Synthetic Studies on the Δ^2-Derivatives of Selenazolines

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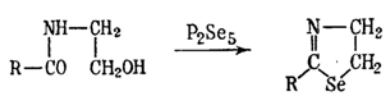
The possible heterocyclic syntheses according to the schema which follow



were pursued in our laboratory, with the desire to obtain selenium-containing ring compounds.

From N-acylethanolamine, H. Wenker[1] synthesized Δ^2-oxazolines and Δ^2-thiazolines.

(1) H. Wenker, *J. Am. Chem. Soc.*, **57**, 1080 (1935).

The procedure was not applied for the preparation of Δ^2-selenazolines.

Recently A. Van Dormael[2] made report on the formation of 2-methylselenazoline by a similar method to Wenker's procedure for the preparation of 2-methylthiazoline.

Hitherto 2-methylselenazoline has been prepared from diacetyldiaminoethyl-β-diselenide hydrochloride and phosphorus pentachloride.[3] It has also been synthesized from bromoethylamine hydrobromide and selenoacetamide.[4]

Unintentionally I have investigated also the reaction between N-acyletanolamine and phosphorus pentaselenide, which was found later to be similar to A. Van Dormael's procedure. This report* describes five homologues of Δ^2-selenazolines, three of which are 2-alkyl derivatives—2-methylselenazoline, 2-ethylselenazoline, and 2-*n*-propylselenazoline; and two of which are 2-aryl derivatives—2-phenylselenazoline, 2-benzylselenazoline. I found that the 2-aryl derivatives were solid and did not give picrates. Contrarily, the 2-alkyl derivatives were liquid and gave picrates easily. In the three 2-alkyl derivatives, the boiling point rises according to the increase of alkyl group weight. However the relation between the melting point of their picrates and the boiling point of free bases is reverse. The higher homologues are more stable and the yields are better.

This procedure is much simpler than the methods which so far have been devised and is convenient to obtain Δ^2-derivatives of selenazolines.

Experimental

Phosphorus pentaselenide.—Phosphorus pentaselenide was prepared by the methods described by W. Bogen[5] and by W. Muthmann & A. Clever.[6]

N-Acylethanolamines. — N-Acylethanolamines were synthesized by the double decomposition of ethanolamines and acid esters. The boiling points of the acylethanolamines used here were as follows:

Acetylethanolamine, b.p. 161°/4.5 mm. Hg,
Propionylethanolamine, b.p. 155—156°/7 mm. Hg,
Butyrylethanolamine, b.p. 159.5°/5 mm. Hg,
Benzoylethanolamine, b.p.202—203°/4 mm. Hg,
Phenylacetylethanolamine, b.p. 207~209°/6.5 mm. Hg.

Δ^2-Selenazolines

(i) 2-Propylselenazoline.—The procedure described here for 2-propylselenazoline was also used for the preparation of the other two 2-alkylselenazolines. In a 500 cc. Claisen distilling flask N-butyrylethanolamine (20 g.) and phosphorus pentaselenide (20.9 g., 5:1.5 mol.) were placed. The flask was connected with a condenser set for downward distillation. A Y-type adaptor was attached tightly at the place between the lower end of the condenser and a receiver. A tube then ran from the side arm of the adaptor to some bottles of granular sodium hydroxide and strong caustic soda to dissolve and decompose any hydrogen selenide which might be formed. The mixture was heated gently in an oil bath to 70—90°, when the reaction commenced violently with a rapid evolution of hydrogen selenide. The heat source was withdrawn until the reaction moderated. After the vigorous reaction had subsided, the flask was arranged for distillation under diminished pressure. The yellow-green liquid was collected at 110—135°/120—150 mm. Hg. During the distillation the bath temperature was maintained at about 200—230°. The liquid collected weighed 16.9 g. (yield 63%). By repeated redistillation 2-*n*-propylselenazoline, a light green liquid (8.7 g., yield 32.4%) which boiled at 116°/70.5 mm. Hg was obtained. The picrate was obtained by adding the base to a saturated alcoholic solution of picric acid. When this material was recrystallized from hot alcohol, it was often decomposed. The crude picrate was recrystallized from chloroform-ligroin, yellow crystals, m.p. 100.5—101°. (Found: C, 35.62; H, 3.33; N, 13.60. Calculated for $C_{12}H_{11}O_7N_4Se$: C, 35.56; H, 3.48; N, 13.82%).

(ii) 2-Ethylselenazoline.—The procedure for 2-ethylselenazoline was similar to the procedure described above in the preparation of 2-*n*-propylselenazoline. The yellow orange liquid (2.4 g., yield 34.8%) distilled at 70—90°/60—70 mm. Hg (bath temperature of 180—190°) was made from propionylethanolamine (5 g.) and phosphorus pentaselenide (5.85 g., 5:1.5 mol).

The redistillation of the crude material gave light green liquid which boiled at 110—111°/135 mm.Hg (1.3 g., yield 19.4%). The picrate was labile in alcoholic solution. The recrystallization of the crude picrate from chloroform-ligroin yielded yellow prisms, m.p. 127—127.5° (Found: C, 34.07; H, 3.03; N, 14.25. Calculated for $C_{11}H_{12}O_7N_4Se$: C, 33.77; H, 3.09; N, 14.32%).

(iii) 2-Methylselenazoline.—By the same procedure as mentioned above, the orange-yellow liquid (6.8 g., yield 18.2%) distilled at 80—92°/50—60 mm.Hg (bath temperature of 160—175°) was made from N-acetylethanolamine (26 g.) and phosphorus pentaselenide (34.4 g., 5:1.5 mol.). Repeated redistillation gave a light yellow liquid

(2) A. Van Dormael, *Chem. Abstr.* **44**, 144 (1950).
(3) W. Michels, *Ber.*, **25**, 3048 (1892).
(4) F. L. White, *Chem. Abstr.* **27**, 5550 (1933); *Brit. Pat.* 392,410.
* The present paper was read at the 4th Annual Meeting of the Chemical Society of Japan in Tokyo held in April 6, 1951.
(5) W. Bogen, *Ann.*, **124**, 57 (1862).
(6) W. Muthmann and A. Clever, *Zeit. anorg. Chem.*, **13**, 191 (1897).

(5.2 g., yield 13.9%) which boiled at 102°/145 mm. Hg. This boiling point coincided with b.p. 160—162°/752 mm. Hg,[3] 71—72°/35 mm. Hg[4] shown in the literatures. The crude picrate recrystallized from chloroform, yellow crystals, m.p. 159—159.5°, which also coincided with the melting point in the literature.[3]

(iv) **2-Phenylselenazoline.**—N-Benzylethanolamine (5 g.) and phosphorus pentaselenide (2.75 g., 5:1 mol.). were placed in a flask. The thermometer was inserted nearly to the bottom of the flask. The reaction started at about 80°, proceeded rapidly at about 120° with the evolution of white smoke, and the temperature rose spontaneously to about 140—160°. Soon the reaction ended. The yellow transparent resinous product was dissolved in chloroform, first washed with about 60 cc. of 5% sodium hydroxide solution and then washed with distilled water. White needles crystallized in the chloroform solution. The chloroform was distilled off under reduced pressure, leaving white yellow solid (3 g.). The recrystallization from benzene (70 cc.) gave white needles, m.p. 116—118°, softening at 105° (2.3g., yield 36.2%). (Found: C, 51.69; H, 4.39; N, 6.72. Calculated for C_9H_9NSe; C, 51.45; H, 4.32; N, 6.67%). The crystals obtained here did not give picrate, differing from the 2-alkylselenazolines.

(v) **2-Benzylselenazoline.**—By the same procedure as mentioned in 2-phenylselenazoline, a yellow-brown transparent resin was obtained from N-phenylacetylethanolamine (5 g.) and phosphorus pentaselenide (2.55 g., 5:1 mol.). The resinous mass was dissolved in chloroform (10 cc.), washed with 5% sodium hydroxide solution (50 cc.) and with distilled water. The chloroform was distilled under reduced pressure, leaving a yellow solid (3.45 g.). The recrystallization from benzene (100 cc.) gave yellow crystals, m.p. 122—124°, softening at 117°. Recrystallization thrice from benzene raised the melting point to 123—126°, softening at 122° but without being decolourized. The elementary analysis showed a fair coincidence with the theoretical value. (Found: C, 53.55; H, 5.30; N, 6.19. Calculated for $C_{10}H_{11}NSe$: C, 53.58; H, 4.95; N, 6.25%). The crystals also did not give picrate.

Summary

(i) Several derivatives of Δ^2-selenazolines were synthesized from N-acylethanolamine and phosphorus pentaselenide.

The larger the alkyl group was, the better the yield became.

(ii) 2-Arylselenazolines were solid and did not give picrates, differing from 2-alkylselenazolines.

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