The Amine Addition Products of Pseudoascaridole

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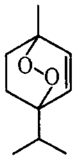
Ascaridole (**1**), the main constituent of chenopodium oil, undergoes thermal rearrangement to yield pseudoascaridole, an isomeric *cis*-diepoxide (**2**).[1] Thoms and Dobke[2] treated pseudoascaridole with aqueous ammonia and methylamine and assigned structures **5a** and **5b**, respectively, to the resulting products. This paper presents data indicating that the correct structures for these amino alcohols are represented by **3a** and **3b**. The product resulting from the reaction of aqueous ammonia and pseudoascaridole (**3a**) was recovered unchanged after 5-hr reflux with 5% HCl. The infrared spectrum of **3a** showed the presence of two hydroxyl groups (two resolved strong peaks at 3230 and 3350 cm^{-1}) while the nmr spectrum showed two one-proton doublets at τ 6.30 and 6.45 with coupling constants of 9 ± 1 Hz. The position of these doublets is indicative of the CH(OH)-CH(OH) structure and the large J value confirms the *cis* configuration of the hydroxyls at C-2 and C-3. Treatment of **3a** with acetyl chloride gave the diacetate hydrochloride **4**. The infrared spectrum of the latter compound showed no absorption in the 3100–3700 cm^{-1} region but had a strong carbonyl band at 1730 cm^{-1}. The product resulting from the reaction of methylamine and pseudoascaridole, **3b**, had a strong peak in the infrared at 3400 cm^{-1} and two one-proton doublets at τ 6.17 and 6.51 with coupling constants of 8 ± 1 Hz.



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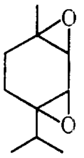

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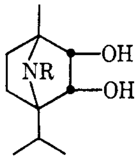
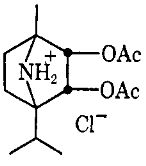


3a, R = H
b, R = CH$_3$



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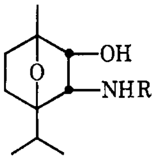
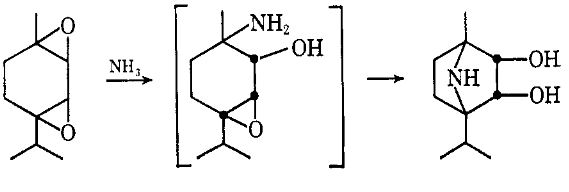


5a, R = H
b, R = CH$_3$

The structures of the amine addition products can be rationalized by the following reactions which involve an initial attack of the amine at C-1 (or C-4) followed by an internal attack of nitrogen at C-4 (or C-1). While the initial attack of nitrogen at a tertiary carbon seems unlikely on steric grounds, it is consistent with the observation that basic hydrolysis of **2** yields the all-*trans* *p*-menthane-1,2,3,4-tetrol (**6**).[1a]



Experimental Section[3]

Pseudoascaridole (2).—Ascaridole was isomerized according to the procedure described by Nelson.[4] The pseudoascaridole was purified by distillation; bp 70–73° (0.5 mm).

1,4-Imino-*p*-menthane-2,3-diol (3a).—Pseudoascaridole and 25% NH$_4$OH were heated at 125° in a sealed tube for 5 hr. The reaction mixture was extracted with ether. The ethereal solution was dried and concentrated to yield 1,4-imino-*p*-menthane-2,3-diol, mp 141°; nmr (8% CDCl$_3$) τ 6.30 (d, 1, J = 9 Hz), 6.45 (d, 1, J = 9 Hz), 7.9–8.3 (m, 5), 8.75 (s, 3), 9.0 (d, 3, J = 7 Hz), 9.1 (d, 3, J = 7 Hz), and a three-proton peak whose position was concentration dependent; ir (Nujol) 3230 and 3350 cm^{-1} (COH).

1,4-Imino-*p*-menthane-2,3-diacetoxy hydrochloride (4) was prepared by adding acetyl chloride to compound **3a**. Recrystallization of the crude product from chloroform–petroleum ether C afforded the hydrochloride, mp 237–238°; ir (Nujol) 1730 cm^{-1} (O=C—O), no absorption between 3700 and 3100 cm^{-1}.

Anal. Calcd for C$_{14}$H$_{24}$O$_4$NCl: C, 54.98; H, 7.91. Found: C, 54.58; H, 7.84.

N-Methyl-1,4-imino-*p*-menthane-2,3-diol (3b).—A mixture of 16 g of pseudoascaridole and 13 g of absolute alcohol containing 4 g of methylamine was heated in a sealed tube at 125–130° for 12 hr.

The ethanol was removed by evaporation and the residue was recrystallized from petroleum ether C-chloroform to yield a white solid, mp 156.5–157.0°; nmr (8% CDCl$_3$) τ 6.17 (d, 1, J = 8 Hz), 6.51 (d, 1, J = 8 Hz), 7.5–8.7 (m, 5), 8.8 (s, 3), 9.00 (d, 3, J = 7 Hz) 9.02 (d, 3, J = 7 Hz), and a two-proton peak whose position was concentration dependent; ir (Nujol) 3400 cm^{-1} (COH).

Registry No.—**3a**, 20797-85-7; **3b**, 20817-02-1; **4**, 20797-86-8.

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[1] (a) O. A. Runquist, Ph.D. Thesis, University of Minnesota, July 1956, pp 20–46; *Dissertation Abstr.*, **16**, 2313 (1956). (b) J. Boche and O. Runquist, *J. Org. Chem.*, **33**, 4285 (1968).

[2] H. Thoms and W. Dobke, *Arch. Pharm.*, **268**, 128 (1930).

[3] Melting points are uncorrected.

[4] E. K. Nelson, *J. Amer. Chem. Soc.*, **33**, 1404 (1911).

Knoevenagel Condensation in the Homophthalic Acid Series. A Synthesis of Zearalenone

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The homophthalic acid system is formally an aromatic analog of malonic acid and might consequently be expected to function in some measure in a Knoevenagel condensation with resultant loss of carbon dioxide and water.[1]

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[1] For a recent review of the Knoevenagel reaction, see G. Jones, *Org. Reactions*, **15**, 204 (1967).