Tetrahedron Letters No. 46, pp 4355 - 4358, 1971. Pergamon Press. Printed in Great Britain.

A CONFORMATIONAL STUDY OF SERICENINE, A TEN-MEMBERED RING FURANOSESQUITERPENE, AND ITS DERIVATIVES

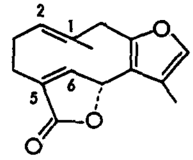
Kazuo Tori, Isao Horibe, Hitoshi Minato and Ken'ichi Takeda

Shionogi Research Laboratory, Shionogi & Co., Ltd., Fukushima-ku, Osaka, Japan

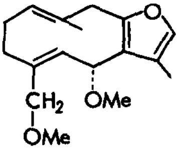
(Received in Japan 1 October 1971; received in UK for publication 9 October 1971)

In our previous PMR spectral studies of ten-membered ring sesquiterpenes, the conformations of linderalactone (I) (1), its related dimethoxy compound (II) (1), isabelin (III) (2), and laurenobiolide (IV) (3), in which both double bonds of their ten-membered rings have the trans configuration, were revealed by the use of intramolecular nuclear Overhauser effects (NOE) (4). Variable-temperature PMR studies demonstrated that compounds (I) and (II) each exist in solution as one rigid conformer in which no inversion of the ten-membered ring occurs at temperatures up to about 100°C, whereas compounds (III) and (IV) exist as two PMR-distinguishable conformational isomers at low temperatures; in the spectra of IV, particularly, rapid inversion of the ring was evidently observed at high temperatures (3).

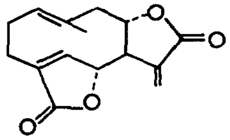
Neolinderalactone (V) having cis (C-1 : C-2) and trans (C-5 : C-6) double bonds, was also found



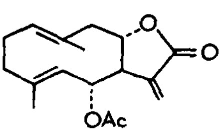
(I)



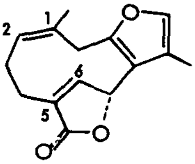
(II)



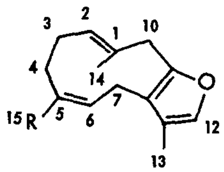
(III)



(IV)



(V)



(VI) R = COOMe
(VII) R = CHO
(VIII) R = Me

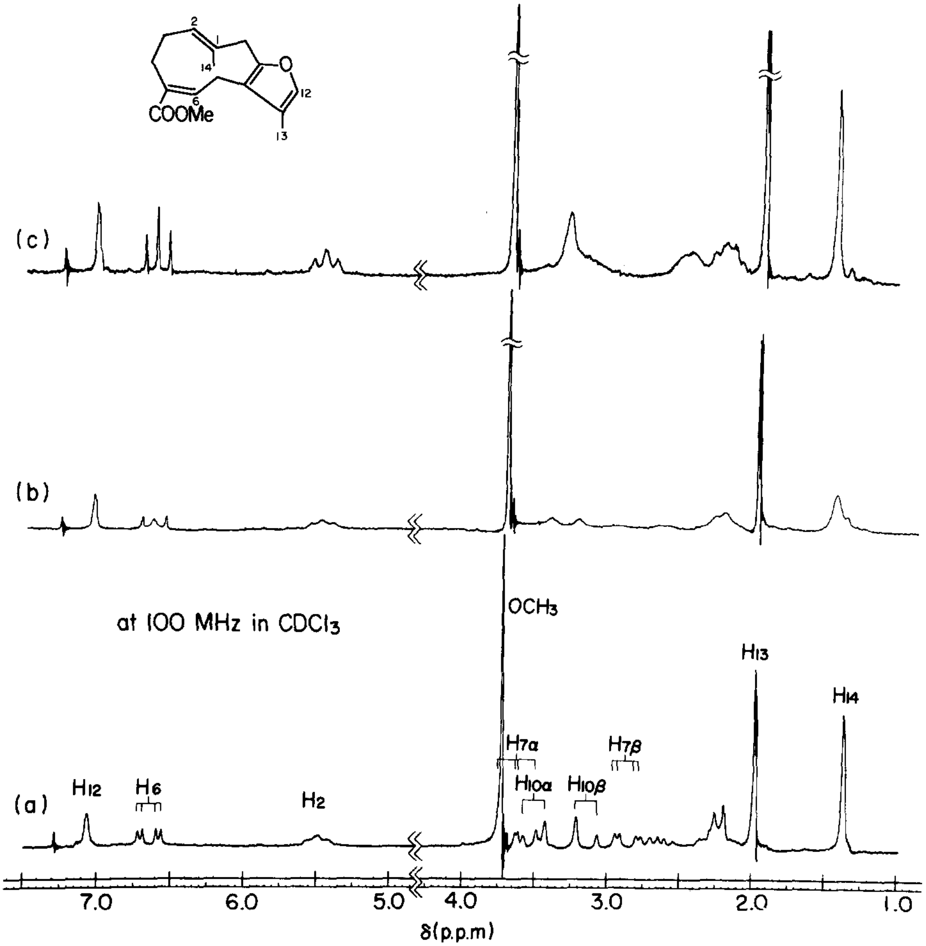


FIG. 1. The variable-temperature PMR spectra of sericenine (VI) in $CDCl_3$ at 100 MHz; (a) -30°, (b) 40°, (c) 70°C.

to exist as two conformational isomers at lower temperatures, and rapid inversion of the ten-membered ring was seen in the spectra at temperatures higher than about 100°C (5).

These results have prompted us to examine the PMR spectra of sericenine (VI), a furanosesquiterpene isolated from the leaf of Neolitsea sericea Koidz. (6,7), and its derivatives (VII) (7) and (VIII) (8), in which the double bonds are trans (C-1 : C-2) and cis (C-5 : C-6). We report here PMR spectroscopic evidence for their conformations.

The 100-MHz PMR spectra of VI in various solvents at room temperature showed rather broad

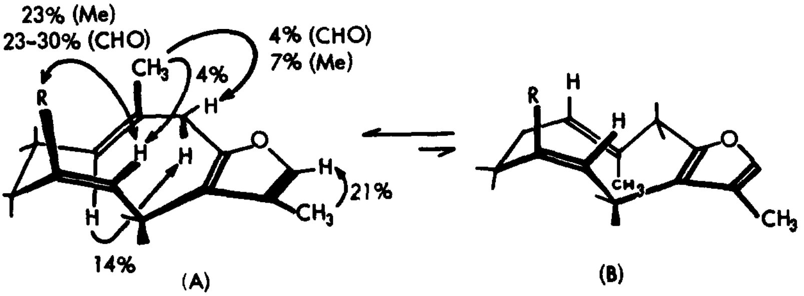


FIG. 2. The molecular conformations of sericenine (VI) and its derivatives, (VII) and (VIII).

signals (FIG. 1b), while at higher and lower temperatures, the spectra exhibited single, but different, sets of sharp signals (FIGs. 1c and 1a, respectively). These facts imply that the sharp signals seen at high temperatures are due to a rapidly inverting ten-membered ring, and that those observed at low temperatures arise from the major conformer of the ring being frozen on the PMR time scale, the signals of the minor conformer being unobservable owing to a decrease in its population with lowering of temperature. An attempt to detect the presence of the minor conformer in the 220-MHz spectra was also unsuccessful.

Examination of molecular models suggests two major conformations (A) and (B), as shown in FIG. 2, for VI, VII, and VIII. NOE measurements were carried out to determine the major conformation of VI in $CDCl_3$ at -10°C. A small but distinct increase (4%) in the integrated intensity of the H-6 signal caused by saturation of the H-14 signal,* and vice versa, indicate that the ten-membered ring in VI adopts a conformation where H-6 and C-1-Me are syn. Further, observations of the NOE's between H-2 and H-10α (14%) and between H-10β and H-14 (4%) clearly determine the conformation of VI as illustrated in FIG. 2(A) (R = COOMe). The spin coupling constants obtained for VI ($J_{6,7\alpha} = 12.5$ and $J_{6,7\beta} = 3.5$ Hz) can reasonably be explained by this conformation.

The variable-temperature 100-MHz spectra of VII and VIII showed features similar to those of VI. The low-temperature double-resonance spectra in acetone-d_6 were therefore examined to determine the conformations of VII and VIII. As shown in FIG. 2 (R = CHO and Me), the NOE results obtained

---

* This NOE value was reported previously to be 24% at room temperature (6).

for VII and VIII unambiguously show that they adopt conformation (A). Conformation (B) is therefore believed to be the minor one.

It is of considerable interest that whereas the potential barrier to inversion of the ten-membered ring of a *trans,trans*-cyclodeca-1,5-diene fused to a furan ring at C-8 : C-9 is considerably high, and the system exists as one stable conformer in solution, the barriers for *trans,cis*- and *cis,trans*-cyclodeca-1,5-dienes are lower. The ten-membered ring in cyclodeca-1,5-dienes trans-fused to a γ-lactone ring at C-8 : C-9, however, have a low barrier, even in compounds having *trans,trans*-double-bonds, such as III and IV (2,3).

The 100-MHz PMR spectra were recorded on a Varian HA-100 spectrometer operating at 100 MHz in the frequency-swept and TMS-locked mode. The NOE experiments were made as previously described (9). The 220-MHz spectra were taken with a Varian HR-220 spectrometer by the courtesy of Department of Hydrocarbon Chemistry, Kyoto University.

REFERENCES

1. K. Takeda, K. Tori, I. Horibe, M. Ohtsuru and H. Minato, *J. Chem. Soc. (C)* 2697 (1970).
2. K. Tori, I. Horibe, H. Yoshioka and T. J. Mabry, *J. Chem. Soc. (B)* 1084 (1971).
3. K. Tori, I. Horibe, K. Kuriyama, H. Tada and K. Takeda, *Chem. Commun.* in the press.
4. F. A. L. Anet and A. J. R. Bourn, *J. Amer. Chem. Soc.* **87**, 5250 (1965).
5. K. Tori, I. Horibe, K. Kuriyama and K. Takeda, *Chem. Commun.* 957 (1970).
6. N. Hayashi, S. Hayashi and T. Matsuura, *Tetrahedron Letters* 4957 (1968).
7. K. Takeda, K. Tori, I. Horibe, H. Minato, N. Hayashi, S. Hayashi and T. Matsuura, *J. Chem. Soc. (C)* 985 (1970).
8. K. Takeda, I. Horibe and H. Minato, *J. Chem. Soc. (C)* 2704 (1970).
9. K. Tori, M. Ohtsuru, I. Horibe and K. Takeda, *Chem. Commun.* 943 (1968).