CHEMISTRY LETTERS, pp. 95-98, 1977. Published by the Chemical Society of Japan

# STRUCTURE OF ALNUSEROL, THE FIRST REPORTED NATURALLY OCCURRING 11-HYDROXYLATED $C_{31}$-DAMMARANE-TYPE TRITERPENE

Toshifumi HIRATA, Kyoko MURAI, and Takayuki SUGA*
Department of Chemistry, Faculty of Science, Hiroshima University
Higashisenda-machi, Hiroshima 730
and
Arild CHRISTENSEN
Syntex Analytical Instruments, Inc., 10040 Bubb Road, Cupertino
California 95014, U.S.A.

Molecular structure and absolute configuration of alnuserol, a novel $C_{31}$-triterpene isolated from *Alnus serrulatoides* Call., were determined to be (20S,24R)-20,24-epoxy-11α-hydroxy-24-methyldammaran-3-one (I) by a combination of X-ray crystallography and circular dichroism measurements.

In contrast to many examples of 11-hydroxylated steroids in animals and microorganisms,[1] 11-hydroxylated triterpenoids rarely occur in higher plants.[2~4] In naturally occurring dammarane-type triterpenes, a few examples of 12β-hydroxylated derivatives have been reported,[2,5,6] but as yet no 11-hydroxylated derivatives. We report here the isolation and the structure elucidation of a novel 11α-hydroxylated $C_{31}$-dammarane-type triterpene, named alnuserol. This triterpene was isolated from the male flowers of *Alnus serrulatoides* Call., as colorless needles, mp 211~212°C, $[\alpha]_D^{25}$ +260° (*c* 0.20, EtOH), m/e 454 ($M-H_2O$). After partial structural information for this triterpene was deduced from the UV, IR, NMR, and MS spectral data, the compound was subjected to single-crystal X-ray analysis to define the complete molecular structure and stereochemistry.

*Crystal data*: $C_{31}H_{52}O_3$, orthorhombic, a=6.599(2), b=14.921(3), c=28.443(8) Å; V=2800.6 Å$^3$; $D_m$=1.06 g·cm$^{-3}$, Z=4, $D_c$=1.119 g·cm$^{-3}$; space group $P2_12_12_1$; μ=5.3 cm$^{-1}$ (for Cu-Kα).

A total of 2262 reflections were collected using Ni-filtered Cu-Kα radiation on a Syntex $P2_1$ automated four-circle diffractometer; 315 reflections were smaller than 1.96 times of σ(I). The structure was solved by non-centrosymmetric direct methods based on 251 reflections with $|E|>1.51$, using the program MALTAN[7] and refined by anisotropic block-diagonal least-squares calculations to a final R-factor of 0.054. The final atomic coordinates of the non-hydrogen atoms are given in Table 1. The structure and relative stereochemistry of the molecule is shown in Fig. 1. The molecular arrangement in the crystal is shown in Fig. 2. The molecules are packed

* To whom all inquiries should be addressed.

TABLE 1. Atomic parameters of alnuserol (I).

| Atom | x/a | y/b | z/c | Atom | x/a | y/b | z/c |
|---|---|---|---|---|---|---|---|
| C(1) | 0.4157 | 0.4682 | 0.7688 | C(18) | -0.1502 | 0.3966 | 0.8667 |
| C(2) | 0.5002 | 0.5610 | 0.7537 | C(19) | 0.0393 | 0.4948 | 0.7712 |
| C(3) | 0.3732 | 0.6403 | 0.7646 | C(20) | -0.0574 | 0.0517 | 0.8948 |
| C(4) | 0.2960 | 0.6482 | 0.8143 | C(21) | -0.2732 | 0.0695 | 0.8800 |
| C(5) | 0.2737 | 0.5546 | 0.8377 | C(22) | 0.0534 | -0.0075 | 0.8597 |
| C(6) | 0.1299 | 0.5568 | 0.8794 | C(23) | 0.1957 | -0.0616 | 0.8913 |
| C(7) | 0.1417 | 0.4674 | 0.9071 | C(24) | 0.0728 | -0.0759 | 0.9351 |
| C(8) | 0.0813 | 0.3872 | 0.8768 | C(25) | 0.2106 | -0.0676 | 0.9808 |
| C(9) | 0.2085 | 0.3837 | 0.8306 | C(26) | 0.0838 | -0.0744 | 1.0251 |
| C(10) | 0.2228 | 0.4769 | 0.8017 | C(27) | 0.3781 | -0.1351 | 0.9817 |
| C(11) | 0.1467 | 0.3026 | 0.8007 | C(28) | 0.4617 | 0.7024 | 0.8407 |
| C(12) | 0.1617 | 0.2119 | 0.8272 | C(29) | 0.0987 | 0.7048 | 0.8137 |
| C(13) | 0.0461 | 0.2175 | 0.8738 | C(30) | 0.3482 | 0.2875 | 0.9175 |
| C(14) | 0.1183 | 0.2981 | 0.9038 | C(31) | -0.0524 | -0.1650 | 0.9322 |
| C(15) | -0.0050 | 0.2827 | 0.9492 | O(1) | 0.3416 | 0.6998 | 0.7348 |
| C(16) | -0.0017 | 0.1786 | 0.9564 | O(2) | 0.2608 | 0.2937 | 0.7578 |
| C(17) | 0.0586 | 0.1366 | 0.9086 | O(3) | -0.0700 | -0.0046 | 0.9365 |

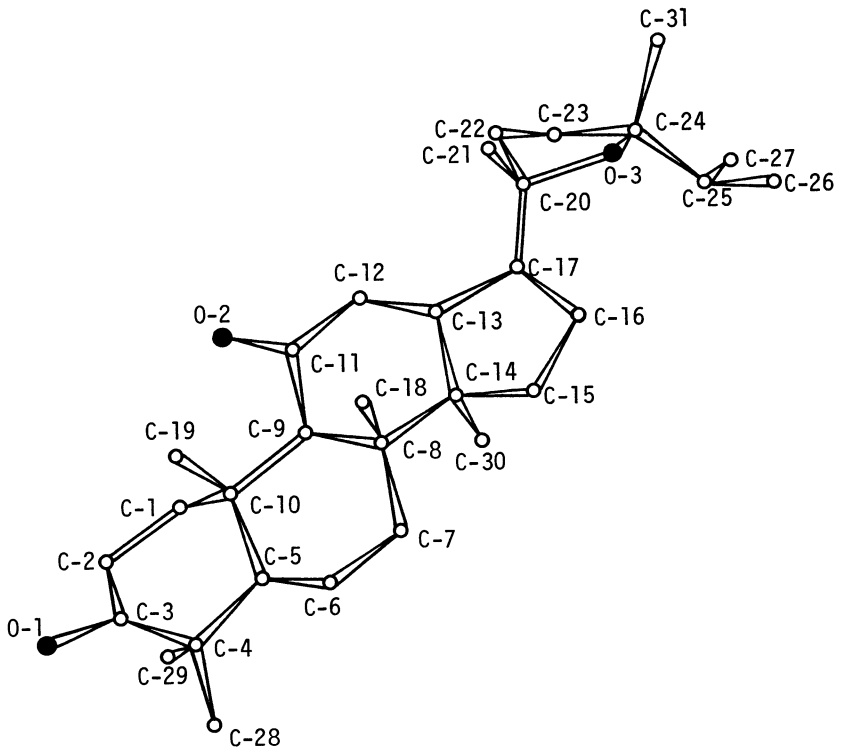



Fig. 1. A stereo-drawing of alnuserol. The atoms indicated with o and ● denote carbon and oxygen atoms, respectively.

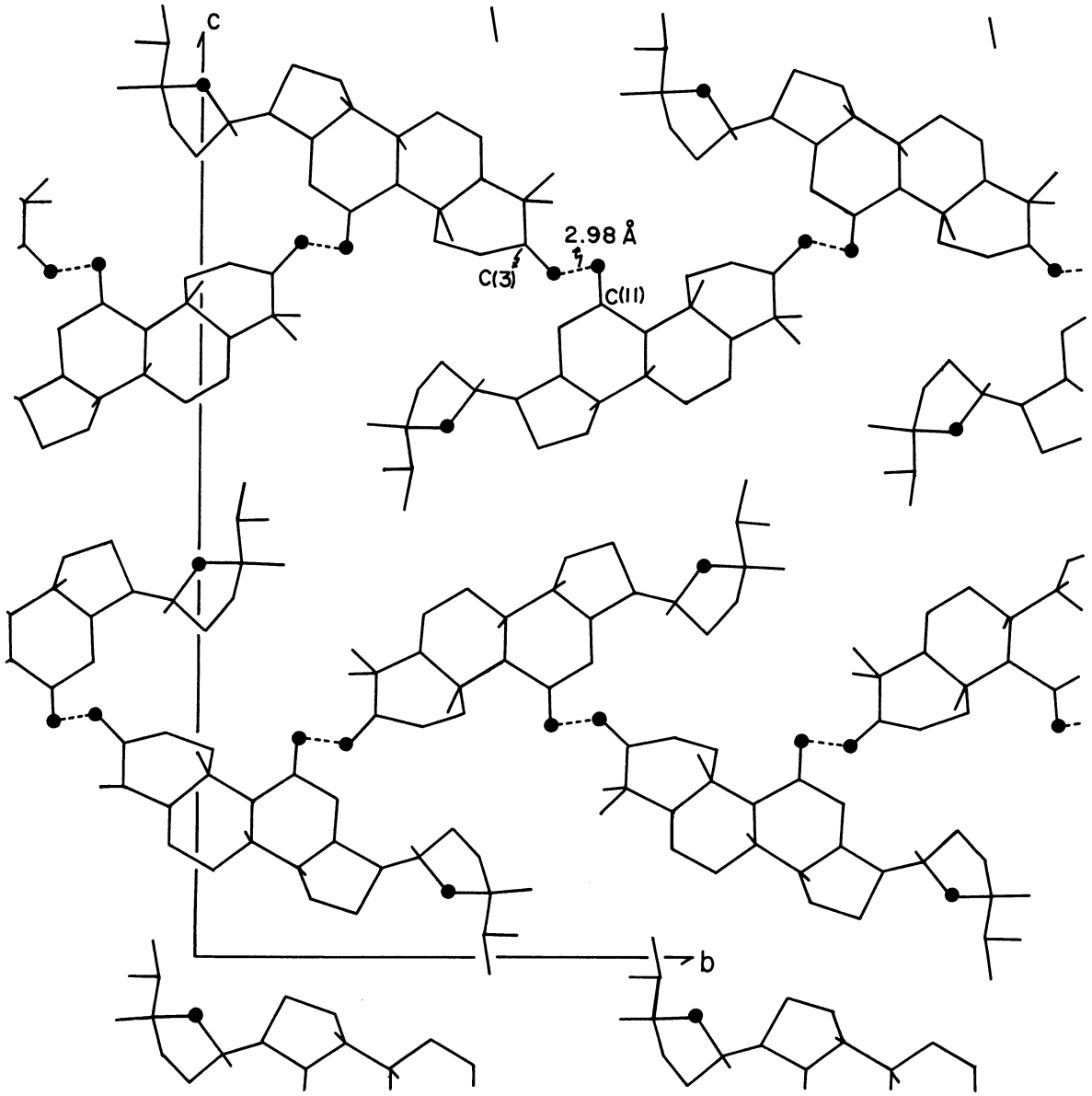
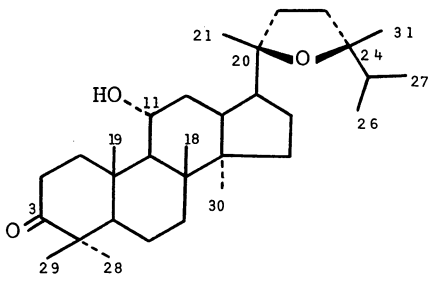



Fig. 2. The crystal structure of alnuserol (I) viewed in projection along the a-axis. Hydrogen bonds are shown by a broken line. The atoms indicated with ● denote oxygen atoms.

along the a-axis, and are linked by O(hydroxyl)---O(carbonyl) intermolecular hydrogen bonds, O---O 2.98 Å, around the $2_1$ screw axis along the b direction.

The c.d. curve of alnuserol in MeOH exhibited a positive Cotton effect[8] with a maximum at 289 nm ([θ] +955). This unambiguously demonstrates that the absolute configuration of alnuserol corresponds to formula I. Thus, the structure of alnuserol has been elucidated to be (20S,24R)-20,24-epoxy-11α-hydroxy-24-methyl-dammaran-3-one (I). To our knowledge, this is the first reported naturally occurring 11-hydroxylated $C_{31}$-dammarane-type triterpene.




I

Acknowledgment. The author (T.S.) is grateful to the Ministry of Education for financial support of this investigation through Grant-in-aid (047089) for Scientific Research in 1975.

References

1) E. Heftmann, "Steroid Biochemistry," Academic Press, New York, N.Y. (1970).
2) A. A. Newman, "Chemistry of Terpenes and Terpenoids," Academic Press, New York, N.Y. (1972), p.239.
3) S. Imai, E. Murata, S. Fujioka, M. Koreeda, and K. Nakanishi, J. C. S. Chem. Commun., 546 (1969).
4) T. Takemoto, S. Arihara, T. Nakajima, M. Okuhira, and A. Hamada, The pre-print of "The 20th Symposium on the Chemistry of Natural Products," Sendai (1976), p.288.
5) K. Nakanishi, T. Goto, S. Ito, S. Natori, and S. Nozoe, "Natural Products Chemistry," Vol. 1, Kodansha, Tokyo and Academic Press, New York, N.Y. (1974).
6) T. Suga, T. Hirata, and N. Iwata, Chem. Lett., 971 (1974).
7) G. Germain, P. Main, and M. M. Woolfson, Acta Cryst., A 27, 368 (1971).
8) W. Moffitt, R. B. Woodward, A. Moscowitz, W. Klyne, and C. Djerassi, J. Amer. Chem. Soc., 83, 4013 (1961).

(Received December 6, 1976)