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THE PRODUCT FROM THE REACTION OF DIAZOMETHANE WITH 1,3-OXASELENOLE DERIVED FROM DIMEDONE

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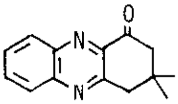
Abstract ——— The 1,3-oxaselenole derivative(VI) obtained from dimedone was treated with an excess of diazomethane to give 1,4,7-dioxaselenocine derivative(VII) in a quantitative yield. The deselenization of VII was carried out by the benzyne-hydrogenolysis method to give 3-methoxy-5,5-dimethyl-2-(5,5-dimethyl-3-oxo-1-cyclohexen-1-yl)oxy-2-cyclohexenone (VIII). Treatment of VII with aqueous alkali gave 5,5,5',5'-tetramethyl-1,1',3,3'-tetroxo-2,2'-cyclohexylmethane(IX), and it afforded 4,4-dibromo-3,3-dimethoxy-5,5-dimethylcyclohexanone(X) with bromine in MeOH. VII was reduced sodium borohydride to an allyl alcohol(XIa) which was converted to its acetate(XIb).

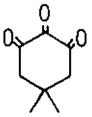
Miyano et al. reported the synthesis of 3,4-dihydrophenazin-1(2H)-one(I) from 3-(2-nitroanilino)-5,5-dimethyl-2-cyclohexenone[1]. It was suggested that I could be prepared from o-phenylenediamine(II) and 5,5-dimethyl-1,2,3-cyclohexatrione(III). It is well known that acetylacetone is oxidized with selenium dioxide(SeO_2) to give penta-2,3,4-trione, which affords 2-acetyl-3-methylquinoxaline(IV) by treatment with II[2,3]. Therefore, to obtain III from dimedone a dioxan solution of the starting material was heated for 20 h at 90°C in the presence of an equimolecular SeO_2 to give quantitatively golden yellow prisms, mp 167-169°C, whose formula was revealed to be $C_{16}H_{20}O_4Se$ from the mass spectrum and the elemental analysis. The structure of this product had been reported[4] to be selenoxide(V), but recently revised[5] to be 1,3-oxaselenole derivative(VI) from the consideration of the ^1H-, ^{13}C-nmr, and X-ray analysis. Although the oxidation product with SeO_2 from dimedone was not III, we were interested in the reactivity of VI. Stamm et al. reported that VI gave 2,2-dibromodimedone by treatment with bromine in MeOH[4].

An ethereal suspension of VI was treated with an excess of diazomethane at room temperature. The crystals of VI disappeared with vigorous evolution of gas and the homogeneous solution was obtained. After evaporation of the solvent, the crystalline product obtained in a quantitative yield was recrystallized from n-hexane to give pale yellow prisms, mp 108-109°C, whose formula was revealed to be $C_{17}H_{22}O_4Se$ from the mass spectrum and the elemental analysis [ir(nujol): 1600, 1630, 1665, 1678cm^{-1}, cf, VI; ir(nujol): 1735, 1710, 1650, 1613cm^{-1}; uv($CHCl_3$), nm(ε): 300(4200), 257(13900), 240(sh 9500)]. The uv spectrum of VI showed an absorption maximum at 402nm(ε: 140) attributable to the spiro conjugation[5]. ^{1}H-nmr($CDCl_3$): 1.10 and 1.12(each 6H, s), 2.33, 2.35, 2.39, 2.92, and 5.78(each 2H, s). The corresponding signal to δ 5.78 lacks in the ^{1}H-nmr spectrum of VI. ^{13}C-nmr($CDCl_3$): 27.8(q), 28.1(q), 31.5, 32.5(s), 43.6(t), 45.3(t), 50.69(t), 50.87(t), 67.4(t, J=110Hz), 114.1(t), 129.1(s), 161.6(s), 171.7(s), 193.8(s), 196.2(s). The corresponding signal to δ 67.4 lacks in the ^{13}C-nmr spectrum of VI. The structure of the product was suggested to be 1,4,7-dioxaselenocine derivative(VII) from the above physical data, the following chemical transformation, and the mechanistic consideration. In the ir spectrum of VII, the lack of high frequency carbonyl absorption showed that the isolated carbonyl group was not presented. In the uv spectrum of VII, the lack of a weak absorption maximum at 402nm showed the system of the spiro conjugation was no more present. A singlet signal at δ 5.78 in the ^{1}H-nmr spectrum was assigned to be the methylenic protons between Se and O. Although the value of the chemical shift was relatively large compared with the expected one, the deshielding effect could be explained in terms of the coplanarity of this methylene group and the both olefins. The chemical shift due to the methylenic carbon between Se and O in the ^{13}C-nmr spectrum could be explained by using the reported data[6,7].

The selenium extrusion from VII was carried out by two methods(A and B) as follows. A) simple hydrogenolysis——— VII was shaken under H_2-atmosphere at room temperature in the presence of an excess of Raney-Ni. The product exhibited two peaks in GC (270°C, 5% SE-30, 3m stainless column), retention time(t_R) 1.8 min and 2.8 min. The latter peak was due to the starting material, VII. B) benzyne-hydrogenolysis[8] ——— VII was treated with benzyne, prepared from anthranilic acid and isoamyl nitrite, followed by hydrogenation over Raney-Ni to give mainly one product, whose t_R was 1.8 min. The gc-mass analysis for the product of t_R1.8 min obtained in two methods revealed that the product was the same one and had the parent peak at m/e 292 corresponding to $C_{17}H_{24}O_4$. The product was purified through silica gel column and recrystallized from ether to give crystals(VIII), mp 107-109°C.



I



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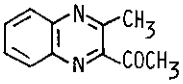

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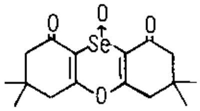

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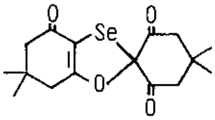

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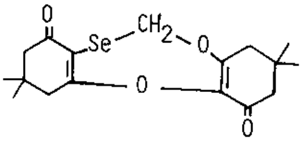
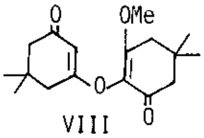
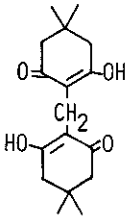


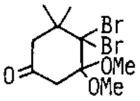
VII



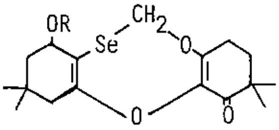
VIII



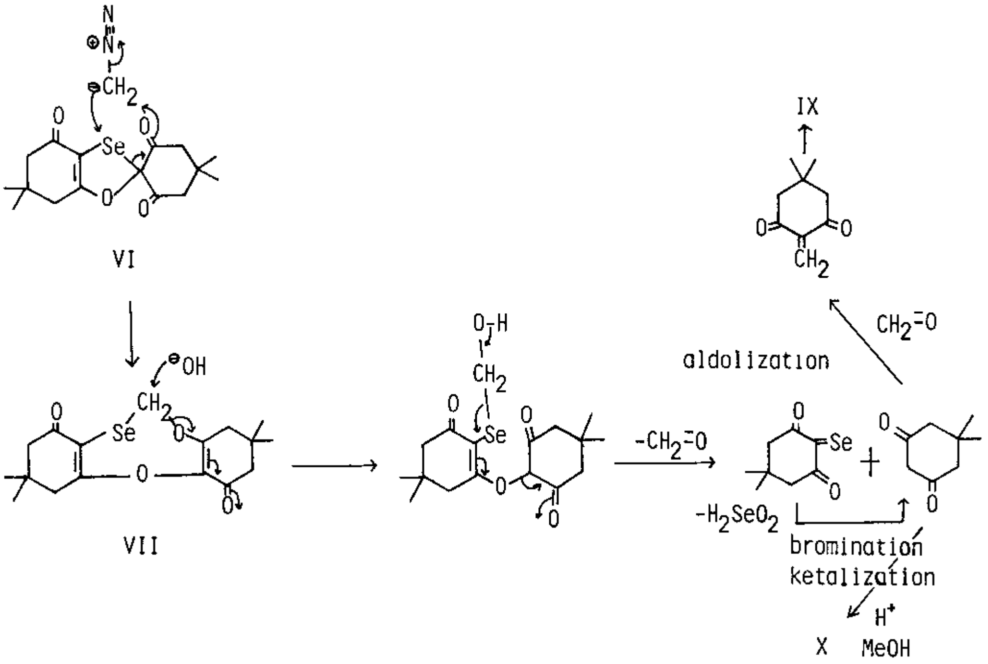
IX



X



XI a: R= H
b: R= Ac



The elemental analysis satisfied the formula mentioned above[ir(nujol): 1670-1560 (br), 1610(s). uv($CHCl_3$): nm(ε): 253(25500). ^1H-nmr($CDCl_3$): seven singlet peaks at 1.12(6H), 1.15(6H), 2.26(2H), 2.35(2H), 2.52(4H), 3.90(3H), and 5.26(1H)]. These physical data could be explained by the structure of 3-methoxy-5,5-dimethyl-2-(5,5-dimethyl-3-oxo-1-cyclohexenyl)-2-cyclohexenone(VIII). Next, VII was treated with 10% aqueous NaOH at 90°C for 5 h to give a crystalline product, mp 182-184°C. The product was revealed to be 5,5,5',5'-tetramethyl-1,1',3,3'-tetroxo-2,2'-cyclohexylmethane(IX) which was identified with the authentic sample. As Stamm et al. reported the reaction of VI and bromine[4], the same reaction was carried out on VII to give 4,4-dibromo-3,3-dimethoxy-5,5-dimethylcyclohexanone, mp 93-96°C [ir($CHCl_3$): 1730cm^{-1}; $C_{10}H_{16}Br_2O_3$(from the mass spectrum and the elemental analysis); nmr(CCl_4): four singlet signals at δ 1.02(6H), 2.06(2H), 2.79(2H), and 3.43(6H)]. Finally VII was treated with sodium borohydride in MeOH to give mono-allyl alcohol. From the uv spectrum, the structure was deduced to be XIa, which was acetylated in pyridine to the corresponding acetate(XIb). XIb: mp 164-166°C; nmr(CCl_4): 1.00(3H, s), 1.06(3H, s), 1.11(6H, s), 1.44(1H, q), 1.90(1H, q), 2.05 (3H, s), 2.22(1H, s), 2.2-2.5(4H, m), 2.85(1H, q), 5.54(br.t), 5.64(1H, d), 6.08 (1H, d); uv($CHCl_3$): nm(ε): 242(11900), 255(sh., 11400); ir($CHCl_3$): 1725-1740(br), 1675, 1625. The mechanisms were proposed for the formation of VII from VI, and IX and X from VII. An alternative path to VII from VI(the attack of diazomethane on oxygen atom) may be unfavorable from the view point of HSAB rule and the assumed product in this case is a symmetrical 1,3,6-dioxaselenol derivative, which would be rejected from the data of the ^1H- and ^{13}C-nmr spectra.

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