PHYTOCHEMICAL STUDY OF SEEDS OF *ABRUS PRECATORIUS*

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Abstract

Phytochemical examination on the petroleum ether extract of Seeds of *Abrus precatorius* led to the isolation of Cis-vaccenic acid (I) and β-Sitosterol (II). The structure of these compounds was elucidated on the basis of different spectroscopic techniques.

Keywords: Abrus precatorius, Biological activity, Natural compounds, Phytochemicals.

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1. INTRODUCTION

Throughout the course of human civilization, herbal plants have held a significant role in treating various ailments and illnesses [1]. This tradition of utilizing herbal remedies predates the development of contemporary pharmacology, medicine, and chemistry. According to the World Health Organization, approximately 75% of the global population continues to rely on medicinal practices derived from herbal plants [2]. The popularity of herbal medicines endures due to their affordability, safety, and diverse range of pharmacological benefits [3]. A notable candidate for herbal medicine is Abrus precatorius, a plant belonging to the Fabaceae family. It goes by several common names, including Indian licorice, Crab's eye, Jequirity, and Rosary pea [4]. In Sanskrit, it is referred to as Gunja, while in Hindi, it is known as Ratti [5]. Indigenous to India, A. precatorius has adapted and thrived in various tropical and sub-tropical regions worldwide [6]. This plant exhibits promising potential for use in herbal medicine, presenting a natural remedy that aligns with the enduring tradition of harnessing the healing properties of herbal flora.

Traditionally, Abrus precatorius has been employed to address a range of health issues, including cuts, wounds caused by animal bites, and ailments such as rabies, tetanus, and leucoderma [7]. This versatile plant has also demonstrated effectiveness in managing dysentery and diarrhea. Furthermore, it boasts a spectrum of therapeutic applications, serving as a tonic, aphrodisiac, emetic, and laxative. The pharmacological potential of A. precatorius is wide-ranging, encompassing antibacterial, antihelminthic, antidiabetic, and antitumor properties [8]. Various groups of secondary compounds have been identified within this species, enriching its medicinal value. These compounds include alkaloids, steroids, triterpenoids, isoflavanoquinones, anthocyanins, starch, tannin, protein, flavonoids, phenolic compounds, fixed oils, amino acids, and flavones such as luteolin, abrectorin, orientin, isoorientin, and desmethoxycentaureidin 7-O-rutinoside [9,10].

The rich chemical composition of Abrus precatorius underscores its potential as a valuable resource in the realm of herbal medicine, offering a wide array of therapeutic benefits that have been harnessed for generations.

2. MATERIALS AND METHODS

General experimental procedures:
Melting points were determined in soft glass capillaries in an electrothermal melting point apparatus. The IR spectra were recorded on FTIR SHIMADZU 8400S spectrometer with KBr pellets. The ^{1}H and ^{13}C NMR spectra were recorded in $CDCl_3$ at 300 MHz and 75 MHz on a Brucker NMR instrument, respectively, using TMS as internal standard. FAB mass spectra were recorded on JEOL SX 102 /DA-6000 mass spectrometer using Argon /Xenon as FAB gas.

Plant material:
The seeds of *Abrus precatorius* were purchased from local market Jaipur city Rajasthan (India). The material was identified by Dr. Mahesh C. Sharma, Professor, Department of Chemistry, University of Rajasthan.

Extraction and isolation of the constituents:
The seeds plant material (2.0 kg) was extracted with methanol for 48 hours. Obtained extract was concentrated under reduced pressure to give crude extract. The methanolic extract was dissolved in the minimum amount of methanol and adsorbed on silica gel to form slurry. The dried slurry was subjected to column chromatography over silica gel. The column was eluted with different solvents in order of increasing polarity where following compounds (I and II) were isolated, purified and characterized.

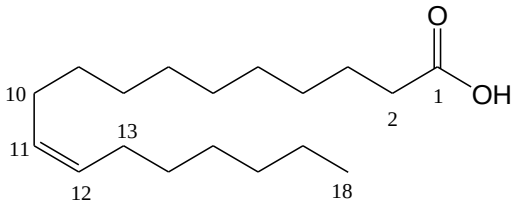
***Isolation of* Cis-vaccenic acid:**
It was isolated on elution of column with Pet ether and benzene (3:1). 1H NMR (δppm, $CDCl_3$); 10.46 (s, 1H, -OH), 2.19 (t, 2H, J= 2.0Hz, H-2), 1.86 (m, 4H, H-10 & H-13), 5.38 (t, 2H, J = 2.9, H-11 & H-12), 0.96 (t, 3H, H-18), 1.29-1.56 (m, remaining 22H); 13C NMR (δppm, $CDCl_3$); 176.54 (C-1), 25.10 (C-2), 29.4 (C-3), 30.20(C-4), 30.50(C-5), 30.55(C-6), 30.60(C-7), 30.62(C-8), 30.65(C-9), 26.90(C-10), 132.10(C-11), 132.15(C-12), 26.80(C-13), 30.61(C-14), 30.15(C-15),

32.60(C-16), 23.10(C-17), 14.15(C-18). m.p. 213^0C; amorphous white.

***Isolation of* β-Sitosterol:**
It was isolated on elution of column with benzene. On crystallisation with methanol white needle like crystals were obtained. It gave positive Liebermann-Burchard test. Its showed m.p. 138°C. IR (KBr, cm^{-1}): 3500-3445 (O–H stretching), 1590 (C=C stretching), 1050 (C-O stretching); ^{1}H NMR (δppm, $CDCl_3$): 3.52 (*m*, 1H, C-3), 5.30 (*t*, 1H, C-6), 0.65 (*s*, 3H, C-18), 0.99 (*s*, 3H, C-19), 1.25 (*d*, 3H, C-21), 0.84 (*d*, 3H, C-26), 0.92 (*d*, 3H, C-27), 0.95 (*t*, 3H, C-29), 1.83 (*m*, 1H, C-25), 2.15 (*dd*, 2H, C-7), 1.45-1.85 (*m*, for remaining 26 protons). ^{13}C NMR (δppm, $CDCl_3$): 31.30 (C-1), 32.00 (C-2), 72.00 (C-3), 42.20 (C-4), 140.01 (C-5), 122.14 (C-6), 32.02 (C-7), 46.11 (C-8), 49.80 (C-9), 36.12 (C-10), 20.98 (C-11), 28.20 (C-12), 42.34 (C-13), 57.00 (C-14), 24.32 (C-15), 40.12 (C-16), 56.20 (C-17), 12.00 (C-18), 19.50 (C-19), 36.20 (C-20), 19.50 (C-21), 36.15 (C-22), 24.67 (C-23), 39.90 (C-24), 36.00 (C-25), 23.40 (C-26), 23.41 (C-27), 32.20 (C-28), 29.45 (C-29). MS (m/z): 414 (M^+), 397, 383, 369, 255 etc. Molecular formula calculated as $C_{29}H_{50}O$

3. RESULT AND DISCUSSION

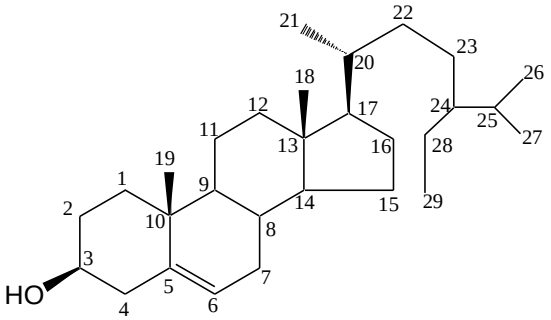
Characterization of Cis-vaccenic acid (I):
The compound, as inferred from its 1H NMR data, is a complex long-chain hydrocarbon or potentially a fatty acid. The spectrum reveals distinct proton environments, including a singlet at 10.46 ppm indicative of a hydroxyl group (-OH), a triplet at 2.19 ppm corresponding to methylene protons (H-2), and a pair of methylene protons at 5.38 ppm (H-11 & H-12) with a small coupling constant (J=2.9 Hz), suggesting the possibility of an alkene or double bond. Additionally, methylene groups at 1.86 ppm (H-10 & H-13) and a methyl group at 0.96 ppm (H-18) are observed, while the remaining 22H in the molecule, spanning chemical shifts from 1.29 to 1.56 ppm, form part of the extensive aliphatic hydrocarbon chain. The 13C NMR spectrum indicates a molecule with multiple distinct carbon environments. The chemical shifts of these carbons suggest a relatively simple structure with predominantly aliphatic carbon atoms. The presence of a carbon at 176.54 ppm (C-1) indicates a carbonyl group (C=O) or another highly electronegative substituent, possibly at the beginning of a carbon chain. The signals between 25.10 ppm (C-2) and 32.60 ppm (C-16) correspond to various aliphatic carbons, likely forming a long carbon chain, with potential branching or substitution points. The carbon signals in the 132.10 ppm to 132.15 ppm range (C-11 and C-12) may suggest the presence of a carbon-carbon double bond or an aromatic ring. Furthermore, the low ppm value at 14.15 ppm (C-18) suggests a methyl group, often found at the terminus of alkyl chains.



Compound-I

Characterization of β-Sitosterol (II):
In the mass spectrum molecular ion peak was observed at m/z 414 (M^+). Other prominent ions were observed at m/z 397, 383, 369, 255 etc. On the basis of mass spectrum the molecular formula of the compound was established as $C_{29}H_{50}O$. In the IR spectrum (KBr, Cm^{-1}) strong absorptions at 3500-3445 (O-H stretching) indicated the presence of hydroxyl group. The absorption at 1590 confirmed the presence of olefinic group (C=C stretching) whereas the absorption at 1050 was assigned for C-O stretching. The proton NMR spectrum (δppm, $CDCl_3$) of compound E showed a singlet at 0.65 for three protons accounted for tertiary methyl group present at C-18 position. The absorption at 0.84 and 0.92 as a doublets confirmed the presence of methyl protons at C-26 and C-27 positions respectively. A triplet observed at 0.95 was assigned for three protons of two methyl groups present at C-29 position. Methyl

protons present at C-19 position showed the absorption at 0.99 as a singlet. The three protons of methyl group present at C-21 position was assigned as a doublet at 1.25. A multiplet was observed at 1.83 for methine proton present at C-25 position. Methylene protons at C-7 appeared as double doublets at 2.15. The olefinic proton present at C-6 was assigned as a triplet at 5.30 with coupling constant *J = 2.8 Hz*. A multiplet observed at 3.52 accounted for one proton and was assigned for a methine proton at C-3 position where the hydroxyl group is attached. The chemical shift and coupling constant *J =5.60 Hz* of methine proton supported β-orientation of hydroxyl (–OH) group at C-3 position. An absorption at 72.00 in ^{13}C NMR spectrum (δppm, $CDCl_3$) also confirmed the presence of hydroxyl group at C-3 position. Olefinic carbon atoms were confirmed by the absorptions at 140.01 and 122.14 which were assigned to C-5 and C-6 carbon atoms respectively. Thus confirming the presence of C=C between carbon atom five and six. Other signals were obtained at 31.30 (C-1), 32.00 (C-2), 42.20 (C-4), 32.02 (C-7), 46.11 (C-8), 49.80 (C-9), 36.12 (C-10), 20.98 (C-11), 28.20 (C-12), 42.34 (C-13), 57.00 (C-14), 24.32 (C-15), 40.12 (C-16), 56.20 (C-17), 36.20 (C-20), 36.15 (C-22), 24.67 (C-23), 39.90 (C-24), 36.00 (C-25), 32.20 (C-28), 12.00 (C-18), 19.50 (C-19), 19.50 (C-21), 23.40 (C-26), 23.41(C-27) and 29.45 (C-29) and their arrangements was done according to the reported values. The above data were found to be similar with those reported [11] for β-sitosterol. On the basis of above spectral studies compound E was characterized as β-sitosterol.



Compound-II

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Conflict of Interest: Authors declare no conflict of interest.

4. REFERENCES

1. Jamshidi-Kia, F., Lorigooini, Z., & Amini-Khoei, H. (2017). Medicinal plants: Past history and future perspective. *Journal of herbmed pharmacology*, *7*(1), 1-7.
2. World Health Organization. (2019). *WHO global report on traditional and complementary medicine 2019*. World Health Organization.
3. Maver, T., Maver, U., Stana Kleinschek, K., Smrke, D. M., & Kreft, S. (2015). A review of herbal medicines in wound healing. *International journal of dermatology*, *54*(7), 740-751.
4. Adelowotan, O., Aibinu, I., & Adenipekun, E. (2008). The In-Vitro Antimicrobial Activity of Abrus precatorius. *Nigerian Postgraduate Medical Journal*, *15*(1), 33.
5. Dahikar, G. K., Rathi, B., & Kamble, S. B. (2020). Critical review on pharmacological uses of Gunja (Abrus precatorious). *Journal of Indian System of Medicine*, *8*(3), 155.
6. Sharma, B. K., Kulshreshtha, S., & Rahmani, A. R. (Eds.). (2013). *Faunal heritage of Rajasthan, India: general background and ecology of vertebrates*. Springer Science & Business Media.
7. Aswin, R. K., Tridiganita, I. S., Arif, N. M. A., Gavrila, A. P., Dina, D. A., & Gabrielle, A. V. P. (2022). Abrus precatorius: A comprehensive insight into the phytochemical, pharmacological, therapeutic activities and safety. *Journal of*

Drug Delivery and Therapeutics, *12*(1), 151-157.

8. Hosen, S. Z., Junaid, M., Alam, M. S., Rubayed, M., Dash, R., Akter, R., ... & Mostafa, M. (2022). GreenMolBD: Nature Derived Bioactive Molecules' Database. *Medicinal Chemistry*, *18*(6), 724-733.
9. Qian, H., Wang, L., Li, Y., Wang, B., Li, C., Fang, L., & Tang, L. (2022). The traditional uses, phytochemistry and pharmacology of Abrus precatorius L.: A comprehensive review. *Journal of Ethnopharmacology*, *296*, 115463.
10. Omoboyowa, D. A., Singh, G., Fatoki, J. O., & Oyeneyin, O. E. (2023). Computational investigation of phytochemicals from Abrus precatorius seeds as modulators of peroxisome proliferator-activated receptor gamma (PPARγ). *Journal of Biomolecular Structure and Dynamics*, *41*(12), 5568-5582.
11. Babu, S., & Jayaraman, S. (2020). An update on β-sitosterol: A potential herbal nutraceutical for diabetic management. *Biomedicine & Pharmacotherapy*, *131*, 110702.