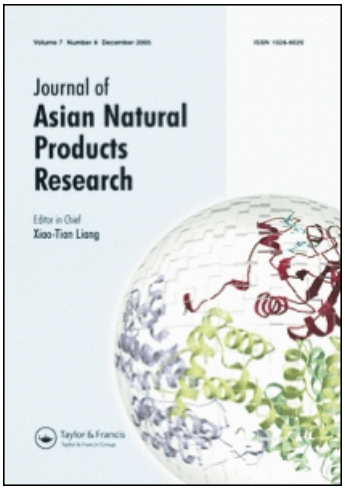

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NOTE

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The phytochemical study of the whole plant of *Derris scandens* (Leguminosae) has resulted in the isolation of a new isoflavone derivative, scandinone A (**11**), together with **11** known compounds (**1**–**10**, **12**). Structural elucidations of these compounds were performed using spectroscopic methods especially 1D, 2D NMR, and mass spectral analyses. The α-glucosidase-inhibitory activity of the isolates was also evaluated.

Keywords: *Derris scandens*; scandinone A; isoflavones; prenylated coumarins; α-glucosidase enzyme inhibition

1. Introduction

Derris scandens (Leguminosae) is a well-known Asian medicinal plant and commonly known as 'Gonj' in India [1]. It is distributed in the sub-Himalayan tract from Oudh eastwards to Assam, and in central and south India to Andaman. This plant is reported to possess anti-inflammatory [2], antibacterial [3], antihypertensive [4], immunomodulatory, and anti-HIV activities [5]. Coumarins, prenylated isoflavones, isoflavone glycosides have been previously reported as chemical constituents of the stem of *D. scandens*. In the previous study, we reported the initial phytochemical and biological investigation of this plant with chemobiological quantification of the active constituents [6]. As part of the ongoing effort to discover potential intestinal α-glucosidase inhibitors from the Indian medicinal plants [7] for development of antidiabetic therapeutics, we observed potent significant α-glucosidase-inhibitory activity in hexane extract of *D. scandens*. The active extract was subjected to the bioassay-guided separation that resulted in the isolation of new prenylated isoflavone derivative **11** along with the known compounds (**1**–**10**, **12**) (Figure 1). We describe herein, the isolation and structure elucidation of the new compound, as well as the α-glucosidase-inhibitory activity potentials for compounds present in hexane extract.

2. Results and discussion

Compound **11** was isolated as a pale yellow solid, mp 126°C, and its molecular formula was determined as $C_{26}H_{26}O_6$ from its HR-ESI-MS, showing an ion at *m/z* 435.1812 $[M+H]^+$ and ^{13}C NMR spectrum. The IR spectrum indicated the presence of hydroxyl (3364 cm^{-1}), carbonyl (1633 cm^{-1}), olefin (1588 cm^{-1}), and ether (1227 cm^{-1}) functionalities. An isoflavone nucleus was identified from

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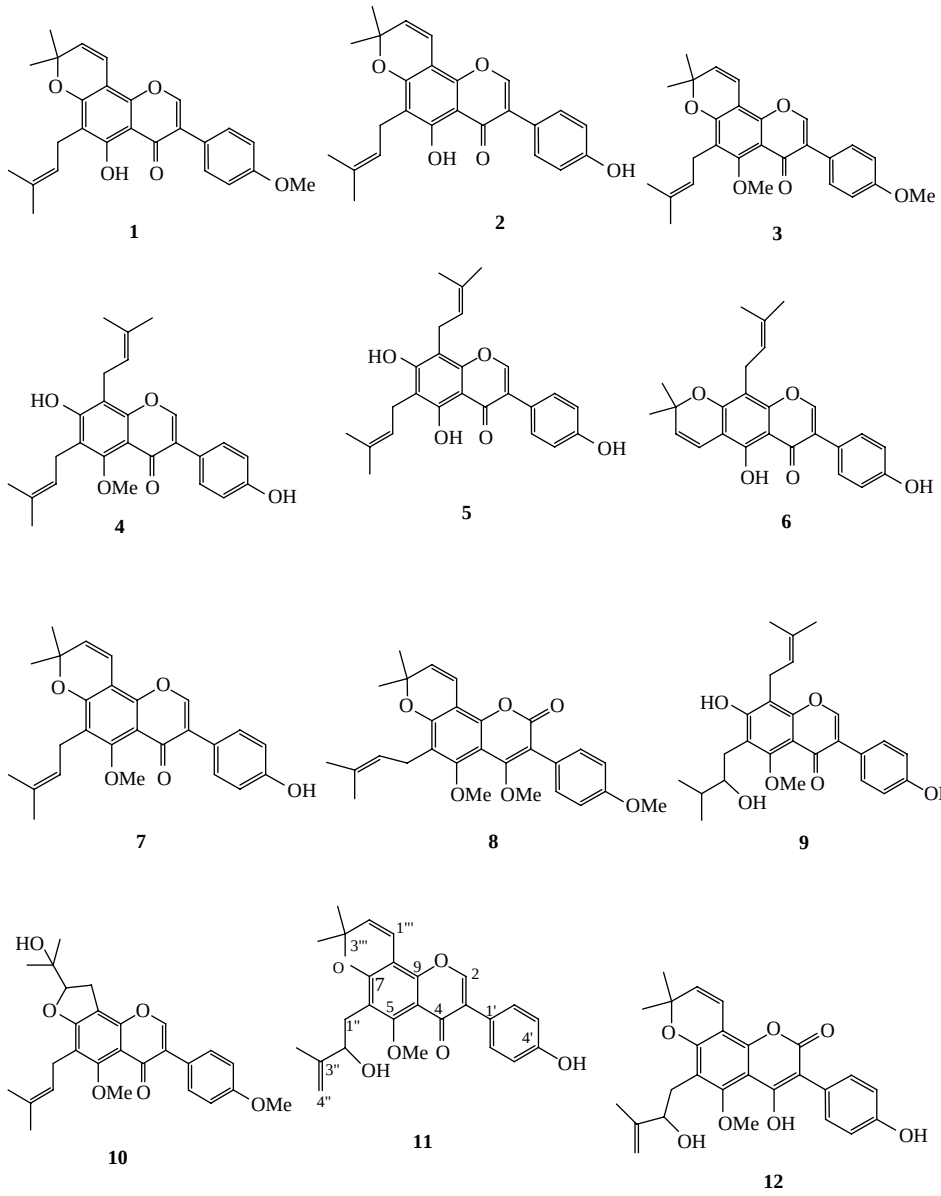

Figure 1. Structures of compounds **1**–**12**.

the UV (λ_{max} 260 nm) data with various shift reagents [8]. The ^{1}H NMR spectrum in $CDCl_3$ revealed a characteristic signal of isoflavone at δ 7.89 (1H, s) assignable to H-2. Two doublets AA′ BB′ type signals at δ 7.35 (2H, d, $J = 8.4$ Hz), and 6.89 (2H, d, $J = 8.4$ Hz) were assignable to H-2′, 6′ and H-3′ 5′ of the ring B. It also showed two doublets at δ 6.80 (1H, d, $J = 9.8$ Hz, H-1‴), and 5.69 (1H, d, $J = 9.8$ Hz, H-2‴) and two signals at δ 1.53, and 1.51, each integrating for three protons assignable to H-4‴, and H-5‴ which is indicative of the chromene system. In addition, ^{1}H NMR spectrum showed ABX type signals at δ 3.34 (1H, dd, $J = 14.5$, 8.6 Hz, Ha-1″), and 2.86 (1H, dd, $J = 14.5$, 2.6 Hz, Hb-1″) and a double doublet at δ 4.25 (1H, dd,

Table 1. ^{1}H NMR (300 MHz) and ^{13}C NMR (75 MHz) spectral data of compound **11** in $CDCl_3$.

Position (C/H)	δ_H	δ_C
1	–	–
2	7.89 (1H, s)	150.4
3	–	125.8
4	–	175.5
5	–	158.4
6	–	123.5
7	–	156.2
8	–	106.0
9	–	152.5
10	–	112.6
1′	–	125.8
2′	7.35 (1H, d, $J = 8.4$ Hz)	130.4
3′	6.89 (1H, d, $J = 8.4$ Hz)	115.6
4′		155.7
5′	6.89 (1H, d, $J = 8.4$ Hz)	115.6
6′	7.35 (2H, d, $J = 8.4$ Hz)	130.4
1″	3.34 (1H, dd, $J = 14.5$, 8.6 Hz) 2.86 (1H, dd, $J = 14.5$, 2.6 Hz)	29.8
2″	4.25 (1H, dd, $J = 8.6$, 2.6 Hz)	78.8
3″	–	147.3
4″	4.97 (1H, s), 4.82 (1H, s)	110.3
5″	1.86 (3H, s)	18.2
1‴	6.80 (1H, d, $J = 9.8$ Hz)	128.7
2‴	5.69 (1H, d, $J = 9.8$ Hz)	115.1
3‴	–	75.8
4‴	1.53 (3H, s)	28.4
5‴	1.51 (3H, s)	28.2
OMe	3.88 (3H, s)	62.4

$J = 8.6$, 2.6 Hz, H-2″) along with the three singlet signals at δ 4.97 (1H, Ha-4″), 4.82 (1H, Hb-4″), and 1.86 (3H, H-5″), derived from a 2-hydroxy-3-methyl-3-butenyl group (Table 1). ^{13}C NMR spectrum of compound 11 showed 26 signals, whose multiplicity was explained from its DEPT experiment as three methyls, one methoxy, two methylenes, eight methines, and 12 quaternary carbon atoms. ^{13}C NMR spectrum showed two intense signals at δ 130.4 (C-2′, C-6′) and 115.6 (C-3′, C-5′), each assigned to two equivalent aromatic carbons of the symmetrical ring B. On the basis of HSQC and HMBC correlations, it was evident that the chromene ring and 2-hydroxy-3-methyl-3-butenyl group were fused to the parent structure at C-7, 8, and C-6, respectively. The complete HMBC spectral data confirmed the structure of compound **11**, which was named as scandinone A (Figure 2).

Along with the new compound, the **11** known compounds were isolated from the *D. scandens*. By comparison of physical and spectroscopic data with those of corresponding authentic samples or literature values, they were identified as 4′-*O*-methyl osajin [9] (**1**), osajin [10] (**2**),

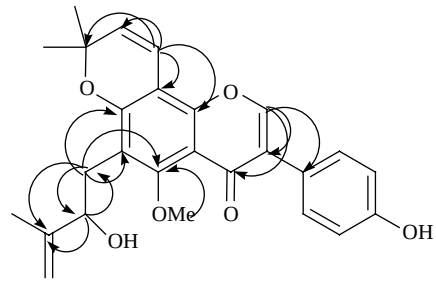

Figure 2. Key HMBC correlations of compound **11**.

4′-*O*-methyl scandinone [11] (**3**), derrisisoflavone [12] (**4**), 4′, 5,7-trihydroxy isoflavone [13] (**5**), scandenone [14] (**6**), scandinone [12] (**7**), 4,4′-di-*O*-methyl scandenin [15] (**8**), derrisisoflavone D [16] (**9**), 4′-*O*-methyl senegalensein [17] (**10**), and scandenin B [7] (**12**), respectively. Among the isolates, compound **11** is reported for the first time from nature.

All the isolates were evaluated for their potential to inhibit intestinal α-glucosidase enzyme activity. Though none of the compounds showed intestinal α-glucosidase-inhibitory activity equal to standard α-glucosidase inhibitor acarbose (IC_{50} 13.2 μM), compounds **4** and **9** displayed more potent activity than other compounds isolated from *D. scandens* hexane extract. This study reveals that standardized hexane extract from *D. scandens* possesses the potential for further evaluation of its antihyperglycemic activity.

3. Experimental

3.1 General experimental procedures

Melting points were recorded on Fisher Johns apparatus and uncorrected. FAB-MS was recorded on VG Auto spec-M instrument. IR spectra were recorded on Nicolet spectrometer. ^{1}H NMR and ^{13}C NMR spectra were obtained on Varian 200, 400 MHz, and Bruker 300 MHz spectrometers using TMS as internal standard. HMBC, HSQC, and NOESY experiments were done on Oxford 500 MHz spectrometer. The solvents used were all of AR grade and were distilled under positive pressure of dry nitrogen atmosphere where necessary. Thin layer chromatography was performed on Merck silica gel 60 F_{254} plates. Visualization was performed using 5% H_2SO_4 solution followed by heating. Column chromatography was performed on silica gel (60–120 mesh) purchased from Merck Specialities Private Ltd, Navi Mumbai 400 706, India.

3.2 Plant material

The whole plant material (leaves, stem and bark) of *D. scandens* was collected from the forest of Tirumala in Chittoor Dist. (Andhra Pradesh, India) in the month of January, and identification was made by Prof. Dr K. Madhava Chetty, Department of Botany, Sri Venkateswara University, Tirupathi. A voucher specimen of the plant is deposited in the herbarium, Department of Botany, with accession number 536.

3.3 Extraction and isolation

The dried plant material (2 kg) was powdered and extracted with hexane in a Soxhlet apparatus for 24 h. The solvent was evaporated under reduced pressure in a rotary flash evaporator to obtain 15 g of extract, which was subjected to column chromatography over silica gel (100–200 mesh) and eluted with hexane/ethyl acetate in the increasing order of polarities to afford eight fractions. Fractions I (5 g) and II (7 g) were further subjected to column chromatography and eluted with hexane/ethyl acetate (99:1) to give four compounds **1** (0.120 g), **2** (1.0 g), **3** (1.9 g), and **4** (0.160 g). Fraction III (2.2 g) was further subjected to column chromatography (100–200 mesh silica gel) and eluted with hexane/ethyl acetate (97:3) to afford compounds **5** (1.0) and **6** (0.80 g). Similarly, the remaining fractions (IV, V, and VI) were rechromatographed with the elution of hexane/ethyl acetate (96:4, 95:5) to yield compounds **7** (0.8 g) and **8** (2.0 g). Furthermore, fraction VII (1 g) was purified by reversed phase C-18 column chromatography with acetonitrile and water (40:60) to afford compounds **9** (0.55 g), **10** (0.9 g), and **11** (0.35 g). Finally, fraction VIII (0.5 g) was purified by silica gel column chromatography (100–200) with the elution of 97:3 (hexane/acetone) to get compound **12** (0.2 g).

Table 2. Intestinal α-glucosidase inhibition activities of isolates from *D. scandens* Benth.

Compound/extract	IC_{50} values (μM)
Hexane extract	20.96 (μg/ml)
4	23
5	50.42
6	92.48
7	81.2
9	25.16
10	60.53
11	113.91
Acarbose	13.21

3.3.1 Scandinone A

Yellow solid; mp 126°C; $[\alpha]_D^{20} = +6$ ($c = 1.0$, MeOH); UV λ_{max}: 260 nm; IR (KBr) ν_{max}: 3364, 2924, 2854, 1633, 1588, 1514, 1463, 1429, 1379, 1245, 1217, 1175, 1134, 1079, 1017, 951, 902, 837, 756, 695, 666, 530 cm^{-1}; ^1H and ^{13}C NMR (see Table 1); HR-ESI-MS *m/z* 435.1812 $[M+H]^+$ (calcd for $C_{26}H_{26}O_6$, 435.1811).

3.4 Assay of α-glucosidase inhibition activity

Determination of α-glucosidase inhibition activity was done according to the procedure described in the literature [18] (Table 2).

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