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Short Communication

The Synthesis of Crowned Phenoselenazinone Derivatives

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Summary. Several substituted crowned phenoselenazin-16-one derivatives were prepared by condensation of substituted zinc 2-amino-benzeneselenolates with 1,4-quinone of benzo[15]crown-5 or its dibromide in alcoholic solution. The dehalogenation of the bromoselenazinones was also investigated.

Keywords. 16 *H*-2,5,8,11,14-Pentaoxacyclopentadecano[2,3-a]phenoselenazin-16-one; 20-Chloro-16 *H*-2,5,8,11,14-pentaoxacyclopentadecano[2,3-a]phenoselenazin-16-one; 17-Bromo-16 *H*-2,5,8,11,14-pentaoxacyclopentadecano[2,3-a]phenoselenazin-16-one; 20-Chloro-17-bromo-16 *H*-2,5,8,11,14-pentaoxacyclopentadecano[2,3-a]phenoselenazin-16-one.

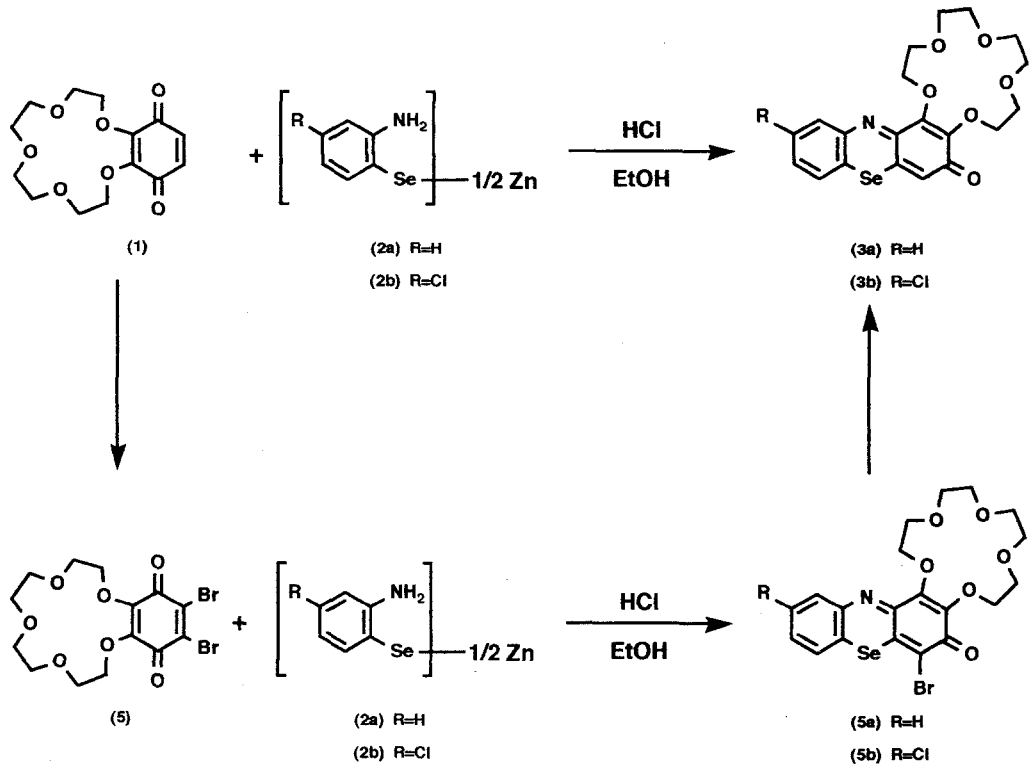
Synthese von Kronen-Phenoselenazinon-Derivaten (Kurze Mitt.)

Zusammenfassung. Es wurden einige substituierte Kronen-Phenoselenazin-16-on-Derivate mittels Kondensation von substituierten Zink-2-aminobenzolselenolaten mit dem 1,4-Chinon von Benzo[15]krone-5 oder seinem Dibromid in alkoholischer Lösung dargestellt. Die Dehalogenierung der Bromselenazinone wurde ebenfalls untersucht.

Introduction

There have been extensive studies of the phenothiazine and phenoselenazine ring system in connection with the development of drugs, dyestufs and indicators [1–4]. In the previous papers we have described the synthesis of crowned phenothiazine and phenoxazine derivatives [5]. The present work extends the synthesis to crowned phenoselenazinone derivatives.

The condensation of crowned quinone (**1**) [6, 7] with zinc 2-aminobenzeneselenolate (**2a**) or its 4-chloro analogoue (**2b**) [8] in ethanol in the presence of hydrochloric acid at room temperature gave 16 *H*-2,5,8,11,14-pentaoxacyclopentadecano[2,3-a]phenoselenazin-16-one (**3a**) and its 20-chloro analogoue (**3b**), respectively. The reaction of 17,18-dibromo crowned quinone (**4**) [5] with **2a** or **2b** under similar conditions afforded 17-bromo-16 *H*-2,5,8,11,14-pentaoxacyclopentadecano(2,3-a)phenoselenazin-16-one (**5a**) or its 20-chloro analogoue (**5b**). The structures of these products were assigned by elemental analysis and spectral data.



Debromination of the compounds **5a** and **5b** in pyridine-dioxane-water in the presence of sodium hydrosulfite under argon atmosphere gave the compounds **3a** and **3b**. Their structures were supported by direct comparison with the same compounds prepared by one step condensation. In particular, the ^{1}H-NMR spectrum of **3a** and **3b** exhibited a characteristic singlet at δ 6.9 due to the olefinic proton, but that of compound **5a** and **5b** did not show any evidence assigned to this kind of proton.

Experimental Part

Melting points were determined on a Yanagimoto micromelting apparatus and are uncorrected. The infrared spectra were recorded on a Jasco A-102 spectrometer, and UV spectra with a Jasco Ubest-30 instrument. The ^{1}H-NMR spectra were measured on a Variant XL-200 spectrometer using tetramethylsilane as internal reference. Mass spectra were obtained with a Hitachi M-2000 spectrometer. Microanalysis were performed by the micro analytical laboratory of Kyoto university.

Reaction of 16,19-Dioxo-2,5,8,11,14-pentaoxabicyclo[13.4.0]-1^{15},17^{18}-nonadecadiene (1,4-Quinone of Benzo[15]crown-5) (**1**) *with Zinc 2-aminobenzeneselenolate* (**2a**)

Crown quinone (100 mg, 0.335 mmol) was dissolved in ethanol (14 ml); then zinc 2-aminobenzeneselenolate (86 mg, 0.212 mmol) was added with stirring. Then hydrochloric acid (6 *N*, 2 ml) was added dropwise in 15 min. The mixture was then allowed to stir at room temperature for 23 h. Ferric chloride hexahydrate (229 mg, 0.85 mmol) was added and the mixture was stirred for additional 4 h, followed by neutralization with saturated sodium bicarbonate solution. The substance was evaporated to dryness and the residue was chromatographed on a column of silica gel using ethyl acetate:hexane (90 : 10) as an eluent. About 80 mg of **3a** (53%) were obtained after recrystallization from chloroform

and hexane; m.p. 120–122°C. IR (KBr): 1615 (C=O), 1590 (C=N) cm^{-1}. ^{1}H-NMR ($CDCl_3$): δ 8.04 (m, 1H, arom.), 7.5 (m, 3H, arom.), 6.91 (s, 1H, vinylic), 4.55 (m, 4H, crown-H), 4.05 (t, J=4 Hz, 2H, crown-H), 3.9 (t, J=4 Hz, 2H, crown-H), 3.75 (m, 8H, crown-H). UV (chloroform): λ_{max}, nm (log ε), 403 (4, 21), 295 (4, 19). $C_{20}H_{21}NSeO_6$: calcd. 450.35, found m/e 450.9 (M^+); calcd: C 53.29, H 4.69, N 3.11, found C 53.62, H 4.76, N 2.64.

20-Chloro-16H-2,5,8,11,14-pentaoxacyclopentadecano[2,3-a]phenoselenazin-16-one (**3b**)

The compound **3b** was prepared by the reaction of crown quinone (**1**) with **2b** in a similar way as **3a** (yield 49%); m.p. 139–140°C. IR (KBr): 1600 (C=0), 1575 (C=N) cm^{-1}. ^{1}H-NMR ($CDCl_3$): δ 8.02 (d, J=4 Hz, 1H, arom.), 7.52 (d, J=8 Hz, 1H, arom.), 7.38 (dd, J=8.4 Hz, 1H, arom.), 6.9 (s, 1H, vinylic), 4.52 (m, 4H, crown-H), 4.03 (t, J=4 Hz, 2H, crown-H), 3.88 (t, J=4 Hz, 2H, crown -H), 3.75 (m, 8H, crown-H). UV (chloroform): λ_{max}, nm (log ε), 403 (4.00). $C_{20}H_{20}NSeClO_6$: calcd. 484.79, found m/e 484.6 (M+); calcd. C 49.55, H 4.15, N 2.88, found C 49.06, H 4.16, N 2.87.

Reaction of 17,18-Dibromo-16,19-dioxo-2,5,8,11,14-pentaoxabicyclo[13.4.0]-1^{15},17^{18}-nonadecadiene (**4**) *with Zinc 2-aminobenzeneselenolate* (**2a**)

Dibromo crown quinone (50 mg, 0.109 mmol) was dissolved in ethanol (7 ml); then zinc 2-aminobenzeneselenolate (54 mg, 0.131 mmol) was added with stirring. Then hydrochloric acid (6 N, 1 ml) was added dropwise in 15 min. The mixture was then allowed to stir at room temperature for 3 h. Then the reaction mixture was neutralized by saturated sodium bicarbonate solution. After removal of the solvent by distillation, the organic material obtained was extracted with chloroform. The extract after evaporation of the solvent was passed down a column of silica gel using ethyl acetate:hexane (75:25) as an eluent. Recrystallization from chloroform and hexane gave 40 mg of **5a** (69%); m.p. 131–132°C. IR (KBr): 1600 (C=O), 1585 (C=N) cm^{-1}, ^{1}H-NMR ($CDCl_3$): δ 8.15 (m, 1H, arom.), 7.62 (m, 3H, arom.), 4.54 (m, 4H, crown-H), 4.06 (t, J=4 Hz, 2H, crown-H), 3.88 (t, J=4 Hz, 2H, crown-H), 3.75 (m, 8H, crown-H). UV (chloroform): λ_{max}, nm (log ε), 511 (3.75), 405 (4.07). $C_{20}H_{20}NSeBrO_6$: calcd. 529.24, found m/e 528.6 (M^+); calcd. C 45.38, H 3.80, N 2.64, found C 45.37, H 3.87, N 2.69.

20-Chloro-17-bromo-16H-2,5,8,11,14-pentaoxacyclopentadecano[2,3-a]phenoselenazin-16-one (**5b**)

5b was prepared by the reaction of **4** with **2b** in a similar way as **5a** (yield 56%); m.p. 195–196°C. IR (KBr): 1610 (C=O), 1580 (C=N) cm^{-1}, ^{1}H-NMR ($CDCl_3$): δ 8.15 (d, J=4 Hz, 1H, arom.), 7.68 (d, J=8 Hz, 1H, arom.), 7.5 (dd, J=8.4 Hz, 1H, arom.), 4.56 (m, 4H, crown-H), 4.08 (t, J=4 Hz, 2H, crown-H), 3.91 (t, J=4 Hz, 2H, crown-H), 3.76 (m, 8H, crown-H). UV (chloroform): λ_{max}, nm (log ε), 519 (3.59), 420 (4.08), 403 (4.11), 370 (3.95), 304 (4.23). $C_{20}H_{19}NSeClBrO_6$: calcd. 563.68, found m/e 564.1 (M^+); calcd. C 42.61, H 3.39, N 2.48; found C 41.81, H 3.28, N 2.50

Debromination of **5a**

To the suspension of **3a** (30 mg, 0.056 mmol) in benzene (5 ml), water (5 ml) and dioxane (3 ml) were added 5 ml of pyridine and (96 mg, 0.56 mmol) of sodium hydrosulfite under argon atmosphere. The mixture was refluxed for 4 h and poured into 50 ml of water and extracted with chloroform. After removing the solvent the residue was chromatographed on a silica gel column, elution with ethyl acetate:hexane 80:20 gave compound **3a**, 13.5 mg (52%).

Debromination of **5b**

The debromination of **5b** was done in a similar way as **5a** (yield 46%).

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