## Prayogik Rasayan

# Isolation of Erucic acid from the Pseudobulb of *Crepidium* acuminatum (Jeevak)

### Abir Chandan Barai, Soumen Patra and Braja Gopal Bag<sup>\*</sup>

Department of Chemistry and Chemical Technology, Vidyasgar University, Midnapore 721102 Email: *brajagb@gmail.com* 

Received: October 12, 2021 | Accepted: December 18, 2021 | Published online: December 26, 2021

Isolation and spectroscopic characterization of a long chain 22C fatty acid erucic acid 1 is reportd from the pseudobulb of *Crepidium acuminatum* (Jeevak). The molecule constitute a long chain hydrocarbon with one carboxyl group attached at one end of the molecule and a double bond at the C13 position. Energy minimized structure revealed that the molecule is 2.42 nm long having a polar 'COOH' group attached at the end of lipophilic hydrocarbon chain making it useful as an amphiphile for nanosicne and nanotechnology.

*Keywords:* Astavarga, *Crepidium acuminatum* (Jeevak), Erucic acid, Chyawanprash

Chyawanprash, an ayurvedic health tonic, is well known for its anti-ageing activities since the ancient period. Jeevak *(Crepidium acuminatum)* is one of the 'set of eight ingredients' called '*Astavarga'* present in *Chyawanprash*.<sup>1</sup> The eight Astavarga plants namely Kakoli, Kshrikakoli, Jeevak, Rishvok, Meda, Mahameda, Riddhi and Vriddhi grow naturally in small patches in particular ecological environments in the Himalaya especially in the North-Western Himalaya at an elevation of 1200 – 4000 m above the sea level.<sup>2</sup> Recent attempts by a group scientists and sages have enabled the proper identification of the eight Astavarga plants. In continuation of our studies on the



Figure 1: Photograph of Jeevak (*Crepidium accuminatum*) taken in the month of July, 2016 at Barlowganj, India.

chemical investigation of the phytochemicals present in the Astavarga plants, we have reported the first isolation of stigmasterol from the medicinal plant *Roscoea purpurea* Sm. (Kakoli).<sup>3</sup> Antioxidant activities of various parts of *Crepidium acuminatum* (Jeevak),<sup>4</sup> *Roscoea purpurea* Sm. (Kakoli),<sup>5,6</sup> *Polygonatum cirrhifolium* (Mahameda),<sup>7</sup> *Habenaria Edgeworthii* (*Vrddhi*)<sup>8,9</sup> and *Habenaria intermedia* (Rddhi) and their use in the green syntheses of metal nanoparticles have also been reported by us.<sup>10,11</sup>

Tremendous medicinal activities of Jeevak (*Crepidium acuminatum*) have been reported.<sup>12,13,14</sup> Thorough literature search by us have revealed that there is no report of the active chemical constituents of most of the Astavarga plants. Herein we report the first isolation of erucic acid from the medicinal plant *Crepidium acuminatum* (Figure 1).



Figure 2: (a) photopgraph of flowering Jeevak with its pseudobulb, (b) molecular structure of erucic acid **1**, (c) energy minimized structure of erucic acid

The *Crepidium acuminatum* sample used in this study was collected from Barlow Ganj, Mussoorie, Uttarakhand, India, in July 2016. Powdered pseudobulb of *Crepidium acuminatum* (10 g) were extracted with ethyl acetate (250 mL) during 24 h at room temperature. The volatiles were removed under reduced pressure to afford a brownish solid material (0.636 g). The crude extract was purified by successive column chromatography (thrice, Si-gel, 100–200 mesh) using 10-20% ethyl acetate/petroleum ether as the eluent to yield compound 1 as a brownish solid 0.17 % isolated yield (unoptimized). Characterization of compound 1 was carried out by NMR, FTIR and HRMS.<sup>15</sup>

High resolution mass spectrum (Figure 3) of the sample showed a molecular ion peak (M<sup>+</sup>) at 338.3284 corresponding to a molecular formula  $C_{22}H_{42}O_2$  (calc. 338.3184). The stretching frequency at 3009 cm<sup>-1</sup> in FTIR spectrum (Figure 4) is assigned to C-H str. vibration of cis-double bond (C=C-H) and 2921-2849 cm<sup>-1</sup> shows C-H asymmetric and symmetric stretching vibrations of the CH<sub>2</sub>/CH<sub>3</sub> aliphatic bond. The band 1707 cm<sup>-1</sup> showed the stretching vibrations of carbonyl group (C=O) of 'COOH' of free fatty acid.<sup>16</sup> The <sup>13</sup>C NMR spectrum (Figure 5b) showed 22 carbon signals supporting the molecular formula  $C_{22}H_{42}O_2$ . The peak at 179.87 indicates

## Prayogik Rasayan

## COMMUNICATION



Figure 3: HRMS of compound 1

the C1 carbon and the peaks at 129.73 and 130.02 indicating the C13 and C14 groups respectively. The <sup>1</sup>H NMR spectrum (Figure 5a) exhibited one multiplet for two olefinic protons at ( $\delta$  5.36 ppm), and two-proton triplet for H-2 at  $\delta$ 2.36 ppm (J = 7.3 Hz), four protons multiplets for H-12,15 at  $\delta$ 2.02 ppm, two-protons multiplate at  $\delta$  1.63 ppm probably due to H-3 and three protons triplets at  $\delta$  0.90 ppm due to H-22 and the multiplets ranging from  $\delta$  1.5-1.1 ppm most probably due to the rest forteen methylene protons (28H, m, 14×CH<sub>2</sub>). The NMR data obtained for the compound 1 matched with the data reported previously in the literature.<sup>17</sup> Erucic acid is present in several other plants.<sup>18,19,20</sup> But to our knowledge erucic acid is the first compound isolated from the *Crepidium acuminatum*.



Energy minimization carried out with PCModel program<sup>21</sup> revealed that the molecule is 2.42 nm long making it useful in nanoscience and nanotechnololgy.

In conclusion, isolation and characterization erucic acid is reported from the pseudobulb of *Crepidium acuminatum*. According to our knowledge, this is the first report of the isolation of erucic acid from *Crepidium acuminatum*. Molecular modeling studies have revealed that erucic acid can act as a functional nano-entity with tremendous potential application in supramolecular chemistry and nano-science.



Figure 5: (a) <sup>1</sup>H and (b) <sup>13</sup>C NMR of compound 1

Acknowledgements BGB thanks India Srilanka project (DST/INT/SL/P25/2016), Science and Engineering Research Board (SERB), India (ref. EMR/2017/000069), UGC-SAP and DST-FIST New Delhi and Vidyasagar University for financial support and infrastructural facilities. ACB thanks UGC to provide research fellowships.

#### **References and notes**

- (a) P.V. Sharma Charaka samhita. Varanasi: Choukhamba Orientalia (1981); (b) Murthy K.R.S. Sushruta samhita (700 BC). Varanasi: Choukhamba Orientalia **2005**.
- Balakrishna A., Srivastava A., Mishra R. K., Patel S. P., Vashistha R.K., Singh A., Jadon V., Saxena P., Astavarga Plants– threatened medicinal herbs of the North-West Himalaya, *Int. J. Med. Arom. Plants.* 2012, *2*, 661.

# Prayogik Rasayan

## COMMUNICATION

- A. C. Barai, B. G. Bag, First isolation of stigmasterol from the Indian medicinal plant *Roscoea purpurea Sm.* (Kakoli), *Prayogik Rasayan.* 2019, *3* (2), 5-6.
- B.G. Bag, S.S. Dash, S.K. Patra, Int. J. Res. Chem. Environ. 2014, 4, 133.
- 5. B.G. Bag, S.S. Dash, A. Roy, Int J Res Chem. Environ. 2014, 4, 174.
- 6. S. Patra, B.G. Bag, Prayogik Rasayan. 2020, 4 (1), 8.
- B.G. Bag, S.S. Dash, A. Mandal, *Prayogik Rasayan.* 2017, 1 (3), 66 -70.
- 8. B. G. Bag, A. C. Barai, , *Prayogik Rasayan.* **2017**, *1* (1), 16-20.
- 9. S. Patra, B.G. Bag, Prayogik Rasayan. 2020, 4 (2), 16.
- 10. S. Patra, B.G. Bag, Prayogik Rasayan. 2019, 3 (4), 36-39.
- 11. S. Patra, B.G. Bag, Prayogik Rasayan, 2020, 4 (2), 12.
- 12. A. Gupta, R. K. Mishra, M. K. Bhati, *Indian journal of ancient medicine and yoga*. **2015**, *8* (4), 178-183.
- M. Arora, G. Kaur, S. Singh, A. Mahajan, J. K. Sembi, *Current Trends in Biotechnology and Pharmacy.* 2019, 13 (4), 366-375.
- C. Rath, K. Suman, B. Dhar, RC Mohanty, R. Dixit, MM Padhi, R. Babu, *Pharmacognosy Journal*, **2011**. *3* (26), 77-85.
- 15. Characterization data of compound 1:

HRMS: m/z calculated for  $C_{22}H_{42}O_2$  (M<sup>+</sup>) is 338.3184 found 338.3284. m/z calculated for  $C_{22}H_{42}O_2NH_4$  [M+NH<sub>4</sub>]+ is 356.3527; found 356.3513,

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>):  $\delta$  = 5.36 (2H, m, H-13,14), 2.36 (2H, t, J = 7.3 Hz, H-2), 2.02 (4H, m, H-12,15), 1.63 (2H, m, H-3), 1.5-1.1 (28H, m, 14×CH<sub>2</sub>), 0.90 (3H, t, J = 6.0 Hz, H-22) ppm.

<sup>13</sup>CNMR (100 MHz, CDCl<sub>3</sub>): δ = 179.87 (C-1), 34.02 (C-2), 129.73 (C-13),130.02 (C-14), 23.0-34.0 (17×CH<sub>2</sub>), 14.3 (C-22,CH<sub>3</sub>) ppm.

FTIR: (ATR Neat) v = 3009 (w), 2921 (s), 2849 (s), 1707 (s), 1446 (m), 1415 (w), 1287 (m), 1232 (w), 1106 (w), 940 (m), 721 (m) cm<sup>-1</sup>.

MP = 32 - 34 °C.

- S. T. H. Sherazi, S. Arain, S. A. Mahesar, M. I. Bhanger, A. R. Khaskheli, *European Journal of Lipid Science and Technology*. 2013, *115* (5), 535-540.
- X. Liang, Y. Huang, X. Pan, Y. Hao, X. Chen, H. Jiang, J. Li, B. Zhou, Z. Yang, *Journal of Pharmaceutical Analysis*. 2020, *10* (2), 130-146.
- N. S. Walter, V. Gorki, R. Singh, D. B. Salunke, S. Kaur, South African Journal of Botany, 2021, 139, 158-166.
- M. Koubaa, H. Mhemdi, Q. Sanlaville, E. Vorobiev, *Chemical Engineering & Technology.* 2016, 39 (8), 1431-1437.
- S. T. H. Sherazi, S. Arain, S. A. Mahesar, M. I. Bhanger, A. R. Khaskheli, *Eur. J. Lipid Sci. Technol.* **2013**, *115*, 535– 540.
- 21. PCModel version 9.2, Serena software.®