

## TWO TAXANE DITERPENES FROM *TAXUS MAIREI*

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**Abstract**—Two new baccatin type diterpenes were isolated from the stem bark of *Taxus mairei*. Their structures were established as 1-dehydroxy-4-deacetylbaccatin IV and 1-acetoxy-5-deacetylbaccatin I on the basis of spectroscopic analysis.

### INTRODUCTION

In the previous paper [1, 2], we have reported three new non-taxane type diterpenes from the bark of *Taxus mairei*, taxamairins A, B and C. As the continuation of our chemical investigation on *T. mairei*, we now report the structures of two new baccatin type diterpenes: 1-dehydroxy-4-deacetylbaccatin IV (1) and 1-acetoxy-5-deacetylbaccatin I (2). The present paper deals with the isolation, structure elucidation and identification of the compounds.

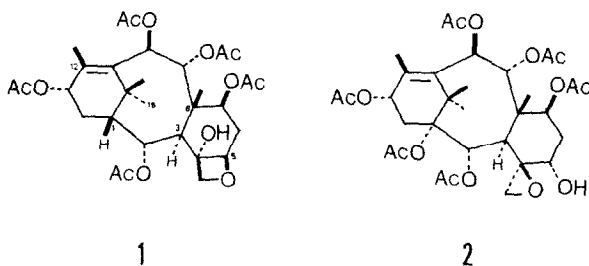
### RESULTS AND DISCUSSION

An ethanolic extract of the bark of *Taxus mairei* (Lemée et Lével.) S. Y. Hu growing in Fujing province, China was fractionated by column chromatography on silica gel or neutral aluminium oxide. Finally 1 and 2 were purified by recrystallization.

Compound 1,  $C_{30}H_{42}O_{12}$  ( $M^+$   $m/z$  594.266), showed a UV maximum at 220 nm which revealed the absence of the cinnamate group. It was shown in the IR spectrum an absorption at  $3461\text{ cm}^{-1}$  relating to a hydroxyl group. The  $^1\text{H}$  NMR spectrum exhibited the presence of tertiary methyl groups of taxane type;  $\delta$  1.20 ( $C_{17}$ ), 1.56 ( $C_{19}$ ), 1.67 ( $C_{16}$ ) and 1.96 ( $C_{18}$ ) ppm. In the range of 2.0–2.2 ppm, there were five methyl signals assignable to acetyl groups. The signals at 4.20 (1H,  $d$ ,  $J=7.4\text{ Hz}$ ) and 4.53 (1H,  $d$ ,  $J=7.2\text{ Hz}$ ) ppm appeared as an AX system indicating a methylene at C-20 of taxane belonging to baccatin IV type [3]. The configuration of five acetyl groups could be assigned as follows. an AX system, which consisted of 6.03 and 6.16 ( $J=12.4\text{ Hz}$ ) ppm, was attributed to  $9\beta\text{-H}$  and  $10\alpha\text{-H}$  ( $\theta=180^\circ$ ). It was resulted in the acetyl groups being  $9\alpha$  and  $10\beta$ . On the other hand, three signals at 2.46 (1H,  $ddd$ ,  $J_{14\beta,14\alpha}=15.2$ ,  $J_{14\beta,13\beta}=7.2$ ,  $J_{14\beta,1}=1.4\text{ Hz}$ ), 1.83 (1H,  $ddd$ ,  $J_{14\alpha,14\beta}=15.2$ ,  $J_{14\alpha,13\beta}=9.0$ ,  $J_{14\alpha,1}=1.4\text{ Hz}$ ) and 6.13 (1H,  $dd$ ,  $J_{13\beta,14\alpha}=9.1$ ,  $J_{13\beta,14\beta}=7.2\text{ Hz}$ ) were assignable to the  $14\beta\text{-H}$ ,  $14\alpha\text{-H}$  and  $13\beta\text{-H}$ , respectively. An acetyl group were shown to be at  $13\alpha$  and a proton to be at C-1 $\beta$ . Furthermore, a characteristic signal of 3-H of taxane appeared at 3.03 ( $d$ ,  $J=5.5\text{ Hz}$ ) ppm. Because the dihedral angle between  $1\beta\text{-H}$  and  $2\beta\text{-H}$  was nearly  $90^\circ$ , a peak for 2-H, which only coupled with

3-H, was observed in a doublet at 5.65 ppm. The result suggested an acetyl group at  $2\beta\text{-C}$ . The signal of 5.52 (1H,  $dd$ ,  $J_{7\alpha,6\beta}=11.0$ ,  $J_{7\alpha,6\alpha}=6.5\text{ Hz}$ ) ppm being attributed to the H-7 $\alpha$  that made clear an acetyl group at the  $7\beta\text{-C}$ . As a matter of course, a hydroxyl was assigned to be at  $4\alpha\text{-C}$ . Finally, the structure of 1-dehydroxy-4-acetylbaccatin I could be proposed for 1.

Compound 2,  $C_{32}H_{44}O_4$  (FD and  $M^+$   $m/z$  652), a UV maximum at 220 nm. It showed a IR absorption at  $3569\text{ cm}^{-1}$  which was related to a hydroxyl group. The  $^1\text{H}$  NMR spectrum of 2 revealed the presence of four tertiary methyl groups of taxane type,  $\delta$  1.22 (17-Me), 1.24 (19-Me), 1.62 (16-Me) and 2.24 (18-Me) ppm. There were signals of six acetyl groups in the range from 2.0 to 2.4 ppm. The signals of 2.25 (1H,  $d$ ,  $J=5.0\text{ Hz}$ ) and 3.63 (1H,  $d$ ,  $J=5.0\text{ Hz}$ ) ppm appeared as an AX system, indicative of a methylene group of the oxetan ring of baccatin I type [4]. In the  $^1\text{H}$  NMR spectrum of 2, it was shown 9-C, 10-C and 13-C bearing an acetyl group, respectively. Two signals of 2.12 (1H,  $ddd$ ,  $J_{6\beta,6\alpha}=15.0$ ,  $J_{6\beta,7\alpha}=9.9$ ,  $J_{6\beta,5\beta}=4.4\text{ Hz}$ ) and 1.76 (1H,  $ddd$ ,  $J_{6\alpha,6\beta}=15.0$ ,  $J_{6\alpha,7\alpha}=4.1$ ,  $J_{6\alpha,5\beta}=3.0\text{ Hz}$ ) ppm were assignable for methylene at 6-C, and a signal of 5.52 (1H,  $dd$ ,  $J_{7\alpha,6\beta}=9.9$ ,  $J_{7\alpha,6\alpha}=4.0\text{ Hz}$ ) ppm was also attributable to 7 $\alpha\text{-H}$ , which showed an acetyl group to be at  $7\beta\text{-C}$ . On the other hand, two signals at 2.52 (1H,  $dd$ ,  $J_{14\beta,14\alpha}=15.0$ ,  $J_{14\beta,13\beta}=9.7\text{ Hz}$ ,  $14\beta\text{-H}$ ) and 1.96 (1H,  $dd$ ,  $J_{14\alpha,14\beta}=15.0$ ,  $J_{14\alpha,13\beta}=7.2\text{ Hz}$ ) ppm suggested two acetyl groups attaching at  $13\alpha\text{-C}$  and  $1\beta\text{-C}$  on the basis of the respective coupling constants. The final acetyl group was at the 2-C.



supported by their chemical shifts and coupling constant between  $3\alpha$ -H [3.18 (d,  $J=4.4$  Hz)] and  $2\beta$ -H [5.52 ( $J=4.4$  Hz)]. Della and coworkers reported [5], if the  $5\alpha$ -C position was substituted with an acetyl group, the signal of  $5\beta$ -H appeared at 5.62 ppm. If the same position was substituted by a hydroxy group, the signal of  $5\beta$ -H appeared at 4.16 ppm. So, the signal of 4.15 ppm of **2** had to show the presence of a hydroxyl group at  $5\alpha$ -C. The structure of **2**, hence could be written as 1-acetoxy-5-deacetylbaecatin I.

### EXPERIMENTAL

**Plant material** Stem barks of *Taxus mairei* were collected in Fujian province, and a voucher was deposited in the Herbarium of China Pharmaceutical University

**Separation and isolation of 1 and 2.** According to our previous papers [1, 2], the EtOAc fraction was chromatographed on a neutral alumina by CC, eluted by a portion of a mixed soln of EtOAc in cyclohexane (5/2 and 1/2). Compounds **1** and **2** were obtained after being recrystallized from MeOH, yielding 0.0017 and 0.005%, respectively

**1-Dehydroxy-4-deacetylbaecatin IV (1)** Colourless crystals, mp 229–230° (EtOH).  $[\alpha]_D^{25} = 40$  (acetone;  $c$  0.5),  $M_r$  594.2665 ( $M^+$ , calcd. 594.2777),  $C_{30}H_{42}O_{12}$ , UV  $\lambda_{max}^{MeOH}$  nm (log  $\epsilon$ ): 219 (3.81), IR  $\nu_{max}$  (KBr) 3461, 1744, 1721, 1651, 1241, 1226, 1027  $cm^{-1}$   $^1H$  NMR (400 MHz,  $CD_3OD$ ).  $\delta$  1.20 (3H, s, 17-Me), 1.56 (3H, s, 19-Me), 1.67 (3H, s, 16-Me), 1.96 (3H, s, 18-Me), 1.83 (1H, ddd,  $J_{14\alpha,14\beta}=15.2$ ,  $J_{14\alpha,14\beta}=9.0$ ,  $J_{14\alpha,1}=1.4$  Hz, 14 $\alpha$ -H), 2.46 (1H, ddd,  $J_{14\beta,14\alpha}=15.2$ ,  $J_{14\beta,13\beta}=7.2$ ,  $J_{14\beta,1}=7.2$  Hz, 14 $\beta$ -H), 1.95 (3H, s, OAc), 2.1 (6H, s, 2  $\times$  OAc), 2.17 (3H, s, OAc), 2.20 (3H, s, OAc), 3.03 (1H, d,  $J_{3\alpha,2\beta}=5.5$  Hz, 3 $\alpha$ -H), 4.20 (1H, d,  $J=7.2$  Hz, 20-H), 4.53 (1H, d, 20-H), 5.00 (1H, d,  $J=10$  Hz, 5 $\alpha$ -H), 5.52 (1H, dd,  $J_{7\alpha,6\beta}=11.0$ ,  $J_{7\alpha,6\alpha}=6.5$  Hz, 7-H), 5.56 (1H, d,  $J_{2\beta,3\alpha}=5.5$  Hz, 2 $\beta$ -H), 6.03 (1H, d,  $J_{9\beta,10\alpha}=12.4$  Hz, 9 $\beta$ -H), 6.13

(1H, dd,  $J_{13\beta,14\alpha}=9.0$ ,  $J_{14\beta,13\beta}=7.2$  Hz, 13- $\beta$ H), 6.16 (1H, d,  $J_{10\alpha,9\beta}=12.4$  Hz, 10 $\alpha$ -H) MS  $m/z$  (rel int): 594 ( $M^+$ , 6.0), 593 (39.2), 490 (31.2), 472 (39.4), 430 (39.4), 412 (9), 205 (25), 195 (93.7), 149 (100), 105 (62.5), 93 (39.7), 67 (28.1), 55 (40.6)

**1-Acetoxy-5-deacetylbaecatin I (2).** Colourless crystal, mp 240–241° (EtOH)  $M_r$  652,  $C_{32}H_{44}O_{14}$ , UV  $\lambda_{max}^{MeOH}$  220 nm IR  $\nu_{max}$  (KBr) 3569, 1742, 1631, 1241  $cm^{-1}$ .  $^1H$  NMR (400 MHz,  $CD_3OD$ ).  $\delta$  1.22 (3H, s, 17-Me), 1.24 (3H, s, 19-Me), 1.62 (3H, s, 16-Me), 2.24 (3H, s, 18-Me), 1.89 (3H, s, OAc), 2.00 (3H, s, OAc), 2.18 (6H, s, 2  $\times$  OAc), 2.22 (3H, s, OAc), 2.24 (3H, s, OAc), 1.76 (1H, ddd,  $J_{6\alpha,6\beta}=15.0$ ,  $J_{6\alpha,7\alpha}=4.1$ ,  $J_{6\alpha,5\beta}=3.0$  Hz, 6 $\alpha$ -H), 2.12 (1H, ddd,  $J_{6\beta,6\alpha}=15.0$ ,  $J_{6\beta,7\alpha}=9.9$ ,  $J_{6\beta,5\beta}=4.4$  Hz, 6 $\beta$ -H), 2.52 (1H, d,  $J=5.0$  Hz, 20-H), 3.63 (1H, d,  $J=5.0$  Hz, 20-H), 1.96 (1H, dd,  $J_{14\alpha,14\beta}=15.0$ ,  $J_{14\alpha,13\beta}=7.2$  Hz, 14 $\alpha$ -H), 2.52 (1H, dd,  $J_{14\beta,14\alpha}=15.0$ ,  $J_{14\beta,13\beta}=9.7$  Hz, 14 $\beta$ -H), 3.18 (1H, d,  $J_{3\alpha,2\beta}=4.4$  Hz, 3 $\alpha$ -H), 4.16 (1H, dd,  $J_{5\beta,6\beta}=4.4$ ,  $J_{5\beta,6\alpha}=3.0$  Hz, 5 $\beta$ -H), 5.50 (1H, d,  $J_{2\beta,3\alpha}=4.4$  Hz, 2 $\beta$ -H), 5.52 (1H, dd,  $J_{7\alpha,6\beta}=9.9$  Hz,  $J_{7\alpha,6\alpha}=4.1$  Hz, 7 $\alpha$ -H), 6.09 (1H, q,  $J_{13\beta,14\beta}=9.9$ ,  $J_{13\beta,14\beta}=7.2$ , 13 $\beta$ -H), 6.10 (1H, d,  $J_{9\beta,10\alpha}=11.0$  Hz, 9 $\beta$ -H), 6.22 (1H, d,  $J_{10\alpha,9\beta}=11.0$  Hz, 10 $\alpha$ -H) FDMS  $m/z$  (rel int.): 653 ( $M+1$ , 32), 652 ( $M$ , 60), 595 (7), 593 (100), EIMS  $m/z$  (rel int.): 594 (4), 533 (17), 490 (14), 430 (14.2), 352 (8), 310 (8), 195 (95), 253 (100), 93 (40)

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