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RESEARCH ARTICLE

Isolation of flavonoids from the bark of *Entada rheedii* Spreng

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Abstract The methanol extract of the bark of *Entada rheedii* has been fractionated to afford petroleum ether, dichloromethane, ethyl acetate and aqueous soluble fraction through modified Kupchan partitioning protocol and those fractions has been subjected to repeated-chromatographic separation by Sephadex size exclusion chromatography and purification processes to isolate the secondary metabolites. A total of seven compounds have been isolated from the bark of *E. rheedii*, which were identified as epicatechin (1), liquiritigenin (2), glabridin (3), 4′-*O*-methylglabridin (4), isoliquiritigenin (5), hispaglabridin A (6) and shinflavanone (7). This is the first report of isolation of these compounds from *E. rheedii*.

Keywords *Entada rheedii* · Isoliquiritigenin · Epicatechin · Glabridin · 4′-*O*-methylglabridin · Hispaglabridin A · Liquiritigenin · Shinflavanone

Introduction

Entada rheedii Spreng. (Fam.: Fabaceae) (Mona et al. 2013) is a woody climber shrub (Ahmed 2009) that grows naturally in Africa, Australia, tropical Asia and a small part of the pacific islands, Malay Peninsula, Indonesia, the Philippines and New Guinea. Khulna, Sylhet and Chittagong hill tracts of Bangladesh are the area where this species is commonly found (Uddin 2006). Locally it is called Gila or Gilagachh (Ahmed 2009).

Scabies is cured by infusion of *E. rheedii* bark in Tanzania (Brink and Achigan-Dako 2012). Pains and itch are mitigated by bark and seeds of *E. rheedii* in South-East Asia (Brink and Achigan-Dako 2012). As a good fiber, bark of *E. rheedii* is used for tying and making fish lines (Brink and Achigan-Dako 2012).

Phytochemical investigation of bark of *E. rheedii* has not yet done extensively. Although seed kernels of *E. rheedii* have been reported to contain tryptophan derivatives, triterpenoid saponins (rheediinoside A and B) (Nzowa et al. 2010), tryptorheedei A and tryptorheedei B (Nzowa et al. 2013), oleanane-type triterpene oligoglycosides (rheedeiosides A, B, C and D), thioamide glycoside and *cis*-entadamide A-β-D-glucopyranoside (Sugimoto et al. 2011).

As a part of our methodical studies on medicinal plants of Bangladesh (Dey et al. 2013; Haque et al. 2005; Ara et al. 2012), we studied *E. rheedii* and report isolation of seven compounds for the first time from this plant.

Materials and methods

General experimental procedures

The ^{1}H NMR and ^{13}C NMR spectrum was recorded using Bruker AMX-400 (400 MHz for ^{1}H and 100 MHz for ^{13}C) instrument in deuterated chloroform ($CDCl_3$) or deuterated methanol (CD_3OD) and the δ values are reported relative to the residual non-deuterated solvent signals. Analytical thin layer chromatography (TLC) was carried out on pre coated (TLC Silica gel 60 F_{254}-Merck KGaA) plates and spots were

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visualized by using UV light and 1 % vanillin/H_2SO_4 reagents.

Plant materials

Fresh bark of *E. rheedii* was collected from Sylhet, Bangladesh in June 2013. The exsiccated plant samples were identified by Mr. Sarder Nasir Uddin, Principal Scientific officer, Bangladesh National Herbarium, Mirpur, Dhaka where voucher specimens for this plant have been conserved for future reference (Accession number: DACB-38640).

Extraction and isolation

The sun dried and powdered materials (1.117 kg) were extracted with 2.5 l of methanol: dichloromethane (DCM) in 1:1 ratio solvent system at room temperature for 20 days with occasional shaking and stirring. The whole mixture was then filtered off through a filter paper and concentrated with a rotary evaporator at reduced temperature (45 °C) and pressure. The filtrate thus obtained was a brownish gummy concentrate of 83.43 g (percent of yield=7.47 %). A portion (25 g) of the concentrated extract which was then fractionated by the modified Kupchan partitioning protocol (Vanwagenen et al. 1993) to afford petroleum ether (5.39 g), dichloromethane (7.05 g), ethyl acetate (3.25 g) and aqueous (8.21 g) soluble materials.

Ethyl Acetate soluble fraction was subjected to Sephadex LH-20 size exclusion chromatography eluted with dichloromethane: methanol in 1:1 ratio solvent system. A total of 50 fractions were collected and screened on TLC plate. Fractions number 12–15 were screened on TLC plate and found to give identical spots. These four fractions were mixed together & subjected to preparative thin layer chromatography (PTLC). From the developed plates one band was isolated and eluted using 100 % ethyl acetate then 100 % methanol. This band yielded Epicatechin (**1**).

Dichloromethane soluble fraction was subjected to Sephadex LH-20 size exclusion chromatography using the solvent system of *n*-hexane: dichloromethane: methanol in 2:5:1 ratio for elution. A total of 50 fractions were collected and screened on TLC plate. From the TLC plate characteristics, fractions 5–7, 9–10, 11–12, 13–14, 26–32, 37–42 and 43–45 were selected and bulked for further purification. After repeated preparative thin layer chromatography (PTLC) over silica gel (Kieselgel 60 F_{254}) the fractions afforded liquiritigenin (**2**), glabridin (**3**), 4′-*O*-methylglabridin (**4**), isoliquiritigenin (**5**), hispaglabridin A (**6**) and shinflavanone (**7**), respectively.

Spectroscopic properties of compounds

Epicatechin (**1**); Brownish amorphous powder; R_f=0.31 in methanol: chloroform (4:96). ^{1}H NMR (400 MHz, CD_3OD): δ 4.59 (1H, *s*, H-2), 4.20 (1H, *s*, H-3), 2.87 (1H, *dd*, *J*=4.4, 17 Hz, H-4β), 2.73 (1H, *br. d*, H-4α), 5.95 (1H, *s*, H-6), 5.93 (1H, *s*, H-8), 6.99 (1H, *s*, H-2′), 6.77 (1H, *d*, *J*=8.2 Hz, H-5′), 6.81 (1H, *d*, *J*=8.2 Hz, H-6′).

^{13}C NMR (100 MHz, CD_3OD): δ 78.49 (C-2), 66.09 (C-3), 27.84 (C-4), 98.69 (C-4a), 157.1 (C-6), 95.02 (C-6), 157.0 (C-7), 94.5 (C-8), 157.0 (C-8a), 130.89 (C-1′), 113.93 (C-2′), 145.0 (C-3′), 145.0 (C-4′), 114.5 (C-5′), 118.0 (C-6′).

Liquiritigenin (**2**); Colorless crystal; R_f=0.26 in ethyl acetate: toluene (6:94). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.39 (1H, *dd*, *J*=13.2, 2.8 Hz, H-2), 3.04 (1H, *dd*, *J*=17.2, 13.2 Hz, H-3α), 2.78 (1H, *dd*, *J*=17.2, 2.8 Hz, H-3β), 7.85 (1H, *d*, *J*=8.4 Hz, H-5), 6.52 (1H, *dd*, *J*=8.4, 2.4 Hz, H-6), 6.43 (1H, *d*, *J*=2.4 Hz, H-8), 7.35 (2H, *d*, *J*=8.4 Hz, H-2′,6′), 6.88 (2H, *d*, *J*=8.4 Hz, H-3′,5′).

Glabridin (**3**); Yellowish powder; R_f=0.36 in ethyl acetate: toluene (6:94). ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.36 (1H, *dd*, *J*=10, 2 Hz, H-2*eq*), 4.03 (1H, *t*, *J*=10 Hz, H-2*ax*), 3.46 (1H, *m*, H-3), 2.86 (1H, *dd*, *J*=15.6, 2 Hz, H-4*eq*), 2.98 (1H, *dd*, *J*=15.6, 10 Hz, H-4*ax*), 6.83 (1H, *d*, *J*=8.4 Hz, H-5), 6.37 (1H, *d*, *J*=8.4 Hz, H-6), 6.32 (1H, *d*, *J*=2.4 Hz, H-3′), 6.39 (1H, *dd*, *J*=8.4, 2.4 Hz, H-5′), 6.96 (1H, *d*, *J*=8.4 Hz, H-6′), 6.65 (1H, *d*, *J*=10 Hz, H-1″), 5.56 (1H, *d*, *J*=10 Hz, H-2″), 1.43 (3H, *s*, H-4″), 1.42 (3H, *s*, H-5″), 4.70 (1H, *s*, OH-2′), 4.86 (1H, *s*, OH-4′).

4′-O-methylglabridin (**4**); White needles; R_f=0.72 in ethyl acetate: toluene (5:95). ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.37 (1H, *dd*, *J*=10.4, 5.2 Hz, H-2*eq*), 4.03 (1H, *t*, *J*=10.4 Hz, H-2*ax*), 3.46 (1H, *m*, H-3), 2.89 (1H, *d*, *J*=5.2 Hz, H-4*eq*), 2.97 (1H, *d*, *J*=10.4 Hz, H-4*ax*), 6.82 (1H, *d*, *J*=8.4 Hz, H-5), 6.37 (1H, *d*, *J*=8.4 Hz, H-6), 6.36 (1H, *d*, *J*=2.4 Hz, H-3′), 6.49 (1H, *dd*, *J*=8.4, 2.4 Hz, H-5′), 7.02 (1H, *d*, *J*=8.4 Hz, H-6′), 6.65 (1H, *d*, *J*=10 Hz, H-1″), 5.56 (1H, *d*, *J*=10 Hz, H-2″), 1.43 (3H, *s*, H-4″), 1.41 (3H, *s*, H-5″), 3.77 (3H, *s*, OCH_3-4′), 4.78 (1H, *s*, OH-2′).

Isoliquiritigenin (**5**); Amorphous yellowish powder; R_f= 0.32 in ethyl acetate: toluene (6:94). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.45 (1H, *d*, *J*=15.2 Hz, H-α), 7.86 (1H, *d*, *J*= 15.6 Hz, H-β), 7.59 (2H, *d*, *J*=8.8 Hz, H-2,6), 6.89 (2H, *d*, *J*=8.8 Hz, H-3,5), 6.42 (1H, *d*, *J*=2.0 Hz, H-3′), 6.44 (1H, *m*, H-5′), 7.84 (1H, *d*, *J*=8.8 Hz, H-6′), 13.94 (1H, *s*, OH-2′), 5.03 (1H, *s*, OH-4), 5.30 (1H, *s*, OH-4′).

Hispaglabridin A (**6**); White needles; R_f=0.68 in ethyl acetate: toluene (5:95). ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.38 (1H, *br. dd*, *J*=10.5 Hz, H-2*eq*), 4.00 (1H, *t*, *J*=10.5 Hz, H-2*ax*), 3.46 (1H, *m*, H-3), 2.86 (1H, *ddd*, *J*=15.0, 5.2, 2 Hz, H-4*eq*), 2.95 (1H, *dd*, *J*=15.0, 10.5 Hz, H-4*ax*), 6.82 (1H, *d*, *J*=8.4 Hz, H-5), 6.37 (1H, *d*, *J*=8.4 Hz, H-6), 6.37 (1H, *d*, *J*=8.4 Hz, H-5′), 6.82 (1H, *d*, *J*=8.4 Hz, H-6′), 6.65 (1H, *d*, *J*=9.6 Hz, H-1″), 5.56 (1H, *d*, *J*=9.6 Hz, H-2″), 1.41 (3H, *s*, H-4″), 1.43 (3H, *s*, H-5″), 3.45 (2H, *d*, *J*=7.2 Hz, H-1‴), 5.27 (1H, *br. t*, *J*=7.2 Hz, H-2‴), 1.79 (3H, *s*, H-4‴), 1.86 (3H, *s*, H-5″), 5.52 (1H, *s*, OH-2′), 4.75 (1H, *s*, OH-4′).

Shinflavanone (**7**); Oily compound; R_f=0.67 in ethyl acetate: toluene (5:95). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.38 (1H, *dd*, *J*=13.2, 2.8 Hz, H-2), 2.80 (1H, *dd*, *J*=16.8, 3.2 Hz, H-3a), 3.02 (1H, *dd*, *J*=16.8, 13.2 Hz, H-3b), 7.74 (1H, *d*, *J*=8.8 Hz, H-5), 6.49 (1H, *d*, *J*=8.8 Hz, H-6), 7.20 (1H, *br.s*, H-2′), 6.86 (1H, *d*, *J*=8 Hz, H-5′), 7.45 (1H, *d*, *J*= 8 Hz, H-6′), 6.64 (1H, *d*, *J*=10 Hz, H-1″), 5.37 (1H, *d*, *J*= 10 Hz, H-2″), 1.43 (3H, *s*, H-4″), 1.47 (3H, *s*, H-5″), 3.40 (2H, *d*, *J*=6.8 Hz, H-1‴), 5.32 (1H, *m*, H-2‴), 1.79 (3H, *s*, H-4‴), 1.80 (3H, *s*, H-5″), 5.20 (1H, *s*, OH-4′).

Results

A total of seven compounds (**1**–**7**) have been identified (Fig. 1) from ethyl acetate and dichloromethane soluble fractions obtained by modified Kupchan partitioning (Vanwagenen et al. 1993) of the methanolic extract of *E. rheedii* bark. The structures of these compounds were identified as epicatechin (**1**), liquiritigenin (**2**), glabridin (**3**), 4′-*O*-methylglabridin (**4**), isoliquiritigenin (**5**), hispaglabridin A (**6**) and shinflavanone (**7**) on the basis of analysis of spectral data and comparison of their ^{1}H NMR data with published values.

Discussion

Compound **1** was isolated as brownish amorphous powder. The ^{1}H NMR (400 MHz, CD_3OD) spectrum of compound **1** showed a number of characteristic signals of epicatechin (Davis et al. 1996). Two signals at δ 5.95 (*s*) and 5.93 (*s*) were due to two phenyl protons situated at 1,3 position to each other on ring A. Two signals at δ 6.81 (1H, *br d*, *J*=8.2Hz) and 6.77 (1H, *d*, *J*= 8.2 Hz) were due to two aromatic protons situated at 1,2 position to each other on ring B and a signal at δ 6.99 (*s*) was due to another phenyl proton at *ortho* position on ring B. A *singlet* at δ 4.20 was due to methine proton (H-3) having an adjacent hydroxyl group and situated between methylene and a methine carbon in ring C. Another *singlet* at δ 4.59 (*s*) was for the methine proton attached with an oxygen atom and CHOH group. A *doublet* of *doublets* resonating at δ 2.87 (1H, *dd*, *J*=4.4, 17.0 Hz) and a broad *doublet* at δ 2.73 (*br. d*) were due to two methylene protons adjacent to a methine carbon(C-4). The ^{13}C NMR data of compound **1** showed 15 carbons which were identical to the published values for epicatechin (Davis et al. 1996). The DEPT spectra revealed the presence of one methylene, seven methine and seven quaternary carbons. The HMBC experiment also showed strong correlations (Table 1) between protons and carbons of **1**. This is the first report of epicatechin from this species.

Compound **2** was obtained as colorless crystals and was identified as liquiritigenin (Konga et al. 2000). The ^{1}H NMR showed signals for a dihydroflavone: ABX-type aromatic unit at δ 7.85 (1H, *d*, *J*=8.4 Hz, H-5), 6.52 (1H, *dd*, *J*=8.4, 2.4 Hz, H-6) and 6.43 (1H, *d*, *J*=2.4 Hz, H-8) due to the A ring. The spectrum also displayed AA′BB′-type aromatic unit at δ 7.35 (2H, *d*, *J*=8.4 Hz, H-2′, 6′) and 6.88 (2H, *d*, *J*=8.4 Hz, H-3′, 5′) due to the B ring. The aliphatic proton signals at δ 5.39 (1H, *dd*, *J*=2.8, 13.2 Hz, H-2), 3.04 (1H, *dd*, *J*=13.2, 17.2 Hz, H-3α) and 2.78 (1H, *dd*, *J*=2.8, 17.2 Hz, H-3β) were attributed to a -CH-CH_2- system. On this basis and comparison of the ^{1}H NMR data with published values (Konga et al. 2000) **2** was established liquiritigenin. This is the first record of liquiritigenin from this plant.

Fig. 1 Structures of **1**–**7**

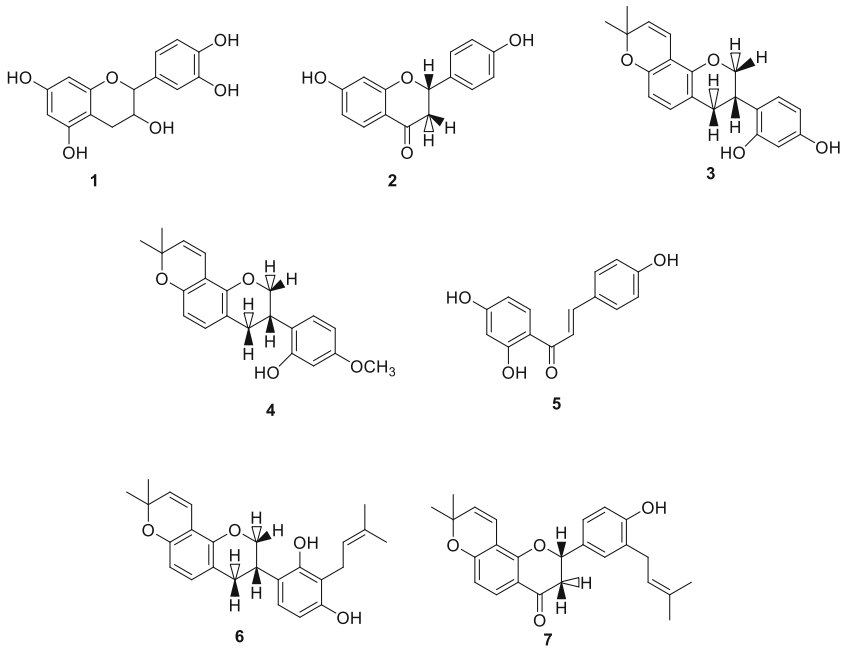

Table 1 NMR, Chemical Shifts & HMBC correlations observed of compound 1

Position	δ_H in ppm (*J* in Hz)	δ_C	HMBC
H-4α	2.73 *br. d*	27.84	C-4a (98.69), C-2(78.49), C-3 (66.09)
H-8	5.93 *s*	94.5	C-8a (157.0), C-4a (98.69), C-6 (95.02)
H-2′	6.99 *s*	113.93	C-3′ (145.0), C-6′ (118.0)
H-5′	6.77 *d* (8.2)	114.50	C-2 (78.49), C-1′ (130.89)
H-6′	6.81 *d* (8.2)	118.00	C-2 (78.49), C-5′ (114.50)

Compound **3** was isolated as yellowish powder and was identified as glabridin (Yoo and Nahm 2007). The ^{1}H NMR spectrum (400 MHz, $CDCl_3$) showed two *singlets* at δ 1.42 (1 × CH_3) and 1.43 (1 × CH_3), a pair of *doublets* (*J*=10 Hz) at δ 5.56 and δ 6.65, which indicated the presence of a chromene ring. The signals for five aromatic protons appeared as AB system (a pair of *doublets* with *J*=8.4 Hz at δ 6.37 and 6.83) and ABM system (a *doublet* with *J*=2.4 Hz, a double *doublet* with *J*=2.4 and 8.4 Hz, and a *doublet* with *J*=8.4 Hz at δ 6.32, 6.39 and 6.96 respectively). The signals for proton on a hetero cyclic ring were observed at δ 4.36 (1H, double *doublet*, *J* =10, 2 Hz), 4.03 (1H, *triplet*, *J*=10 Hz), 3.46 (1H, *multiplet*), 2.98 (1H, double *doublet*, *J*=15.6, 10 Hz) and 2.86 (1H, double *doublet*, *J*=15.6, 2 Hz) as ABMXX′ system, which would be assigned to H-2 (*eq.*, *ax.*), H-3 (*ax.*) and H-4 (*ax.*, *eq.*) protons of an isoflavan skeleton, respectively. The location, the hydroxyls at 2′ and 4′ (δ 4.70 and 4.86), was revealed by the spitting pattern (ABM) of the aromatic protons in the NMR spectrum. Compound **3** was identified as glabridin by comparison of the ^{1}H NMR spectral data with those published for this compound (Yoo and Nahm 2007). Glabridin has been isolated from *E. rheedii* for the first time.

Compound **4** was obtained as white needles and was identified as 4′-*O*-methylglabridin (Mitscher et al. 1980). The ^{1}H NMR showed two *singlets* at δ 1.41 (1 × CH_3) and 1.43 (1 × CH_3), a pair of *doublets* at δ 5.56 and 6.65 (1H, *J*=10 Hz), indicated the presence of a chromene ring. The signals of five aromatic protons showed couplings of AB system (a pair of *doublets* with *J*=8.4 Hz at δ 6.37 and 6.82) and ABM system (a *doublet* with *J*=2.4 Hz, a double *doublet* with *J*=2.4 and 8.4 Hz, and a *doublet* with *J*=8.4 Hz at δ 6.36, 6.49 and 7.02 respectively). The signals of a hetero ring were observed at δ 4.37 (1H, *dd*, *J*=10.4, 5.2 Hz), 4.03 (1H, *t*, *J*=10.4 Hz), 3.46 (1H, *m*), 2.97 (1H, *d*, *J*=10.4 Hz) and 2.89 (1H, *d*, *J*=5.2 Hz) as ABMXX′ system, which would be assigned to H-2 *(eq., ax.*), H-3 (*ax.*) and H-4 (*ax., eq.*) protons of an isoflavan skeleton, respectively. These ^{1}H NMR data are in close agreement with that of glabridin except two *singlets* at δ 4.78 (1H, *s*) and 3.77 (3H, *s*). The earlier *singlet* can be attributed as the aromatic hydroxyl group at 2′ and the later as methoxy group at 4′ position. On this basis of above spectral data compound **4** was characterized as 4′-*O*-methylglabridin. The identity which is validated by comparison of ^{1}H NMR with the published values (Mitscher et al. 1980). This is the first report of isolation of 4′-*O*-methylglabridin from this plant.

Compound **5** was isolated from the dichloromethane extract as an amorphous yellowish powder and was identified as isoliquiritigenin (Sato et al. 2007). The ^{1}H NMR data of compound **5** exhibited signals for an ABX-type aromatic unit at δ 7.84 (1H, *d*, *J*=8.8 Hz, H-6′), 6.44 (1H, *m*, H-5′) and 6.42 (1H, *d*, *J*=2.0 Hz, H-3′) due to the A ring; AA′BB′-type aromatic unit at δ 7.59 (2H, *d*, *J*= 8.8 Hz, H-2,6) and 6.89 (2H, *d*, *J*=8.8 Hz, H-3,5) due to the B ring; the olefinic proton signals at δ 7.86 (1H, *d*, *J*=15.6 Hz), and 7.45 (1H, *d*, *J*=15.2 Hz) were attributed to positions β and α of a chalcone skeleton, and the coupling constant of ~15.4 Hz between H-α and H-β revealed that the olefinic system had a *trans* geometry. Comparison of the ^{1}H NMR with previously reported spectral data (Sato et al. 2007) compound **5** was established isoliquiritigenin. This is the first report of isoliquiritigenin from *E. rheedii*.

Compound **6** was obtained as white needles and was identified as hispaglabridin A (Mitscher et al. 1980). The ^{1}H NMR showed two *singlets* at δ 1.41 (1 × CH_3) and 1.42 (1 × CH_3), a pair of *doublets* at δ 5.56 and 6.65 (1H, *J*=9.6 Hz), indicating the presence of a chromene ring system. The signals for four aromatic protons showed couplings of AB system which include a pair of *doublets* (each of 2H intensity) with *J*=8.4 Hz at δ 6.37 and 6.82. The signals for protons of a hetero ring were observed at δ 4.38 (1H, *br.d*, *J*=10.5 Hz), 4.00 (1H, *t*, *J*=10.5 Hz), 3.46 (1H, *m*), 2.95 (1H, *dd*, *J*=15.0, 10.5 Hz) and 2.86 (1H, *ddd*, *J*=15.0, 5.2, 2 Hz) as ABMXX′ system, which would be assigned to H-2 (*eq., ax.*), H-3 (*ax.*) and H-4 (*ax., eq.*) protons of an isoflavan skeleton, respectively. The existence of a dimethylallyl moiety, which was confirmed from two vinylic methyl groups (δ 1.79 and l.86) and an A_2M system δ 3.45 (2H, *d*, *J*=7.2 Hz) and 5.27 (1H, *br. t*, *J*=7.2 Hz). Additional presence of the hydroxyls at (δ 4.75 and δ 5.52), the splitting pattern (AB) of the aromatic protons in the NMR spectrum suggested a tetra substituted prenylated phenolic moiety. Other than the dimethylallyl moiety, compound **6** was in close resemblance with established structure of glabridin. On this basis and comparison of ^{1}H NMR with published values

(Mitscher et al. 1980) compound **6** was identified as hispaglabridin A. and which is first record from *E. rheedii*.

Compound **7** was isolated as oily compound and was identified as shinflavanone (Kitagawa et al. 1994). The ^{1}H NMR data of compound **7** showed the signals for typical A_2B pattern at δ 2.80 (1H, *dd*, *J*=16.8, 3.2 Hz), 3.02 (1H, *dd*, *J*=16.8, 13.2 Hz), and 5.38 (1H, *dd*, *J*=13.2, 2.8 Hz) which were assignable to H-3 and H-2 in the flavanone skeleton. Two *singlets* at δ 1.43 (1 × CH_3) and 1.47 (1 × CH_3), a pair of *doublets* at δ 5.37 and 6.64 (1H, *J*=10 Hz), indicated the existence of a 6,6-dimethylpyran unit. The *ortho*-coupled proton signals at δ 6.49 and 7.74 (1H, *d*, *J*=8.8 Hz) suggested that the 6,6-dimethylpyran unit was fused to A ring of a pyranoflavanone structure. Furthermore, three aromatic proton signals observed at δ 6.86 (1H, *d*, *J*=8 Hz), 7.20 (1H, *br. s*), and 7.45 (1H, *d*, *J*=8 Hz) suggested the existence of a 1,2, 4-trisubstituted benzene ring. Additionally, the NMR spectrum showed the presence of a phenolic group (at δ 5.20) and a dimethylallyl moiety, which was confirmed from two vinyl methyl groups (δ 1.79 and l.80) and an A_2M system δ 3.40 (2H, *d*, *J*=6.8 Hz) and 5.32 (1H, *m*). This allowed characterizing compound **7** as shinflavanone. This identity of which further substantiated by comparison with published values (Kitagawa et al. 1994). Shinflavanone has been isolated from *E. rheedii* for the first time.

Conclusion

Entada rheedii, a species of Fabaceae grown in Bangladesh has not been studied extensively. The phytochemical investigations of *E. rheedii* bark was conducted to isolate secondary metabolites from it which might be important lead for medicinal interest. Extractions with organic solvent and fractionation of the extractives by using chromatographic techniques have led to the isolation of seven compounds from this plant species for the first time. The isolated compounds have to be further investigated to explore its medicinal value.

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Compliance with ethical standards

Ethical Statement The objectivity and transparency in research have been ensured and accepted principles of ethical policies of Oriental Pharmacy and Experimental Medicine have been followed. The experiment does not involve any human or animal subjects.

Conflict of Interest The authors declare no conflict of interest.

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