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COUMARINS IN *ARTEMISIA CARUIFOLIA*

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Key Word Index—*Artemisia caruifolia*; Compositae; coumarins; daphnetin derivatives; 3,4-dimethoxy-2-hydroxy cinnamic acid.

Abstract—Isolation of daphnethin 7-methyl ether, daphnetin dimethyl ether, daphnetin methylene ether, daphnetin 7-methyl-8(3,3-dimethylallyl) ether and 3,4-dimethoxy-2-hydroxycinnamic acid from *Artemisia caruifolia* is reported.

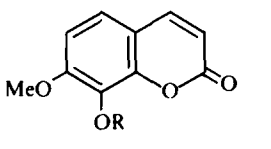
In a search for sesquiterpene lactones which are characteristic constituents of *Artemisia* species [1] we have examined the aerial parts of *Artemisia caruifolia* Roxb. (*A. carnifolia* Ham. in Roxb.). Sesquiterpene lactones were not found but daphnetin 7-methyl ether (**1a**), daphnetin dimethyl ether (**1b**), daphnetin 7-methyl-8-(3,3-dimethyl allyl) ether (**1c**), daphnetin methylene ether (**2**) and the dihydrocinnamic acid **3a** were isolated. Compounds **1c** and **3a** appear to be new.

Coumarin **1c**, mp 94°, was hydrolysed to **1a**, thus providing evidence for the distribution of the two ether functions. The structure of **3a** was established by cyclization to **4** which was identical with material obtained by hydrogenation of **1b**.

EXPERIMENTAL

Aerial parts of *Artemisia caruifolia* Roxb. wt 2 kg, collected on 22 May, 1979 in the Jangimukh area of the Sibsagu district, Assam, India (voucher on deposit in the herbarium of RRL) were extracted with $CHCl_3$ in a Soxhlet apparatus until the extract was colourless. After evapn of $CHCl_3$ at red. pres. the residue was dissolved in 400 ml of MeOH containing 10% H_2O and left overnight. The ppt. was filtered and the filtrate was washed thoroughly with petrol (bp 60–80°, 8 × 200 ml). The MeOH layer was evapd at red. pres. and the residue extracted with $CHCl_3$ (4 × 200 ml). The washed and dried extract after evapn. yielded 6 g of crude gum which was chromatographed over 200 g of Si gel (60-120 mesh), 200 ml fractions being collected as follows: 1-5 (C_6H_6, 6-10 (C_6H_6–EtOAc, 9:1), 11 16 (C_6H_6 EtOAc, 4:1), 17-21 (C_6H_6–EtOAc, 2:1), 22-28 (C_6H_6–EtOAc, 1:1), 29-32 (C_6H_6–EtOAc, 1:2), 33-38 (C_6H_6–EtOAc, 1:4), 39 41 (C_6H_6–EtOAc, 1:6), 42-43 (EtOAc), 44-47 (EtOAc–MeOH, 99:1), 48-50 (EtOAc–MeOH, 19:1), 51-55 (EtOAc MeOH, 9.1).

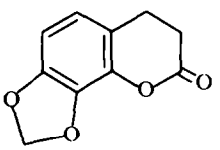
Although TLC of fractions 3 5 showed only one major spot, PLC of the residue, wt 50 mg, yielded material whose NMR spectrum indicated the presence of a mixture. Fractions 6–10 were combined and recrystallized from EtOAc to yield 90 mg of **2**, mp 178°, MS *m/e* at 190(M^+), 162 and 132. While the mp was somewhat lower than reported (lit 188° [2], 187 189° [3]), direct comparison with an authentic sample [3] (TLC, NMR) identified the material as **2**. TLC of fractions 12-15 showed the presence of two major components. The combined material (320 mg) was separated by PLC (C_6H_6–EtOAc, 7:1). The less polar material was crystallized from EtOAc, yield of **1c** 120 mg, mp 94; IR ($CHCl_3$) 1730, 1640, 1605, 1275, 1185, 1120, 1070, 825 cm^{-1}; UV λ_{max}^{MeOH} 260 and 323 nm; NMR ($CDCl_3$) δ 7.56*d* and 6.14*d* (9.5, H-3



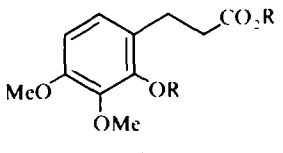
1a R = H

1b R = Me

1c R =

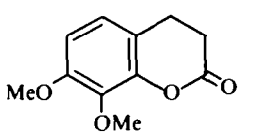


2



3a R = H

3b R = Me



4

and H-4), 7.07*d* and 6.76*d* (8.5, H-5 and H-6), 5.42*t* (7, H-2'), 4.60*d* (7, 2 H, H-1'), 3.93 (OMe), 1.75*br* (6 H, vinyl methyls), MS *m/e* at 260 (M^+), 206, 192, 177 and 164. (Calc. for $C_{15}H_{16}O_4$: C, 69.22; H, 6.20. Found: C, 68.81; H, 6.12). A mixture of 30 mg of **1c** in 3 ml of MeOH and 0.5 ml of 10% aq. H_2SO_4 was refluxed for 1 hr, diluted with cold H_2O and extracted with $CHCl_3$. The washed and dried extract was evapd. to give 15 mg of **1a** identical in all respects with material from fractions 17–21 (*vide infra*).

The more polar compound from fractions 12–15 was recrystallized from EtOAc to give 180 mg of **1b**, mp 118°, lit. 119–120° [3]. Direct comparison with an authentic sample of **1b** [3] (TLC, NMR) established identity. Demethylation of 35 mg of **1b** by refluxing with 2 ml of HOAc and 1 ml of HI for 2 hr, diluting with H_2O, extracting with EtOAc and recrystallizing (EtOAc) the residue from the extract afforded 20 mg of daphnetin, mp 248°, lit. mp 254° [5], IR (KBr) 3500, 1675, 1595, 1000 and 825 cm^{-1}, NMR (MeOD) δ 7.45*d* and 5.85*d* (9.5, H-3 and H-4), 6.65*d* and 6.45*d* (8.5, H-5 and H-6), MS *m/e* at 178 (M^+) and 150.

Fractions 17–21 which showed a single spot on TLC were combined and recrystallized from EtOAc–MeOH to yield 110 mg of **1a**, MS *m/e* at 192 (M^+), 177, 168 and 150, mp 155°. This is considerably lower than the lit. mp (169–171° [3]), but the mp given for the isomeric daphnetin 8-methyl ether, 185° [5], is even higher. Methylation of the substance with diazomethane gave **1b**, mp 117°, identical with the more polar material from fractions 12–15; also TLC behavior and NMR spectrum of the substance were indistinguishable from those of authentic **1a** [3] (TLC, NMR).

Fractions 29–32 exhibited one major spot on TLC. Combination and recrystallization from $CHCl_3$–petrol afforded 58 mg of **3a**, mp 134°, IR ($CHCl_3$) 3300 – 2800 (broad, carboxyl), 1720, 1605, 1580, 1150, 1115, 1090, 1025, 975 and 830 cm^{-1}, NMR δ 7.55*d* and 6.15*d* (8.5, H-5 and H-6), 4.00 and 3.80 (OMe), 2.70*m* (4 H, H-1' and H-2'), MS *m/e* at 226 (M^+), 208, 192, 167, 166, 151. (Calc. for $C_{11}H_{14}O_5$: MW, 226.0480. Found: MW (MS), 226.0847.) Methylation of 20 mg of **3a** gave 20 mg of **3b** as a gum, NMR ($CDCl_3$) 6.75*d* and 6.30*d* (8.5, H-5 and H-6), 3.80, 3.77 and 3.60 (OMe), 2.63*m* (4 H, side chain protons), MS *m/e* at 254 (M^+), 239, 181, 151 and 136.

A solution of 35 mg of **3a** in 0.5 ml of Py and 1 ml of Ac_2O was allowed to stand overnight. Dilution with H_2O and extraction with $CHCl_3$ gave a quantitative yield of **4** identical with material obtained by hydrogenation of 30 mg of **1b** in 20 ml of EtOAc with 50 mg of Pd/C for 0.5 hr. The gummy substance, yield 25 mg, had IR bands at 1770, 1620, 1245, 1130, 1085, 1050, 1020, 980 and 960 cm^{-1}, NMR δ 6.75*d* and 6.55*d* (8.5, H-5 and H-6), 3.87 and 3.84 (OMe), 2.78*m* (4p, H-3 and H-4), MS *m/e* at 208 (M^+), 193, 180, 166, 151 and 137.

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