Tetrahedron Letters No. 48, pp 4219 - 4222, 1974. Pergamon Press. Printed in Great Britain.

NOJIGIKU ALCOHOL, A NEW CAMPHENE ALCOHOL FROM *CHRYSANTHEMUM JAPONENSE*

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(Received in Japan 28 September 1974; received in UK for publication 21 October 1974)

In the course of our chemosystemtic investigation of *Chrysanthemum* native in Japan,$^{1)}$ a new monoterpene alcohol was isolated from an essential oil of *Ch. japonense* (Makino) Nakai (Japanese name Nojigiku), and the structure including absolute configuration was determined as formula I. This is the first case in which an oxygen-containing derivative of camphene was isolated from the nature world.$^{2)}$ We propose the name of nojigiku alcohol for this compound, and the evidences for the proposed structure are described here.

Nojigiku alcohol(I), $C_{10}H_{16}O(M^+\ 152)$; mp 52-53°; $[\alpha]_D$ +12.0°(c 1.1, $CHCl_3$), was isolated together with a small amount of its acetate(II), $C_{12}H_{18}O_2(M^+\ 194)$; $[\alpha]_D$ +20.9°(c 0.58, $CHCl_3$); $\nu_{max}^{CCl_4}$ 1740, 1250, 1035 cm^{-1}; $\delta_{ppm}^{CCl_4}$ 1.95(3H, s), 4.55(1H, d.d, J=7.0, 3.0), from the essential oil obtained by steam distillation of stalks and leaves of the plants by means of the fractional distillation followed by the elution chromatography with silica gel and a mixed solvent of hexane and ethyl acetate(6 : 1).

The alcohol furnished a crystalline 3,5-DNB, $C_{17}H_{18}N_2O_6(M^+\ 346)$; mp 107-108°, and a monoacetate, $C_{12}H_{18}O_2(M^+\ 194)$; $[\alpha]_D$ +11.6°(c 1.20, $CHCl_3$); $\nu_{max}^{CCl_4}$ 1740, 1250, 1035 cm^{-1}, in treating with acetic anhydride in pyridine, which was identical with the co-occurring acetate. The IR and NMR spectra of the alcohol exhibited the presence of a *gem*-dimethyl($\nu_{max}^{CCl_4}$ 1380, 1375, 1360 cm^{-1}; $\delta_{ppm}^{CCl_4}$ 0.96, 1.01, each 3H, s), an *exo*-methylene(ν 3060, 1655, 885; δ 4.60, 4.81, each

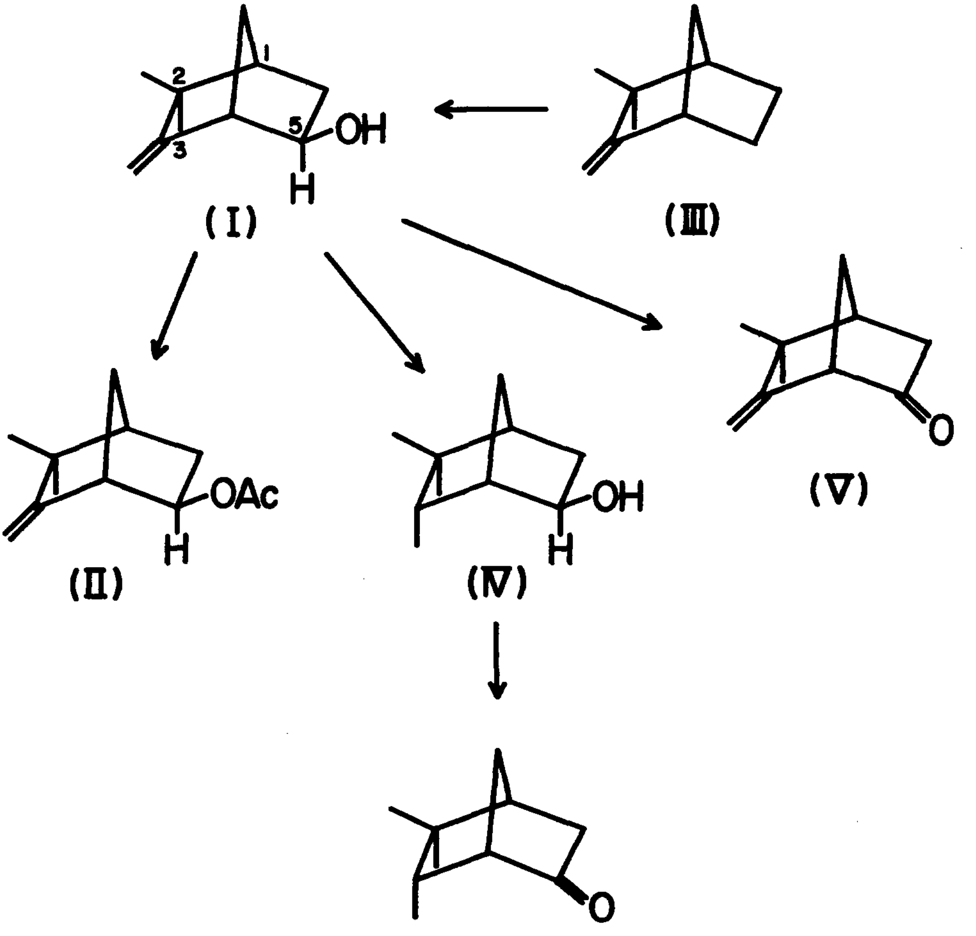
1H, s), an allylic methine(δ 2.63, 1H, br.s) and a secondary hydroxyl group(ν 3615, 3350, 1050; δ 2.72, 1H, br.s, exchangeable with D_2O, 3.71, 1H, d.d, J=7.0, 3.0). Besides, this NMR spectrum had close resemblance in the whole pattern to that of camphene(III) except the proton signals due to the secondary hydroxyl group. The alcohol was catalytically hydrogenated over PtO_2 in AcOH to give two saturated dihydro derivatives having the *endo*-methyl and *exo*-methyl group in a ratio of 4 : 1, and the NMR spectrum of the major product(IV), $C_{10}H_{18}O(M^+ 154)$; mp 68-69°; $\nu_{max}^{CCl_4}$ 3620, 3320, 1040 cm^{-1}, had also resemblance to that of the *endo* form of dihydro camphene except the signals related to the secondary hydroxyl group($\delta_{ppm}^{CCl_4}$ 1.70, 1H, br.s, exchangeable with D_2O, 3.97, 1H, d.d, J= 7.0, 3.0). From the above evidences, nojigiku alcohol was characterized as a camphene derivative having a hydroxyl group on one of C_5, C_6 and C_7.

In order to determine the position of the secondary hydroxy group, the alcohol was oxidized with Jones reagent to give a five-membered ketone(V), $C_{10}H_{14}O(M^+ 150)$; mp 47-48°; $[\alpha]_D$ +33.7°(c 0.86, $CHCl_3$); $\nu_{max}^{CCl_4}$ 1755 cm^{-1}; semicarbazone, mp 189-190°, whose NMR spectrum showed the allylic methine proton ($\delta_{ppm}^{CCl_4}$ 3.0, 1H, br.s) in a lower field compared with that(δ 2.63) of the original alcohol due to anisotropic effect of the carbonyl group and whose IR spectrum an absorption band of a newly-formed active methylene at ν 1420. The formation of such oxidation product selected the position of the hydroxyl group on C_5. The planar structure of nojigiku alcohol was thus elucidated to be 2,2-dimethyl-3-methylene bicyclo[2.2.1]heptan-5-ol.

Furthermore, the fact that, in NMR spectra of nojigiku alcohol, its acetate and saturated alcohol, the proton on C_5 bearing the hydroxyl or acetoxy group showed uniformly a double doublet(J=7.0, 3.0) at δ 3.71, 4.55 or 3.97 indicated the C_5-protons of these compounds to have the *endo* configuration on the examination of the molecular models.[3)] The stereostructure of these compounds are shown by formulae I, II and IV.

The formation of this alcohol had been reported by Jennings *et al* in chlorination of *dl*-camphene with *tert*-butyl hypochlorite followed by alkaline hydrolysis.[4)] For the confirmation of the identity, we synthesized this compound from *dl*-camphene according to their report and the good agreement with the IR, NMR and MS spectra was observed between nojigiku alcohol and synthetic one.

Next, in order to determine the absolute configuration, the above mentioned *endo*-form of dihydro alcohol(IV) was submitted to Jones oxidation and it was converted into a saturated ketone(VI), $C_{10}H_{16}O$(M^+ 152); mp 58-59°; $\nu_{max}^{CCl_4}$ 1750 cm^{-1}, which showed a negative Cotton effect($[\phi]_{297}$ -4690, $[\phi]_{265}$ +1600, A=62.9, in MeOH) on the ORD curve. This negative effect indicated according to the information of Ourisson *et al* on the Cotton effect of bicyclo[2.2.1]heptan-2-one system[5] that the saturated ketone had such absolute configuration as shown by formula VI.



On the basis of the above evidences, the absolute configurations of nojigiku alcohol and its acetate isolated from *Ch. japonense* could be respectively represented by stereostructures I and II which corresponded to the configuration of *d*-camphene. This conclusion agreed with the result the C_5-chirality of nojigiku alcohol was determined to be *R*-configuration by the application of Horeau's method using racemic *α*-phenylbutyric anhydride(optical yield, +56 %).6)

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