Xanthones from *Swertia nervosa* Wall.

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Phytochemical investigations of the whole plant *Swertia nervosa* yielded three tetraoxygenated xanthones namely 1,8-dihydroxy-3,7-dimethoxyxanthone, swertiaperennine (1), 1-hydroxy-3,7,8-trimethoxyxanthone, decussatin (2) and 1,7-dihydroxy-3,8-dimethoxy-xanthone gentiacaulein (3). The spectral details of these compounds have been presented.

Swertia chirata also known as *Chirata, Kirat, Kirayata* or *Chirayata* is one of the oldest medicinal herbs of Indian System of Medicine[1]. Traditionally, it has been used as a tonic, anthelmintic, febrifuge, laxative, for the treatment of pain, skin diseases and is an important ingredient of a number of herbal formulations presently sold for liver disorders, diabetes and skin diseases[2,3]. However unsustainable collections over the years have depleted *S. chirata* to near extinction in its wild resources in India. As a result, commercial suppliers intentionally or ignorantly use other species of *Swertia*, like *S. alata, S. purpurascens, S. paniculata, S. cordata* and *S. angustifolia* which are commonly available in India. The morphological similarity of various species in dry form makes the act of substitution easy. In view of this, our laboratory initiated phytochemical and comparative studies of different species of *Swertia* to exploit their industrial potential[4-6]. In the present study, *S. nervosa* was taken up for chemical investigations, which led to the isolation of three xanthones from this species. This is the first xanthones report on *S. nervosa*.

Swertia nervosa Wall. (Gentianaceae) whole plant was collected from Mussoorie (Uttaranchal) at an altitude of 2000 m. The plant material was authenticated on the basis of taxonomic characters and by direct comparison with herbarium specimens available at Forest Research Institute, Dehradun. The voucher specimen of the plant (No.1461) has been deposited at the Museum-cum-Herbarium of our Institute. It was shade dried, powdered (475 g) and macerated with methanol. The methanol extract was concentrated under reduced pressure. The residue (96 g) was suspended in water (700 ml) and sequentially partitioned with hexane (300 ml×4), chloroform (300 ml×4) and butanol (300 ml×4) respectively. The hexane extract (10 g) was column chromatographed over silica gel (60-120 mesh) using chloroform and chloroform:methanol (99.5:0.5 to 96:4) and fractions showing similar TLC pattern were pooled to get 11 fractions. Elution with chloroform led to the isolation of compound 1 (42 mg) from fraction 4. Compound 2 (131 mg) was isolated from fraction 8, eluted in chloroform:methanol (99:1). The fraction 9 eluted in chloroform:methanol (99:1) was rechromatographed using chloroform:acetone (99:1 to 85:15) as eluting solvent. The sub fraction 4 eluted in chloroform:acetone (99:1) afforded compound 3 (125 mg). The mass, UV, IR, ^{1}H-NMR and ^{13}C-NMR spectra of these compounds were taken to identify their structures. Compound 1, was crystallized from mixture of chloroform and methanol as yellow needles (42 mg), Rf- 0.69 (toluene:acetone 97:3), mp- 184-188°, UV λ_{max} (cyclohexane): 209, 237, 260, 306, 331 nm, IR υ_{max} (KBr): 3080, 2940, 1660, 1630, 1600, 1460, 1080, 740 and 575 cm^{-1}; ^{1}H-NMR δ (300 MHz, $CDCl_3$): 3.89 (3H, *s*), 3.94 (3H, *s*), 6.33 (1H, *d*, *J*=2.2 Hz), 6.39 (1H, *d*, *J*=2.2 Hz), 6.85 (1H, *d*, *J*=9 Hz), 7.26 (1H, *d*, *J*=9 Hz), 11.97 (1H, *s*), 12.11 (1H, *s*); ^{13}C-NMR δ (75 MHz, $CDCl_3$): 55.90 (3-OCH_3), 57.07 (7-OCH_3), 92.86 (C-2), 97.23 (C-4), 102.30 (C-1a), 105.57 (C-5), 109.08 (C-8a), 120.35 (C-6), 142.90 (C-7), 144.4 (C-8), 150.22 (C-5a), 158.23 (C-1), 162.93 (C-4a), 166.76 (C-3), 184.96 (C-9); MS *m/z* (relative intensity %): 288 (M^+, 100), 273 (43), 259 (10), 245, (93), 229 (3), 215 (2), 202 (19), 186 (2), 174 (1), 144 (3), 123 (6), 79 (5). The spectral data and comparison with literature values suggested it to be 1,8-dihydroxy-3,7-dimethoxyxanthone, swertiaperennine[7,8].

Compound 2, crystallized as yellow needles from mix-

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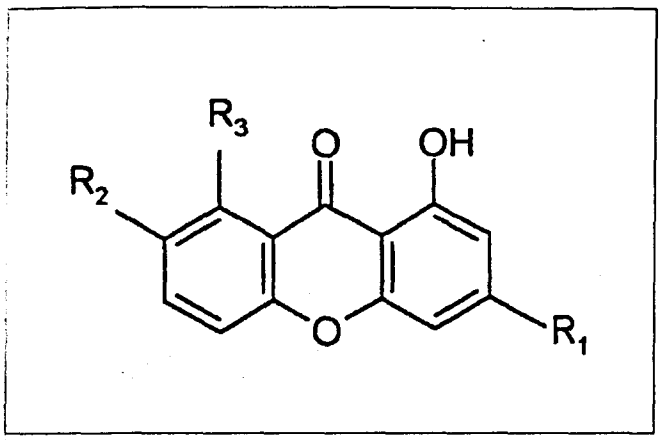

Fig. 1: Structures of xanthones of *S. nervosa*.

The xanthones isolated from *S. nervosa* are, 1 swertiaperennine 1,8-dihydroxy-3,7-dimethoxyxanthone) R_1,R_2=OCH_3, R_3=OH, 2 decussatin (1-hydroxy-3,7,8-trimethoxyxanthone) R_1,R_2,R_3=OCH_3 and 3 gentiacaulein (1,7-dihydroxy-3,8-dimethoxyxanthone) R_1,R_3=OCH_3, R_2=OH.

ture of chloroform and methanol (131 mg), Rf- 0.37 (toluene:acetone 97:3), mp- 152-155°, UV λ_{max} (cyclohexane): 240, 256, 307, 363 nm; IR υ_{max} (KBr): 2970, 2850, 1660, 1595, 1565, 1480, 1430, 1280, 1160, 1050, 795 and 560 cm^{-1}; ^{1}H-NMR d (300 MHz, $CDCl_3$): 3.88 (3H, *s*), 3.93 (3H, *s*), 4.00 (3H, *s*), 6.31 (1H, *d*, *J*=2.3 Hz), 6.34 (1H, *d*, *J*=2.3 Hz), 7.17 (1H, *d*, *J*=9 Hz), 7.34 (1H, *d*, *J*=9 Hz), 13.27 (1H, *s*); ^{13}C-NMR δ (75 MHz, $CDCl_3$): 55.76 (3-OCH_3), 57.13 (7-OCH_3), 61.77 (8-OCH_3), 92.01 (C-2), 96.88 (C-4), 104.33 (C-1a), 112.78 (C-5), 115.73 (C-8a), 120.36 (C-6), 146.83 (C-7), 149.26 (C-8), 150.95 (C-5a), 157.12 (C-1), 163.61 (C-4a), 166.40 (C-3), 181.17 (C-9); MS *m/z* (relative intensity %): 302 (M^+, 93), 287 (100), 273 (28), 259 (37), 243 (9), 216 (11), 201 (15), 186 (4), 171 (3), 144 (21), 123 (5), 95 (3). From spectral data and literature reports it was identified as 1-hydroxy-3,7,8-trimethoxyxanthone, decussatin[7,8].

Compound 3 was crystallized from mixture of chloroform and methanol (125 mg) as yellow crystals, Rf- 0.20 (toluene:acetone 97:3), mp- 192-194°; UV λ_{max} (cyclohexane): 220, 237, 254, 306, 370 nm; IR υ_{max} (KBr): 3370, 2840, 1650, 1610, 1575, 1200, 1160, 1050, 805, 640, 535 cm^{-1}; ^{1}H-NMR δ (300 MHz, $CDCl_3$): 3.87 (3H, *s*), 4.02 (3H, *s*), 5.98 (1H, *s*), 6.30 (1H, *d*, *J*=2.4 Hz), 6.33 (1H, *d*, *J*=2.4 Hz), 7.13 (1H, *d*, *J*=9 Hz), 7.35 (1H, *d*, *J*=9 Hz), 13.09 (1H, *s*); ^{13}C-NMR δ (75 MHz, $CDCl_3$): 54.96 (3-OCH_3), 61.11 (8-OCH_3), 91.18 (C-2), 96.18 (C-4), 103.35 (C-1a), 112.43 (C-5), 114.48 (C-8a), 123.04 (C-6), 144.88 (C-7), 145.99 (C-8), 149.68 (C-5a), 156.55 (C-1), 162.97 (C-4a), 165.70 (C-3), 180.10 (C-9); MS *m/z* (relative intensity %): 288 (M^+, 83), 270 (100), 259 (16), 245 (51), 229 (13), 214 (20), 202 (18), 184 (4), 171 (3), 152 (2), 144 (4), 123 (1), 115 (3). All these spectral evidences suggested it to be 1,7-dihydroxy-3,8-dimethoxyxanthone, gentiacaulein[9].

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