

## Note

### Isomeric phenylpropanoid from *Stereospermum suaveolens* (Roxb.) DC growing in Bangladesh

Md Moniruzzaman<sup>a</sup>, A M Sarwaruddin Chowdhury<sup>a</sup>, Sania Ashrafi<sup>b</sup>, Choudhury Mahmood Hasan<sup>b</sup>, M Aftab Uddin<sup>c</sup>, Mohammad Sharifur Rahman<sup>b</sup> & Mohammad A Rashid<sup>\*b</sup>

<sup>a</sup>Department of Applied Chemistry & Chemical Engineering,  
Faculty of Engineering and Technology,  
University of Dhaka, Dhaka-1000, Bangladesh

<sup>b</sup>Department of Pharmaceutical Chemistry,  
Faculty of Pharmacy, University of Dhaka,  
Dhaka-1000, Bangladesh

<sup>c</sup>Department of Genetic Engineering and Biotechnology,  
Faculty of Biological Sciences,  
University of Dhaka, Dhaka-1000, Bangladesh

E-mail: monirjaman32@gmail.com, sarwar@du.ac.bd,  
sania.ashrafi@du.ac.bd, cmhasan@gmail.com, aftabu@du.ac.bd,  
msr@du.ac.bd, arpharm64@du.ac.bd

Received 25 April 2024; accepted (revised) 5 August 2024

Plants have long been a crucial source of bioactive compounds for developing innovative therapeutics against various diseases. The research aimed to explore the natural compound composition of methanol extracts from the leaves and stem bark of *Stereospermum suaveolens* (Roxb.) DC (Family: Bignoniaceae) through repeated chromatographic separation and purification processes using silica gel. The phytochemical investigation led to the identification of two isomeric phenylpropanoids, namely 4-methoxy-*cis*-cinnamic acid (**1**) and 4-methoxy-*trans*-cinnamic acid (**2**). The chemical structures of these isolated compounds have been determined by using the data obtained from <sup>1</sup>H and <sup>13</sup>C NMR, COSY, HSQC and HRMS, and have been confirmed by comparing the results with published reports. Notably, this marks the first reported instance of the isolation of the isomeric 4-methoxycinnamic acids from any plant species so far.

**Keywords:** *Stereospermum suaveolens*, Phenylpropanoid, Cinnamic acid derivatives, Secondary metabolites

Studying medicinal plants is crucial for advancing healthcare. With a rich history of traditional use across cultures, these plants offer valuable therapeutic potential. Research on their chemical composition and biological activities can uncover active compounds, informing the development of new drugs or natural remedies<sup>7,8</sup>.

*Stereospermum suaveolens* (Roxb.) DC, belonging to the Bignoniaceae family, is a large deciduous plant native to Bangladesh, India, and Myanmar, particularly

found in the hilly areas of Chattogram, Bangladesh, where it is known locally as Parul or Atkopali. This plant has a rich history of traditional use in Ayurvedic medicine for treating various ailments. Its extracts have been reported to exhibit diverse therapeutic properties, including anti-inflammatory, analgesic, anticancer, anti-hyperglycemic, antioxidant, and antidiabetic effects. Past phytochemical investigations have identified several compounds, such as lapachol, scutellarein, stereolensin, sterekunthal B, dinatin, dinatin-7-glucuroniside, stereocheols A and B, fridelin,  $\beta$ -sitosterone,  $3\beta$ -friedelanol,  $\beta$ -amyrone, stigmaterol, glyceryl tricaprates, 3,4-dimethoxy *cis*-caffeic acid,  $\beta$ -amyrin and 4-methoxycinnamic acid<sup>1,2</sup>. In this current study, two isomeric phenylpropanoids, namely 4-methoxy-*cis*-cinnamic acid (**1**) and 4-methoxy-*trans*-cinnamic acid (**2**), were isolated and characterized from *S. suaveolens*.

### Experimental Section

Leaves and stem bark of *S. suaveolens* were gathered from Baldha Garden, Dhaka, Bangladesh, in October 2015. The plant samples underwent air drying and were subsequently ground into a coarse powder using a grinding machine. A total of 350 g of the powdered *S. suaveolens* materials were mixed, macerated in 2.5 L of methanol for 15 days, and then filtered through Whatman filter paper. The resulting filtrate was concentrated using a rotary evaporator at 40°C under reduced pressure. Approximately 5 g of the concentrated extract was subjected to solvent-solvent partitioning, following the modified Kupchan method<sup>9</sup>, resulting in hexane, carbon tetrachloride, chloroform, and aqueous soluble fractions.

The carbon tetrachloride soluble partitionate of the methanol extract was individually subjected to fractionation over gel permeation chromatography with lipophilic Sephadex (LH-20) was resulted in 25 fractions of 10 mL each. Through repeated preparative TLC of sub-fractions 17-19 from the carbon tetrachloride soluble fraction over silica gel, utilizing an ethyl acetate and toluene mobile phase (40:60), compounds **1** and **2** were obtained. These two compounds were also identified in the chloroform soluble fraction.

Preparative thin-layer chromatography (PTLC) was conducted on pre-coated plates (TLC, Silica gel 60 F<sub>254</sub>) to purify the compounds. The detection of pure

compounds on TLC and PTLC plates was accomplished by spraying with vanillin-sulfuric acid, followed by heating for 5 min at 110°C.

## Results and Discussion

Repeated chromatographic separation and purification of the methanol extract of leaf and stems of *S. suaveolens* provided two compounds, the structures of which were determined by extensive NMR studies.

Compound **1** was obtained as white crystalline powder. The  $^1\text{H}$  NMR spectrum (400 MHz,  $\text{CDCl}_3$ , Fig. 1) (Fig. S1 and S2; Table 1) of compound **1** exhibited two doublets ( $J = 8.4$  Hz) centered at  $\delta$  6.90 (H-3/H-5) and 7.58 (H-2/H-6), each integrated for two protons for a *para* disubstituted aromatic moiety. Two additional doublets ( $J = 12.4$  Hz) at  $\delta$  7.75 (H-7) and 5.87 (H-8) subsequently confirmed the presence of a pair of *cis*-coupled olefin protons. The spectrum also exhibited a singlet of three proton intensity at  $\delta$  3.86 for a methoxy group at the *para*-position of the aromatic ring. The  $^1\text{H}$ - $^1\text{H}$  COSY spectrum (Fig. S4 and S5) showed the presence of three cross peaks, which indicated the correlation of the proton between H-7 ( $\delta$  7.75) and H-8 ( $\delta$  5.87), H-2 ( $\delta$  7.58) and H-3 ( $\delta$  6.90) also H-5 ( $\delta$  6.90) and H-6 ( $\delta$  7.58). The HQSC spectrum (Fig. S6) of this compound showed the single broad correlations between the protons with its attached carbon. The  $^{13}\text{C}$  NMR (Fig. S3) and DEPT-135 spectrum (100 MHz,  $\text{CDCl}_3$ ) of this compound exhibited presence of total ten (10) carbons containing eight olefin carbons at  $\delta$  127.06 (C-1), 130.09 (C-2), 114.43 (C-3), 160.73 (C-4), 113.54 (C-5), 132.53 (C-6), 145.73 (C-7), 115.80 (C-8), a carboxylic group carbon at  $\delta$  170.08 and a methoxy group carbon at  $\delta$  55.32. The electro spray ionization

(ESI) mass spectrum (Fig. S7) of this compound exhibited the pseudo molecular ion peak for  $[\text{M}+\text{H}]^+$  at  $m/z$  179.075, appropriate for a molecular formula  $\text{C}_{10}\text{H}_{10}\text{O}_3$ . On this basis, it was characterized as 4-methoxy-*cis*-cinnamic acid and it was found consistent with the previously published literature<sup>3</sup>.

Compound **2** was also obtained as white crystalline powder.  $^1\text{H}$  NMR spectrum (400 MHz,  $\text{CDCl}_3$ ) (Fig. S8 and S9; Table 1) of compound **2** exhibited two doublets centered at  $\delta$  6.94 (H-3/H-5, 8.4 Hz) and  $\delta$  7.53 (H-2/H-6, 8.8 Hz), integrated for two protons each. Two additional doublets at  $\delta$  7.74 (16.0 Hz, H-7) and  $\delta$  6.32 (16.0 Hz, H-8), respectively revealed the existence of a pair of *trans*-coupled olefin protons. The spectrum also exhibited a three-proton intensity singlet at  $\delta$  3.87 indicative of a methoxy group at the *para*-position of the aromatic ring.  $^{13}\text{C}$  NMR spectrum (100 MHz,  $\text{CDCl}_3$ ) (Fig. S10) of this compound showed presence of total ten carbons containing eight olefin carbons at  $\delta$  126.84 (C-1), 130.09 (C-2), 114.47 (C-3), 161.78 (C-4), 115.80 (C-5), 132.53 (C-6), 146.70 (C-7), 113.54 (C-8), a carboxylic group carbon at  $\delta$  171.53 and a methoxy group carbon at  $\delta$  55.42. The Electro spray ionization (ESI) mass spectrum (Fig. S11) of this compounds presented the pseudo molecular ion peak for  $[\text{M}+\text{H}]^+$  at  $m/z$  179.036, appropriate for a molecular formula  $\text{C}_{10}\text{H}_{10}\text{O}_3$ . On this basis, it was characterized as

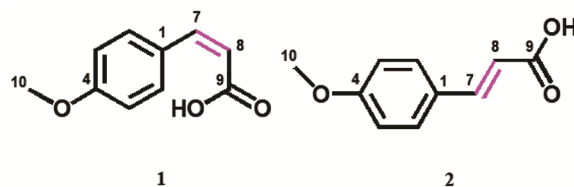


Fig. 1 — Structures of the isolated compounds **1** and **2**

Table 1 —  $^1\text{H}$  and  $^{13}\text{C}$  NMR data of compounds **1** and **2** in deuterated chloroform ( $\text{CDCl}_3$ )

Position of proton	<b>1</b>		<b>2</b>	
	$\delta_{\text{H}}$	$\delta_{\text{C}}$	$\delta_{\text{H}}$	$\delta_{\text{C}}$
1	—	127.03	—	126.84
2	7.58 (2H, d, 8.8 Hz) (H-2/H-6 overlap)	130.09	7.53 (2H, d, 8.8 Hz) (H-2/H-6 overlap)	130.09
3	6.90 (2H, d, 8.4 Hz) (H-3/H-5 overlap)	114.42	6.94 (2H, d, 8.4 Hz) (H-3/H-5 overlap)	114.47
4	—	160.73	—	161.78
5	—	113.54	—	113.54
6	—	132.53	—	132.53
7	7.75 (1H, d, 12.4 Hz)	145.73	7.74 (1H, d, 16.0 Hz)	146.70
8	5.87 (1H, d, 12.8 Hz)	115.80	6.32 (1H, d, 16.0 Hz)	115.80
9	—	170.08	—	171.53
10	3.86 (3H, s)	55.32	3.87 (3H, s)	55.42

4-methoxy-*trans*-cinnamic acid and it was found consistent with the previously published literature<sup>5</sup>.

Throughout human history, nature has consistently served as a dependable provider for diverse human necessities, spanning from sustenance to medicinal solutions. In contemporary times, there is an increasing inclination towards using natural products as dietary supplements for disease prevention and as complementary and alternative medicines (CAM) for treatment. This rising popularity is rooted in the extensive biological and molecular diversity of natural products, presenting promising possibilities as novel templates for designing future drugs<sup>4</sup>.

Cinnamic acid derivatives have been reported to play a significant role in the treatment of various conditions, including cancer, bacterial infections, diabetes, and neurological disorders. Their structure, consisting of a benzene ring, an alkene double bond, and an acrylic acid functional group, allows for the modification of these functionalities with a variety of compounds. This modification results in the creation of bioactive agents with enhanced efficacy. The effectiveness of synthesized cinnamic acid derivatives is significantly influenced by the nature of the substituents incorporated, with the potential to either enhance or decrease their biological efficacy<sup>6</sup>.

The study successfully isolated two cinnamic acid derivatives, namely 4-methoxy-*cis*-cinnamic acid and 4-methoxy-*trans*-cinnamic acid, from *S. suaveolens* (Roxb.) DC. Notably, this research marks the first

report of the isolation of isomeric 4-methoxycinnamic acid from any plant species. The findings contribute to the growing body of knowledge on the phytochemical composition of *S. suaveolens* and hold potential implications for further exploration of these cinnamic acid derivatives in the context of their bioactive properties and potential therapeutic applications. Further research is recommended to delve into the specific biological activities of the isolated compounds and examine their potential applications in various contexts.

### Supplementary Information

Supplementary information is available in the website <http://nopr.niscpr.res.in/handle/123456789/58776>.

### References

- 1 Balasubramanian T, Chatterjee T K, Sarkar M & Meena S L, *Pharm Biol*, 48 (2010) 318.
- 2 Begum F, Haque M, Kazi S, Nahar K & Rashid M, *Dhaka Univ J Pharm Sci*, 13 (2014) 31.
- 3 De P, Koumba Yoya G, Constant P, Bedos-Belval F, Duran H, Saffon N, Daffé M & Baltas M, *J Med Chem*, 54 (2011) 1449.
- 4 Harvey A L, *Drug Disc Today*, 13 (2008) 894.
- 5 Kim H, *J Med Plant Res*, 6 (2012) 3923.
- 6 Ruwizhi N & Aderibigbe B A, *Int J Mol Sci*, 21 (2020) 5712.
- 7 Süntar I, *Phytochem Rev*, 19 (2020) 1199.
- 8 Rehman U F, Kalsoom M, Adnan M, Fazeli-Nasab B, Naz N, Ilahi H, Ali M F, Ilyas M A, Yousaf G & Ali Z, *Int J Pharm Biomed Res*, 8 (2021) 1.
- 9 VanWagenen B C, Larsen R, Cardellina J H, Randazzo D, Lidert Z C & Swithenbank C, *J Org Chem*, 58 (1993) 335.