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A FLAVONE FROM *ARTEMISIA CAPILLARIS*

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Key Word Index—*Artemisia capillaris*; Compositae; flower spikes; flavone; 5,2′,4′-trihydroxy-6,7,5′-trimethoxyflavone; structure elucidation.

Abstract—A new flavone was isolated from *Artemisia capillaris* and its structure was determined by spectroscopic methods as 5,2′,4′-trihydroxy-6,7,5′-trimethoxyflavone.

In traditional Chinese medicine, the spikes of *Artemisia capillaris* Thunb. have been used in crude drug prescriptions for the treatment of icterus and infectious hepatitis. The essential oils [1] and its oil-free extract have been shown to increase bile secretion in rat [2]. As the active principles, scoparone and capillarisin were isolated [3–5] and shown to have choleretic action [4]. On the other hand, the drug extract was recently demonstrated to have inhibitory action on the adherence of *Streptococcus mutans*, a bacterium which causes dental caries in animals and humans, to teeth surfaces [6]. In the present communication, we report the isolation and structure elucidation of a new flavone in the course of a survey of antiplaque agents in traditional Chinese medicines [7, 8].

The flavone (**1**) was obtained as pale yellow needles, mp > 300°, $C_{18}H_{16}O_8$ (M^+, 360), Mg–HCl (+), and formed a triacetate. The elemental composition and spectral characteristics indicated **1** to be a trihydroxytrimethoxyflavone. The UV spectrum and diagnostic shifts strongly suggested the presence of a 5,4′-dihydroxy system in **1** [9]. The ^{1}H NMR spectrum showed the signals due to three methoxy, two hydroxy, one hydrogen-bonded hydroxy and three aromatic (each singlet) and C-3 protons. These findings indicated that three of the six oxygen functions in **1** were in the B-ring at the 2′,4′,5′-positions and the rest in the A-ring at the 5,6,7-, 5,7,8- or 5,6,8-positions. Compound **1** gave a positive Gibbs indophenol test [10] and a negative $SrCl_2$–ammonia test [11]; thus, the only oxidation pattern tenable for the A-ring is 5,6,7, including a 5-hydroxy-6-methoxy system. The presence of 6-methoxyl, being *diortho* substituted by two oxygen functions, was further supported by the ^{13}C NMR spectrum, in which the signal due to the 6-methoxyl appeared downfield (δ60.1) compared with those of the other two isolated methoxyls [12]. In the UV spectrum, **1** showed no significant bathochromic shift of band II with sodium acetate, usually suggesting the presence of a 7-methoxyl in **1** [9]. It has, however, been reported that this spectral method for detecting a 7-hydroxyl is inapplicable to flavonoids possessing a 6-methoxyl [13–15]. Finally, the presence of a 7-methoxyl was confirmed by comparing the ^{13}C NMR spectra of **1** and its acetate with those of 5-hydroxy-6,7-dimethoxyflavone (**2**) and 5,7-dihydroxy-6-methoxyflavone, and their acetates. The carbon signals, due to the A-rings of **1** and its acetate, were superimposable on those of **2** and its acetate, respectively [16]. The remaining one methoxyl in the B-ring was readily proved to be at the 5′-position from the facts that the UV spectrum of **1** showed no bathochromic shift of band I in the presence of sodium acetate–boric acid [9], and the *ortho–para*-diphenol test using cobalt reagent [17, 18] was also negative. Thus, the structure of **1** was established as 5,2′,4′-trihydroxy-6,7,5′-trimethoxyflavone.

EXPERIMENTAL

Isolation of a new flavone. The crude drug, *A. capillaris spica* (the spikes of *A. capillaris* Thunb.) (500 g), was extracted (× 3) with MeOH (3 l.). The combined soln was concd to *ca* 2 l. and washed with *n*-hexane (2 l. × 3). The resulting extract was then chromatographed on Si gel [4, 5]. A new flavone (**1**) was isolated in a yield of *ca* 15 mg, in addition to the previously reported compounds, scoparone, cirsilineol, cirsimaritin, rhamnocitrin, 2-(*p*-hydroxyphenoxy)-6,7-dimethoxy-5-hydroxychromone, 2-(*p*-hydroxyphenoxy)-5,7-dihydroxychromone.

Compound **1**. Pale yellow needles, mp > 300° (from MeOH). $FeCl_3$ (+), Mg–HCl (+), Gibbs (+) [10], $SrCl_2$–NH_3 (−) [11], Co reagent (−) [17, 18]. (Found: C, 60.03; H, 4.50. $C_{18}H_{16}O_8$ requires: C, 60.00; H, 4.48%.) Accurate MS: observed 360.085, calcd. 360.084. UV λ_{max}^{MeOH} nm: 267, 373; NaOAc, 270, 420; NaOMe, 270, 428; $AlCl_3$, 240, 272 (sh), 298 (sh), 327 (sh), 376, 420 (sh); $AlCl_3$ + HCl, 240, 269 (sh), 298 (sh), 322 (sh), 372, 410 (sh); H_3BO_3 + NaOAc, 270, 378. IR ν_{max}^{KBr} cm^{-1}: 3400 (OH), 1660, 1638 (conjugated C=O), 1600, 1573, (aromatic C=C). ^{1}H NMR (100 MHz, DMSO-d_6): δ 3.76, 3.84, 3.96 (each 3H, each *s*, OMe × 3), 6.57 (1H, *s*, H-3′)*, 6.96 (1H, *s*, H-8)*, 7.11 (1H, *s*, H-3)*, 7.46 (1H, *s*, H-6′)*, 10.54 (1H, *s*, OH-2′, OH-4′), 10.10 (1H, *s*, OH-2′ or OH-4′), 13.00 (1H, *s*, OH-5). ^{13}C NMR (25 MHz, DMSO-d_6): δ 162.4 (*s*, C-2), 107.5 (*d*, C-3)*, 182.5 (*s*, C-4), 152.8 (*s*, C-5), 132.1 (*s*, C-6), 158.7 (*s*, C-7), 91.7 (*d*, C-8)*, 153.3 (*s*, C-9), 105.1 (*s*, C-10), 107.1 (*s*, C-1′), 152.2 (*s*, C-2′), 104.8 (*d*, C-3′)*, 152.2 (*s*, C-4′), 141.9 (*s*, C-5′), 112.9 (*d*, C-6′)*, 60.1 (*q*, OMe-6), 57.2, 56.5 (each *q*, OMe × 2). MS, 70 eV, *m/z* (rel. int.): 360 $[M]^+$ (100), 345 $[M-Me]^+$ (99), 331 $[M-CHO]^+$ (21), 317 $[M-MeCO]^+$ (11), 181 $[A_1-Me]^+$ (43), 167 $[B_2]^+$ (14), 165 $[B_1+H]^+$ (29), 153 $[A_1$

*Assignments were confirmed by selective decoupling.

$-MeCO]^+$ (34). On treatment with boiling Ac_2O–pyridine, **1** yielded an acetate, colourless needles, mp 188–189.5° (from $CHCl_3$–MeOH). (Found: C, 59.30; H, 4.52. $C_{24}H_{22}O_{11}$ requires: C, 59.26; H, 4.56%.) UV λ_{max}^{MeOH} nm: 239, 262 (sh), 310. IR ν_{max}^{KBr} cm^{-1}: 1762 (OAc), 1624 (conjugated C=O), 1562 (aromatic C=C). ^1H NMR (100 MHz, DMSO-d_6): δ 2.32, 2.36, 2.42 (each 3H, each *s*, OAc × 3), 3.80, 3.96, 4.05 (each 3H, each *s*, OMe × 3), 6.54 (1H, *s*, H-3), 7.19 (1H, *s*, H-8), 7.24 (1H, *s*, H-3′), 7.55 (1H, *s*, H-6′). ^{13}C NMR (25 MHz, DMSO-d_6): δ 159.4 (*s*, C-2), 111.5 (*d*, C-3), 175.2 (*s*, C-4), 141.6 (*s*, C-5), 139.3 (*s*, C-6), 157.9 (*s*, C-7), 99.0 (*d*, C-8), 153.8 (*s*, C-9), 110.5 (*s*, C-10), 123.0 (*s*, C-1′), 141.2 (*s*, C-2′), 119.1 (*d*, C-3′), 141.2 (*s*, C-4′), 149.3 (*s*, C-5′), 113.2 (*d*, C-6′), 61.0 (*q*, OMe-6), 56.8, 56.5 (each *q*, OMe × 2), 169.1, 168.9, 168.3 (each *s*, OCOMe × 3), 20.7, 20.6, 20.3 (each *q*, OCOMe × 3). MS 70 eV *m/z* (rel. int.): 486 $[M]^+$ (8), 444 $[M-CH_2CO]^+$ (95), 402 $[M-CH_2CO \times 2]^+$ (100), 387 (31), 360 $[M-CH_2CO \times 3]^+$ (26) 345 (52), 181 (10), 167 (21), 153 (14).

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TWO FURTHER ACYLATED FLAVONE GLUCOSIDES FROM *ANISOMELES OVATA*

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Abstract—The structures of two new acylated apigenin glucosides are reported from the aerial parts of *Anisomeles ovata*. They were separated as their acetates and identified as apigenin 7-*O*-β-D-(2″,6″-di-*O*-*p*-coumaroyl)glucoside and apigenin 7-*O*-β-D-(4″,6″-di-*O*-*p*-coumaroyl)glucoside by ^1H NMR study of the acetates and by chemical degradative methods. The allocation of the *p*-coumaroyl moieties is also supported by a study of the ^{13}C NMR spectrum of the inseparable mixture of glucosides.

INTRODUCTION

In an earlier communication [1] we have reported the isolation of a new compound anisofolin-A [apigenin 7-*O*-β-D-(3″,6″-di-*O*-*p*-coumaroyl)glucoside] from the aerial parts of *Anisomeles ovata* R. Br. The present communication deals with the characterization of two new compounds **1** and **2** from a study of their acetates.

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