  
Found C 39.3 H 3.8 N 7.2.

NMR spectrum (DMSO): δ = 2.75—3.15 (unresolved m, 2H, central CH₂); 4.70—5.10 (poorly resolved t, 4H, N—CH₂); 8.3—8.6 (m, 2H, 4,12-aromatic); 8.95—9.3 (m, 4H, 3,5,11,13-aromatic); 9.62 (s, 2H, 14,15-aromatic) [ppm].
UV spectrum (H₂O, pH 8.2): \( \lambda_{\text{max}} \) 274 (log \( \varepsilon \) 4.0) [nm].

b) 3,3’-Bipyridine (2 g) and 1,3-dibromopropane (15 ml) were heated at 150 °C for 2 h. The brownish precipitate was washed with acetone and crystallized from aqueous ethanol to afford the dibromide product identical to that formed in method a) above (yield 29%).

c) The hygroscopic 1-(3-hydroxypropyl)-3,3’-bipyridinium bromide (9, \( X = \text{Br} \) (2 g) was refluxed with concentrated hydrobromic acid (50 ml) for 3 h. The orange reaction mixture was evaporated to dryness in vacuo to afford an orange precipitate of the hydrom bromide of 1-(3-bromopropyl)-3,3’-bipyridinium bromide. Without purification the latter salt (1.5 g) was dissolved in water (20 ml) and solid sodium hydrogen carbonate was added until effervescence ceased. The mixture was evaporated to dryness in vacuo to afford a brownish hygroscopic product which was converted to the perchlorate salt by treatment with aqueous lithium perchlorate. The product was crystallized from aqueous ethanol to afford white crystals of the diperclorate salt identical to that prepared by method a) above (yield 41%).

6,11-Diazoniatricyclo[9.3.1.1⁵]heptadeca-1(15),2,4,6(16),11,13-hexaene dibromide (8, \( n = 4 \))

a) 3,3’-Bipyridine (2 g) and 1,4-dibromobutane (1.5 ml) in ethanol (10 ml) were refluxed for 7 h and allowed to stand overnight at ambient temperature. The white precipitate which formed was washed with acetone and crystallized (twice) from aqueous ethanol to afford white crystals of the hemihydrate, m.p. 306–308 °C (yield 67%).

\( \text{C}_{15} \text{H}_{18} \text{Br}_{2} \text{N}_{2} \cdot 0.5 \text{H}_{2} \text{O} \)

Calcd
C 44.1 H 4.5 N 7.3 Br(total) 42.0 Br(ionic) 42.0
Found
C 43.9 H 4.4 N 7.7 Br(total) 41.6 Br(ionic) 41.8.

NMR spectrum (CF₃COOD): \( \delta = 2.35–2.75 \) (unresolved m, 4H, central CH₂); 4.85–5.25 (unresolved m, 4H, \( \text{N–CH}_2 \)); 8.15–8.45 (m, 2H, 4,13- aromatic); 8.85–9.25 (m, 4H, 3,5,12,14-aromatic); 9.85 (s, 2H, 15,16-aromatic) [ppm].

UV spectrum (H₂O, pH 8.2): \( \lambda_{\text{max}} \) 274 (log \( \varepsilon \) 4.01) [nm].

b) 3,3’-Bipyridine (2 g) and 1,4-dibromobutane (15 ml) were heated at 150 °C for 2 h. The brownish precipitate was washed with acetone and then crystallized (thrice) from aqueous ethanol to afford white crystals of the hydrate, m.p. 262–264 °C (yield 51%).

\( \text{C}_{15} \text{H}_{18} \text{Br}_{2} \text{N}_{2} \cdot \text{H}_{2} \text{O} \)

Calcd
C 44.6 H 4.95 N 6.9 Br(ionic) 39.6
Found
C 44.6 H 5.1 N 6.8 Br(ionic) 39.3.

NMR spectrum (CF₃COOD): \( \delta = 1.5–2.7 \) (unresolved m, 6H, central CH₂); 4.7–5.1 (unresolved m, 4H, \( \text{N–CH}_2 \)); 8.15–8.4 (m, 2H, 4,14-aromatic); 8.85–9.1 (m, 4H, 3,5,13,15-aromatic); 9.7 (s, 2H, 16,17-aromatic) [ppm].

UV spectrum (H₂O, pH 8.2): \( \lambda_{\text{max}} \) 274 (log \( \varepsilon \) 4.02) [nm].

6,13-Diazoniatricyclo[11.3.1.1⁵]octadeca-1(17),2,4,6(18),13,15-hexaene dibromide (8, \( n = 6 \))

3,3’-Bipyridine (2 g) and 1,6-dibromohexane (2.0 ml) in ethanol (10 ml) were refluxed for 7 h during which time a white precipitate formed. After standing overnight at ambient temperature the white solid was washed with acetone and crystallized (twice) from aqueous ethanol to afford white crystals of the hydrate, m.p. 316–318 °C (with decomposition) (yield 46%).

\( \text{C}_{16} \text{H}_{30} \text{Br}_{2} \text{N}_{2} \cdot \text{H}_{2} \text{O} \)

Calcd
C 45.9 H 5.3 N 6.7 Br(total) 38.3 Br(ionic) 38.3
Found
C 46.2 H 5.0 N 6.6 Br(total) 38.7 Br(ionic) 38.1.

NMR spectrum (CF₃COOD): \( \delta = 1.6–2.8 \) (unresolved m, 8H, central CH₂); 4.85–5.3 (unresolved m, 4H, \( \text{N–CH}_2 \)); 8.3–8.6 (m, 2H, 4,15-aromatic); 9.0–9.3 (m, 4H, 3,5,14,16-aromatic); 9.8 (s, 2H, 17,18-aromatic) [ppm].

UV spectrum (H₂O, pH 8.2): \( \lambda_{\text{max}} \) 274 (log \( \varepsilon \) 4.01) [nm].

6,14-Diazoniatricyclo[12.3.1.1⁵]nonadeca-1(18),2,4,6(19),14,16-hexaene dibromide (8, \( n = 7 \))

3,3’-Bipyridine (2 g) and 1,7-dibromohexa-4,5-diene dibromide (2.2 ml) in ethanol (10 ml) were refluxed for 7 h during which time a white precipitate formed. After standing overnight at ambient temperature the white solid was washed with acetone and crystallized
(twice) from aqueous ethanol to afford white crystals of the hydrate, m.p. 292–294 °C (yield 53%).

C$_{17}$H$_{22}$Br$_2$N$_2$, H$_2$O
Calcd C 47.2 H 5.55 N 6.5 Br(ionic) 37.0,
Found C 47.3 H 5.6 N 6.6 Br(ionic) 37.0.

NMR spectrum (CF$_3$COOD): $\delta = 1.3$–2.45 (unresolved m, 10H, central CH$_2$); 4.65–5.1 (unresolved m, 4H, N–CH$_2$); 8.15–8.55 (m, 2H, 4,17-aromatic); 8.85–9.25 (m, 4H, 3,5,16,18-aromatic); 9.62 (s, 2H, 19,20-aromatic) [ppm].

UV spectrum (H$_2$O, pH 8.2): $\lambda_{\text{max}}$ 274 (log $\varepsilon$ 4.0) [nm].

6,15-Diazeniatricyclo[13.3.1.1$^{2,6}$]eicosa-1(19),2,4,6(20),15,17-hexaene dibromide (8, n = 8)
$\quad$ 3,3'-Bipyridine (2 g) and 1,8-dibromo-o-xylene (2.4 ml) in ethanol (10 ml) were refluxed for 4 h during which time a white precipitate formed. After standing overnight at ambient temperature the white solid was washed with acetone and crystallized (twice) from aqueous ethanol to afford white crystals of the hydrate, m.p. 265–267 °C (yield 45%).

C$_{18}$H$_{23}$Br$_2$N$_2$, H$_2$O
Calcd C 48.4 H 5.8 N 6.3 Br(ionic) 35.9,
Found C 48.3 H 5.7 N 5.8 Br(ionic) 35.4.

NMR spectrum (CF$_3$COOD): $\delta = 1.05$–2.35 (unresolved m, 12H, central CH$_2$); 4.65–5.05 (unresolved m, 4H, N–CH$_2$); 8.10–8.55 (m, 2H, 4,17-aromatic); 8.85–9.25 (m, 4H, 3,15,16,18-aromatic); 9.60 (s, 2H, 19,20-aromatic) [ppm].

UV spectrum (H$_2$O, pH 8.2): $\lambda_{\text{max}}$ 274 (log $\varepsilon$ 4.0) [nm].

8,9-Benzox-6,11-diazeniatricylo[9.3.1.1$^{2,6}$]hexadeca-1(15),2,4,6(16),8,11,13-heptaene dibromide (10)
$\quad$ 3,3'-Bipyridine (2 g) and $\alpha,\alpha'$-dibromo-o-xylene (3.4 g) in ethanol (15 ml) were refluxed for 2.5 h during which time a greenish precipitate formed. After standing overnight at ambient temperature the greenish product was collected and washed with acetone. It was then dissolved in the minimum volume of water and aqueous lithium perchlorate solution (7.5%) was added. The resultant product was crystallized (twice) from aqueous ethanol to afford off-white crystals of the hemihydrate, m.p. 210–220 °C (yield 48%).

C$_{18}$H$_{16}$Cl$_2$N$_2$O$_6$, 0.5 H$_2$O
Calcd C 46.15 H 3.6 N 6.0,
Found C 45.9 H 4.0 N 5.9.

NMR spectrum (CF$_3$COOD): $\delta = 6.55$ (s, 4H, CH$_2$); 7.25–7.75 (m, 4H, benzene); 8.2–8.5 (m, 2H, 4.13-aromatic); 8.85–9.25 (m, 4H, 3.5,12,14-aromatic); 10.05 (s, 2H, 15,16-aromatic) [ppm].

UV spectrum (H$_2$O, pH 8.2): $\lambda_{\text{max}}$ 274 (log $\varepsilon$ 4.0) [nm].

$1,1''$-(1,2-ethanediyl)-bis-3,3'-bipyridinuim dibromide (11, X = Br) (2 g) and dimethyl sulfate
(10 ml) were heated at 160 °C for 2 h. The mixture was cooled and diluted with acetone whereupon a white solid precipitated. The solid was dissolved in water and treated with an aqueous solution of lithium perchlorate (7.5%). The solid which precipitated was crystallized twice from aqueous ethanol to afford crystals of the hydrate, m.p. 282–288 °C (with decomposition) (yield 87%).

\[ \text{C}_{24}\text{H}_{26}\text{Cl}_4\text{N}_4\text{O}_{16}, \text{H}_2\text{O} \]
Calcd C 36.6 H 3.6 N 7.1,
Found C 36.7 H 3.4 N 6.9.

NMR spectrum (DMSO): \( \delta = 4.48 \text{ (s, 6H, CH}_3 \);
5.38 (s, 4H, CH\text{2}); 8.10–9.60 (m, 16H-aromatic) [ppm].

UV Spectrum (H\text{2}O, pH 8.2): \( \lambda_{\text{max}} \) 274 (log \( \varepsilon \) 4.29) [nm].

1,1'-Dimethyl-3,3'-bipyridinium bis(methyl sulfate) (14)

3,3'-Bipyridine (2 g) was added slowly to dimethyl sulfate (10 ml). The reaction mixture heated up and almost immediately a white solid precipitated. The mixture was stirred for 10 min. The solid was washed with acetone and crystallized from ethanol (twice) to afford white crystals, m.p. 186–190 °C (yield 80%).

\[ \text{C}_{14}\text{H}_{20}\text{N}_2\text{O}_8\text{S}_2 \]
Calcd C 41.2 H 4.9 N 6.9,
Found C 41.0 H 5.2 N 7.15.

NMR spectrum (CF\text{3}COOD): \( \delta = 3.85 \text{ (s, 6H, CH}_3\text{S}_0\text{4});
4.70 (s, 6H, CH\text{3}-N); 8.13–9.33 (m, 8H-aromatic) [ppm].

UV spectrum (H\text{2}O, pH 8.2): \( \lambda_{\text{max}} \) 274 (log \( \varepsilon \) 4.02) [nm].