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NATURAL MEDICINE NOTE

Lignan glycosides and flavonoids from *Saraca asoca* with antioxidant activity

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Abstract Five lignan glycosides, lyoniside, nudiposide, 5-methoxy-9-β-xylopyranosyl-(−)-isolariciresinol, icariside E_3, and schizandriside, and three flavonoids, (−)-epicatechin, epiafzelechin-(4β→8)-epicatechin and procyanidin B_2, together with β-sitosterol glucoside, were isolated from a methyl alcohol (MeOH) extract of *Saraca asoca* dried bark. Their structures were determined by 1D and 2D nuclear magnetic resonance (NMR) and mass spectroscopic analysis. Antioxidant activities were evaluated by 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging assay.

Keywords *Saraca asoca* · Caesalpiniaceae · Lignan glycoside · Flavonoid · Antioxidant activity

Saraca asoca (Roxb.) De Wilde or *S. indica* Linn. (Family: Caesalpiniaceae; local names: Ashok, Anganapriya, etc.) is a medicinal plant of Bangladesh whose bark is astringent and used in menorrhagia, bleeding haemorrhoids and haemorrhagic dysentery [1]. The isolation of tannins [2], flavonoids [3], proanthocyanidins [4] and leucoanthocyanidins [5] were previously reported from the bark. In our assay method, a methyl alcohol (MeOH) extract of the dried bark showed potent antioxidant activity determined by 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical-scavenging assay [6]. Following this activity, we isolated eight compounds (**1**–**8**) from this plant (Fig. 1). This paper describes isolation and identification of isolated compounds together with their antioxidative potential. The bark of *S. asoca* was collected from Satkhira, Bangladesh, in August 2005. A voucher specimen has been deposited in the Laboratory of Natural Products Chemistry, Graduate School of Pharmaceutical Sciences, Chiba University, Japan.

The dried bark of *S. asoca* was ground into a coarse powder (195 g), which was extracted with 1.3 L MeOH to get the extract (14.7 g). Based on the medicinal uses, the extract was tested for antioxidant activity using DPPH radical-scavenging assay that showed a potent effect with an IC_{50} value of 25 μg/ml. The extract was then suspended in 440 ml 10% aqueous MeOH and partitioned successively with *n*-hexane, ethyl acetate (EtOAc) and *n*-butanol (*n*-BuOH) that afforded four extracts (*n*-hexane extract: 217 mg; EtOAc extract: 3.11 g; *n*-BuOH extract: 8.74 g; water extract: 2.87 g). Among them, EtOAc and *n*-BuOH extracts showed clear DPPH positive spots on thin-layer chromatography (TLC). These two extracts were then subjected to further separations by repeated-column chromatography. From the *n*-BuOH extract (4.0 g), compounds **1** (20 mg), **2** (16 mg), **3** (4 mg) and **4** (8 mg) were isolated. Compounds **1** (5 mg), **3** (2 mg), **5** (5 mg), **6** (20 mg), **7** (36 mg) and **8** (17 mg), together with β-sitosterol glucoside (12 mg) [7], were isolated from the EtOAc extract (3.0 g). Compounds **1**–**5** were lignan glycosides, which were identified as lyoniside $[\alpha]_D^{21}$ + 22 (c 1.0, MeOH) [8],

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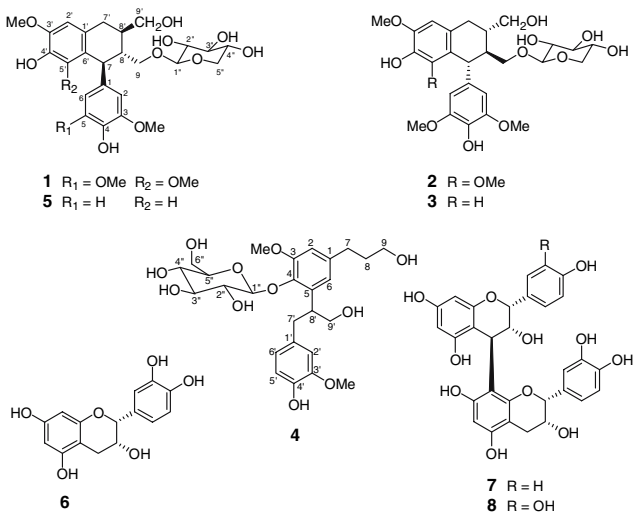

Fig. 1 Structures of compounds **1**–**8** from *Saraca asoca*

nudiposide $[\alpha]_D^{22} - 52$ (c 1.0, MeOH) [9], 5-methoxy-9-β-D-xylopyranosyl-(−)-isolariciresinol $[\alpha]_D^{19} - 40$ (c 1.0, MeOH) [10], icariside E_3 $[\alpha]_D^{22} - 57$ (c 2.0, MeOH) [11] and schizandriside $[\alpha]_D^{23} + 18$ (c 1.0, MeOH) [12], respectively (Table 1). The flavonoids **6**–**8** were identified as (−)-epicatechin $[\alpha]_D^{24} - 42$ (c 2.6, acetone) [13], epiafzelechin-(4β→8)-epicatechin $[\alpha]_D^{23} + 43$ (c 1.7, acetone) [14] and procyanidin B_2 $[\alpha]_D^{24} + 35$ (c 1.8, acetone) [15, 16], respectively, by comparison of their spectroscopic data with those in the literature. The lignan glycosides (**1**–**5**) were obtained from *S. asoca* for the first time. The IC_{50} values of DPPH radical-scavenging assay for compounds **1**–**8**, and the positive control quercetin were 104, 85, 44, 75, 55, 50, 55, 40 and 30 μM, respectively. In conclusion, all the isolated compounds exhibited moderate antioxidant activity that might be responsible together for the therapeutic efficacy of this herb.

Table 1 ^1H and ^{13}C nuclear magnetic resonance (NMR) spectroscopic data of compounds **1**–**5** (δ in ppm, J in Hz)

Position	1		2		3		4		5	
	C	H	C	H	C	H	C	H	C	H
1	139.4		139.6		137.9		140.3		138.6	
2	106.9	6.42 (1H, s)	106.8	6.40 (1H, s)	107.8	6.42 (1H, s)	111.7	6.71 (1H, brs)	114.2	6.77 (1H, d, 1.8)
3	149.0		148.9		149.1		153.1		148.9	
4	134.5		134.4		134.9		143.6		145.8	
5	149.0		148.9		149.1		138.6		116.1	6.73 (1H, d, 8.2)
6	106.9	6.42 (1H, s)	106.8	6.40 (1H, s)	107.8	6.42 (1H, s)	120.3	6.71 (1H, brs)	123.1	6.62 (1H, dd, 8.2, 1.8)
7	43.0	4.37 (1H, d, 6.7)	43.4	4.21 (1H, d, 7.0)	49.5	3.80 (1H, overlapped)	33.1	2.63 (2H, dd, 8.2, 7.4)	47.9	4.05 (1H, brd, 10.3)
8	46.7	2.00–2.06 (1H, m)	46.9	1.98–2.03 (1H, m)	45.5	1.90 (1H, tdd, 10.3, 4.3, 2.4)	35.6	1.81 (2H, m)	45.9	1.84 (1H, tt, 10.3, 2.8)
9	71.0	3.41 (1H, dd, 9.8, 3.7)	70.9	3.57 (1H, dd, 10.0, 4.9)	70.0	3.61 (1H, dd, 10.1, 2.4)	62.2	3.55 (2H, td, 6.4, 0.6)	69.3	3.21 (1H, dd, 10.1, 3.1)
		3.83 (1H, dd, 9.8, 4.9)		3.81 (1H, dd, 10.0, 4.6)		3.74 (1H, m)				3.97 (1H, dd, 10.1, 2.4)
1′	130.1		130.1		129.2		133.3		129.1	
2′	107.8	6.56 (1H, s)	107.6	6.56 (1H, s)	112.3	6.64 (1H, s)	113.6	6.55 (1H, d, 2.0)	112.3	6.64 (1H, s)
3′	148.6		148.6		147.3		148.4		147.1	
4′	138.9		138.9		145.3		145.3		145.1	
5′	147.6		147.5		117.3	6.19 (1H, s)	115.6	6.54 (1H, d, 8.0)	117.4	6.16 (1H, s)
6′	126.4		126.3		133.6		122.6	6.46 (1H, dd, 8.0, 2.0)	134.3	
7′	33.9	2.63 (1H, dd, 15.0, 11.3)	34.1	2.68 (2H, dd, 9.8, 6.5)	33.8	2.75 (1H, dd, 15.5, 4.6)	39.2	2.69 (1H, dd, 13.7, 9.5)	33.9	2.77–2.86 (2H, m)
		2.71 (1H, dd, 15.0, 4.6)				2.87 (1H, dd, 15.5, 11.6)		2.97 (1H, dd, 13.7, 5.2)		
8′	40.5	1.66–1.73 (1H, m)	40.6	1.67–1.74 (1H, m)	40.4	1.97–2.04 (1H, m)	42.8	3.92–3.98 (1H, m)	39.6	2.03–2.10 (1H, m)
9′	66.0	3.55 (1H, dd, 11.0, 6.7)	66.0	3.62 (2H, tlike, 4.3)	65.3	3.72 (1H, m)	67.1	3.65 (1H, dd, 10.7, 7.2)	65.1	3.76 (1H, dd, 11.0, 3.7)
		3.65 (1H, dd, 11.0, 4.3)				3.80 (1H, overlapped)		3.75 (1H, dd, 10.7, 6.1)		3.70 (1H, dd, 11.0, 6.1)
3-OMe	56.8	3.74 (3H, s)	56.7	3.74 (3H, s)	56.7	3.78 (3H, s)	56.3	3.79 (3H, s)	56.4	3.788 (3H, s)
5-OMe	56.8	3.74 (3H, s)	56.7	3.74 (3H, s)	56.7	3.78 (3H, s)				
3'-OMe	56.6	3.84 (3H, s)	56.5	3.84 (3H, s)	56.3	3.80 (3H, s)	56.2	3.68 (3H, s)	56.3	3.794 (3H, s)

Table 1 continued

Position	1		2		3		4		5	
	C	H	C	H	C	H	C	H	C	H
5'-OMe	60.0	3.31 (3H, s)	59.9	3.28 (3H, s)						
1″	105.5	4.21 (1H, d, 7.6)	105.0	4.09 (1H, d, 7.6)	104.8	4.02 (1H, d, 7.6)	105.6	4.61 (1H, d, 7.4)	105.8	4.04 (1H, d, 7.6)
2″	75.0	3.21 (1H, dd, 8.9, 7.6)	74.9	3.18 (1H, dd, 9.2, 7.6)	74.9	3.16 (1H, dd, 9.1, 7.6)	77.9	3.41 (1H, m)	75.0	3.18 (1H, dd, 9.2, 7.6)
3″	78.0	3.27–3.29 (1H, m)	78.0	3.26 (1H, overlapped)	78.0	3.24 (1H, dd, 9.8, 9.1)	75.9	3.43 (1H, m)	77.9	3.28 (1H, t, 8.9)
4″	71.3	3.47 (1H, ddd, 10.4, 9.0, 5.8)	71.3	3.47 (1H, ddd, 10.4, 8.9, 5.8)	71.3	3.46 (1H, ddd, 10.4, 9.8, 5.5)	71.2	3.37 (1H, m)	71.3	3.42–3.47 (1H, m)
5″	67.0	3.16 (1H, dd, 11.6, 10.4)	67.1	3.12 (1H, dd, 11.3, 10.4)	67.0	3.04 (1H, dd, 11.3, 10.4)	78.1	3.09–3.12 (1H, m)	66.9	3.11 (1H, dd, 11.3, 10.4)
		3.82 (1H, dd, 11.6, 5.8)		3.85 (1H, dd, 11.3, 5.8)		3.81 (1H, overlapped)				3.80 (1H, dd, 11.3, 5.8)
6″							62.5	3.67 (1H, overlapped)		
								3.78 (1H, overlapped)		

NMR was recorded in CD_3OD; ^1H NMR at 500 MHz and ^{13}C NMR at 125 MHz

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References

1. Ghani A (2003) Medicinal plants of Bangladesh with chemical constituents and uses. 2nd edn. Asiatic Society of Bangladesh, Dhaka
2. Indrani N, Balasubramanian K (1985) Isolation of condensed tannins from *Saraca ashoka*—part II. Leather Sci 32:12–13
3. Indrani N, Balasubramanian K (1985) Isolation of condensed tannins from *Saraca ashoka*—part I. Leather Sci 31:349–350
4. Middelkoop TB, Labadie RP (1985) Proanthocyanidins in the bark of *Saraca asoca* Roxb de Wilde. Z Naturforsch [B] 40B:855–857
5. Duggal JK, Misra K (1980) Leucoanthocyanidins from *Saraca asoca* stem bark. J Indian Chem Soc 57:1243
6. Sadhu SK, Okuyama E, Fujimoto H, Ishibashi M (2003) Separation of *Leucas aspera*, a medicinal plant of Bangladesh, guided by prostaglandin inhibitory and antioxidant activities. Chem Pharm Bull 51:595–598
7. Faizi S, Ali M, Saleem R, Irfanullah BS (2001) Complete ^1H and ^{13}C NMR assignments of stigma-5-en-3-*O*-β-glucoside and its acetyl derivative. Magn Reson Chem 39:399–405
8. Dada G, Corbani A, Manitto P, Speranza G, Lunazzi L (1989) Lignan glycosides from the heartwood of European oak *Quercus petraea*. J Nat Prod 52:1327–1330
9. Inoshiri S, Sasaki M, Kohda H, Otsuka H, Yamasaki K (1987) Aromatic glycosides from *Berchemia racemosa*. Phytochemistry 26:2811–2814
10. Vecchietti V, Ferrari G, Orsin F, Pelizzoni F (1979) Alkaloid and lignan constituents of *Cinnamosa madagascariensis*. Phytochemistry 18:1847–1849
11. Miyase T, Ueno A, Takizawa N, Kobayashi H, Oguchi H (1988) Studies on the glycosides of *Epimedium grandiflorum* Morr var *thunbergianum* (Miq.) Nakai III. Chem Pharm Bull 36:2475–2484
12. Takani M, Ohya K, Takahashi K (1979) Studies on constituents of medicinal plants. XXII. Constituents of *Schizandra nigra* Max (4). Chem Pharm Bull 27:1422–1425
13. Shen CC, Chang YS, Ho LK (1993) Nuclear magnetic resonance studies of 5,7-dihydroxyflavonoids. Phytochemistry 34:843–845
14. Kashiwada Y, Iizuka H, Yoshioka K, Chen RF, Nonaka G, Nishioka I (1990) Tannins and related compounds. XCIII. Occurrence of enantiomeric proanthocyanidins in the Leguminosae plants, *Cassia fistula* L. and *C javanica* L. Chem Pharm Bull 38:888–893
15. Fletcher AC, Porter LJ, Haslam E, Gupta RK (1977) Plant proanthocyanidins. Part 3. Conformational and configurational studies of natural procyanidins. J Chem Soc Perkin Trans I:1628–1637
16. Nonaka GI, Nishioka I, Nagasawa T, Oura H (1981) Tannins and related compounds I Rhubarb. Chem Pharm Bull 29:2862–2870