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FTIR and UV–Visible Spectroscopic Study of a Traditional Polyherbal Formulation from the Nallamala Forest, Telangana, India

G. Rajendar[1], K. HariPrasad[2], G. Bagyanarayana[3], K. Padmavathi[4]

[1,2]Assistant Professor of Botany, MVS Government Arts and Science College (A), MahabubNagar, Telangana State, 509001.

[3]Department of Botany, University College of Science, Osmania University, Hyderabad, Telangana State, 500007.

[4]Professor of Chemistry, M.V.S. Government Arts and Science College (A), Mahabubnagar, Telangana, 509001

Abstract

Traditional herbal formulations remain essential to indigenous healthcare, yet most lack scientific validation. This study investigates a polyherbal remedy used by Chenchu healers of the Nallamala forest for managing ovarian and menstrual disorders. The preparation consists of four medicinal plants-*Aloe vera*, *Mesua ferrea*, *Nelumbo nucifera*, and *Tribulus terrestris*. Plant parts were shade-dried, powdered, and analysed through phytochemical screening, FTIR, and UV–Visible spectroscopy.

Phytochemical tests confirmed major secondary metabolites including alkaloids, flavonoids, phenolics, glycosides, tannins, saponins, steroids, and amino acids. FTIR spectra revealed functional groups such as O–H, N–H, C=O, C=C, and C–H, indicating alcohols, amines, aldehydes, aromatic and aliphatic compounds. UV spectra showed $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions, reflecting conjugated antioxidant-rich molecules.

The analytical results validate the biochemical complexity and therapeutic relevance of the formulation, supporting its role in menstrual regulation, anti-inflammatory action, and hormonal balance. The study demonstrates how integrating traditional knowledge with modern spectroscopy strengthens evidence-based phytomedicine and reinforces the importance of conserving tribal healthcare wisdom.

Keywords: Ethnomedicine, FTIR spectroscopy, UV–Visible analysis, Menstrual disorders, Phytochemical profiling

1. Introduction

FTIR Spectroscopy

Fourier Transform Infrared Spectroscopy (FTIR) is a widely used analytical technique that identifies molecular structures by measuring the absorption of infrared radiation by chemical bonds, where each functional group generates a unique spectral pattern that acts as a molecular fingerprint [6, 20, 33, 37]. Unlike conventional dispersive infrared instruments, FTIR uses a Michelson interferometer to collect all wavelengths simultaneously, producing an interferogram that is mathematically converted into a spectrum through Fourier transformation, resulting in higher resolution, improved signal-to-noise ratio, and rapid data acquisition [7,30, 38].

FTIR is valued for non-destructive testing, minimal sample preparation, and its applicability across chemistry, pharmaceuticals, biomaterials, polymers, forensics, and environmental analysis [4, 26]. Functional groups such as –OH, C=O, –NH, and aromatic rings are easily identified from characteristic peak positions [37,40]. The use of ATR, DRIFTS, and transmission cells enables analysis of powders, films, and biological samples without complex pretreatment [30]. Emerging advancements such as micro-FTIR mapping and portable FTIR systems now support field-level spectral imaging and on-site authenticity testing [4, 38]. Although limitations such as peak overlap and atmospheric interference may occur, chemometric analysis and complementary methods help resolve spectral complexity [20, 33, 30].

UV–Visible Spectroscopy

UV–Visible spectroscopy measures the absorption of electromagnetic radiation in the 200–800 nm range to study electronic transitions within molecules, primarily $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ excitations [20, 30]. Absorbance follows Beer–Lambert's law, allowing both qualitative functional group identification and quantitative estimation of analyte concentration [30, 38]. Bathochromic (red) and hypsochromic (blue) shifts in λ max values are diagnostic for conjugation, aromatic systems, carbonyl groups, and solvent effects [20, 37].

UV–V is spectroscopy is widely employed in phytochemical profiling, plant metabolite quantification, pharmaceutical analysis, pigment detection, and nanomaterial characterization [20, 30]. It is rapid, inexpensive, and requires simple sample processing, making it suitable for routine laboratory and quality-control studies [30]. However, spectral overlaps in complex extracts and interference from colored or turbid samples may restrict its ability to yield complete structural information, necessitating integration with FTIR or other spectroscopic tools [33, 37, 38].

2. Materials & Methods

Study Area: Billakal (16°17'22.6"N 78°37'39.8"E), Balmoor mandal, Nagarkurnool District

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MAP 1 Nagarkurnool district map (**Source: Nagarkurnool District website**)

Sample Medicine

Table: 1 List of constituent plants and their useful parts

S. No.	Name of the plant	Common Name	Biological Source
1	*Aloe vera*	Kalabanda	Roots.
2	*Mesua ferrea*	Naagakesaralu	Flower Buds.
3	*Nelumbo nucifera*	Thamara	Petals.
4	*Tribulus terrestris*	Palleru	Fruits.

Collection of constituent plant parts.

Aloe vera roots were collected during the month of September, roots were harvested by making proper digs around the plants. Soil attached to the roots was washed with water and dried in the sun for some time and later shifted to the shade. *Mesua ferrea* flower buds, and *Nelumbo nucifera* petals were, harvested in the month of March and November respectively. Collected early in the mornings, just before the opening of buds. *Tribulus terrestris* fruit is collected in the month of December after complete maturity only. [3, 32]

As per the procedure all the collected plant produces are initially separated from each other and discarded the unwanted materials like other biological plant remains, foreign matters etc., and washed with water if necessary dried in sun in the mornings later shifted to shade. [14,15]

After drying each individual drug is thoroughly examined and to ascertain verified that there is no foreign material. Each product is powdered in a proper way by using Richerds mixer and sieved with 70mm mesh and stored at room temperature in glass bottles for further investigations as required. [32,33]

Chemical analysis

Preliminary qualitative Phyto-chemical screening was carried out by preparing various extracts such as distilled water, methanol, chloroform, petroleum ether, ethyl alcohol and ethyl acetate for various secondary metabolites like alkaloids, anthraquinones, amino acids, cardiac glycosides, flavonoids, steroids, tannins, phenols, saponins. For the preparation of extract the powdered drug is dissolved in the solvent for 72 hours and filtered. The extract is tested by various reagents according to the standard protocols of Dhandapani, Sofowara, Harbourne, Trease, and Kokate methods. [8, 9, 32]

FTIR spectral analysis

The Infrared spectroscopy was employed to study the functional groups and composition of the primary and secondary metabolites present in the prepared powder samples. Before going to the spectral analysis, the individual powder sample was characterized by adding with Potassium bromide pallets separately. These samples were scanned under the Fourier transformed infra-red (FT–IR) spectrometer (Shimadzu IR Prestige_21 spectrophotometer) in the region of 4000–400 cm^{-1}. The peaks in the absorption spectra, that reveals the presence of stretching bonds and various functional groups at distinct range of wavenumbers. [10, 13, 20, 21, 33]

UV visible spectral analysis

For the Preparation of ethanol extraction 10 g of above said individual prepared and moisture free powders were placed in 100 ml of ethanol either 72 hours maceration or boiled for 5- 6 hours and filtered through Whatman filter paper and condensed in hot water bath and used for UV spectral analysis. [2, 4, 9, 33]

3. Result Analysis and Discussion

The sample medicine contains the following plants: these were used to treat disorders in the Ovaries and Menstrual cycle. [33]

1. *Aloe vera*. (L) Brum.f.

Family: Liliaceae.

Vernacular Names: Kalabanda in Telugu, Gruhakanya in Sanskrit, Indian aloe in English

Collection Number: GRNF 1

Description: It is an evergreen perennial that grows in tropical, subtropical, and even arid areas. Kalabanda is a large succulent plant that has rosette leaves. Root system is fibrous. Roots have a thickness of about 10-15 cm at base, grow about 20-40 cm long. Leaves are green in color, may grow up to 60 cm long and even 15 cm width at base. Sessile leaves, acute apex and ends with a spine. Leaf has concave abaxial surface, Convex to rounded adaxial surface. Leaves are filled with a transparent juicy fluid known as Aloetic fluid. [31, 34]

Phenology: February to May.

Plant parts used: Leaf, root.

Human ailments: Used to improve follicles at the right time. Regulates menstruation and best treated in amenorrhea.

2. *Mesua ferrea* L.

Family: Clusiaceae.

Vernacular Names: Naagakesaralu in Telugu, Naagakesar in Sanskrit, Indian rose chestnut, cobra saffron in English. Ceylon iron wood (SriLankan National Tree).

Collection number: GRNF 2. (collected plant part from healer).

Description: Naagakesar is an evergreen, medium sized tree. It grows about 13 m. height and 90 cm in dia with a strong hard wood. Timber yielding plant, in olden days it was used to prepare railroad ties, and

for making lances. Leaves are simple, oblong and dark green in color (when young red to yellowish pink), attains a size about 7-15 cm. Flower- Solitary, Bisexual, Pentamerous. Fruit- Berry. [2, 8, 9, 10, 11]
Phenology: January to October.
Plant parts used: Flower.
Human ailments: Dried flowers best function against hemorrhoids and in bleeding disorders. Powder from dried flowers is used to treat irregular menses.

3. *Nelumbo nucifera* Geartn.
Family: Nelumbonaceae.
Vernacular Names: Tamara in Telugu, Padma, nalina pankaja (grows in mud) in Sanskrit.
Sacred lotus in English, National flower of India, Symbol of Purity and holiness, have a cultural and traditional value.
Collection number: GRNF 3
Description: Aquatic, perennial herb. Rhizome anchors in mud with adventitious roots. Leaves are simple, solitary, with a long petiole approximately 2 m long, and a waxy coated wide lamina about 20 to 80 cm. Leaves are dark green at abaxial and pale green at adaxial surfaces. Solitary flower with a long peduncle, actinomorphic, bisexual, showy white or reddish white, and red in color. [21, 24, 36, 44]
Phenology: July to December.
Plant parts used: Flower, root, and seeds.
Human ailments: Flowers are used in bleeding disorders like menorrhagia. Seeds are used to curtail vomiting. Powder form of root is used to heal burning sensation.

4. *Tribulus terrestris* L.
Family : Zygophyllaceae.
Vernacular Names: Palleru in Telugu, Gokshura in Sanskrit, Puncture vine in English.
Collection number: GRNF 4.
Description: A prostate herb grows up to 10 cm to 1 m dia. Hairy stem, pinnately compound leaf. Solitary flower, auxiliary in position, actinomorphic, pentamerous, lemon-yellow flowers. Seed bears 2-4 sharp spines with 10 mm long and 5 mm broad. [13, 24]
Plant parts used: Dried roots and fruits.

Human ailments:
- Induces Ovulation.
- Used to treat disorders related to ovaries like PCOD, female infertility.
- Works against urinary disorders.
- Decreases the excessive menstrual bleeding and regulates the irregularity.

Plate No.1- Constituent plant parts of Sample

Pic.1.1 Aloe vera plant

1.2 Dried roots

1.3 Powder.

Pic.2.1 Mesua ferrea twig with flower

2.2 Dried buds

2.3 Powder

Pic.3.1 Nelumbo nucifera Flower

3.2 Dried Petals

3.3. Powder

Pic.4.1 Tribulus terrestis Twig

4.2. Dried fruits

4.3 Powder

Phytochemical Analysis

The Phyto-chemical analysis of traditional medicine used for Ovaries and Menstrual disorders i.e. Sample and its constituent plants, showed the presence of Phytochemical compounds in the various extracts. [20, 32, 42]

Table No. 2 Phytochemical analysis of Ethnomedicinal Sample extract in various solvents

Phytochemical Constituents	Distilled Water	Methanol	Chloroform	Petroleum Ether	Ethyl Alcohol	Ethyl Acetate
Alkaloids	-	-	-	-	+	-
Anthraquinones	-	-	+	-	+	-
Amino Acids	-	+	+	+	-	-
Cardiac Glycosides	+	+	+	+	-	+
Flavonoids	+	+	+	+	+	+
Steroids	-	+	-	-	-	-
Tannins	-	+	+	+	+	+
Phenols	+	+	+	+	+	+
Saponins	+	-	+	-	-	-

FTIR analysis:

The FTIR spectral analysis of Sample and its Constituent plants reveals the presence of various kinds of functional groups in the form of following Stretching's at the following Wave numbers (cm−1). [6, 8]

- The absorption peaks at 3769 in Sample, 3790 in *Nelumbo nucifera*, indicate the presence of Carbon with halide stretching.
- The absorption peaks at 3550 in Sample, 3512 in *Mesua ferrea*, 3557 in *Tribulus terrestris* indicating the presence of C-OH stretching.
- The absorption peaks at 3337 in Sample, 3342 in *Aloe vera*, 3351 in *Mesua ferrea*, 3329 in *Nelumbo nucifera*, 3339 in *Tribulus terrestris* indicating the presence of N-H stretching.
- The absorption peaks at 2921 in Sample, 2921 in *Aloe vera*, 2922 in *Mesua ferrea*, 2921 in *Nelumbo nucifera* are indicating the presence of alkyl stretching.
- The absorption peaks at 2854 in Sample, 2853 in *Mesua ferrea*, 2853 in *Nelumbo nucifera*, 2854 in *Tribulus terrestris*, are indicating that presence of C-H stretching.
- The absorption peaks at 1739 in Sample, 1740 in *Aloe vera*, 1704 in *Mesua ferrea*, 1740 in *Nelumbo nucifera*, indicating the presence of C=O stretching indicating the presence of aldehyde functional group.
- The absorption peaks at 1610 in Sample, 1612 in *Aloe vera*, 1611 in *Mesua ferrea*, 1614 in *Nelumbo nucifera*, 1629 in *Tribulus terrestris*, indicating the presence of C=C stretching.

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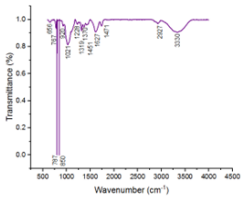
- The absorption peaks at 1370 in Sample, 1316 in *Aloe vera*, 1376 in *Mesua ferrea*, 1372 in *Tribulus terrestris* indicating the presence of N-C bonding indicating the presence of amine group.
- The absorption peaks at 1026 in Sample, 1034 in *Tribulus terrestris* indicating the presence of anhydride functional group.

Table 3 FTIR Absorption frequencies of Samples and their constituent plants.

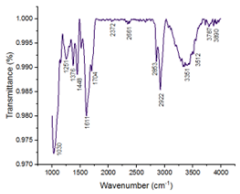
Plant material	*Aloe vera*	*Mesua ferrea*	*Nelumbo nucifera*	*Tribulus terrestris*	Sample
C-X stretching	-	-	3790	-	3769
C-OH stretching	-	3512	-	3557	3550
N-H stretching	3342	3351	3329	3339	3337
Alkyl stretching	2921	2922	2921	-	2921
C-H stretching	-	2853	2853	2854	2854
C=O stretching	1740	1704	1740	-	1739
C=C stretching	1612	1611	1614	1629	1610
N-O stretching	1316	1376	-	1372	1370
CHO Stretching	-	-	-	1034	1026

FTIR spectra's

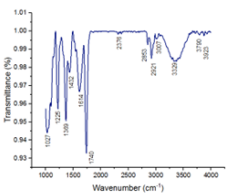
Pic.5 *Aloe vera*



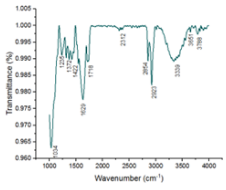
Pic.6 *Mesua ferrea*



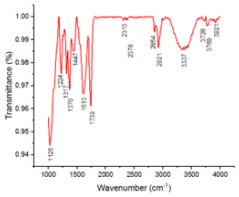
Pic.7 *Nelumbo nucifera*



Pic.8 *Tribulus terrestris*



Pic.9. Sample



UV spectral analysis

This UV absorption spectral peaks indicates, 1) from 300 nm to 500 nm, π –π * bonding, 2)500 nm to700nm, N –π *bonding. [2]

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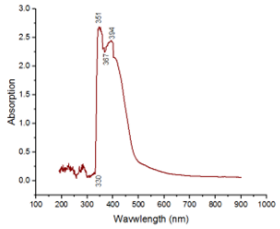
π –π * stretching in Sample at 384 nm, 357 nm, 349 nm, in *Aloe vera* at 394 nm,351 nm, in *Mesua ferrea* at 427 nm, 356 nm, 352 nm, 349 nm, in *Nelumbo nucifera* at 381 nm, 357 nm, 351 nm, 310 nm, and in *Tribulus terrestris* at 348 nm.
N –π * stretching in Sample at 658 nm, 598 nm, in *Mesua ferrea* at 658 nm, in *Tribulus terrestris* at 657 nm.

Table 4 UV spectral analysis of Sample and its constituent plants

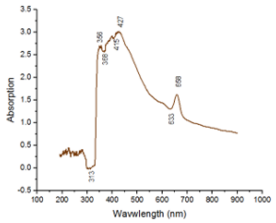
Stretching/ Peaks	*Aloe vera*	*Mesua ferrea*	*Nelumbo nucifera*	*Tribulus terrestris*	Sample
π –π *	394	427	381	348	384
	351	356	357	-	357
	-	352	351	-	349
	-	349	310	-	-
N –π *	-	658	-	657	658
	-	-	-	-	598

UV-Visible spectra's

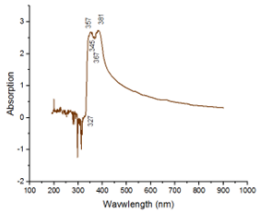
Pic.10 Aloe vera



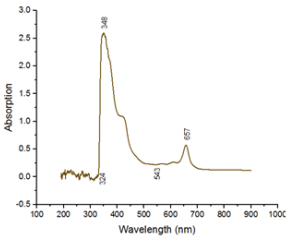
Pic.11 Mesua ferrea



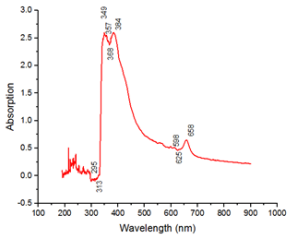
Pic.12 Nelumbo nucifera



Pic.13 *Tribulus terrestris*



Pic.14 Sample



4. Conclusion

For the chemical analysis, plant extracts were prepared by following the standard protocols. These extracts when tested with various reagents revealed the presence of various active principles in constituent plant parts, those act against Menstrual disorders. Further FTIR, and UV spectral analysis strengthen the investigation of active principles in the crude drug. The analysis of FTIR spectra, peaks in the graphs

indicate C=O, C=C, C-H, C-N bonding at distinct wavelengths in the powder forms of the Constituent plants. In the UV spectral analysis, the transmittance peaks indicated C=C, C-N/ C=O bonds at distinct wave numbers in the ethanol extracted powder forms. All these investigations indicate the presence of various type of Alkaloids, Glycosides, Saponins, Phenolic compounds, Tannins, Amino acids, Steroids, and Anthraquinones which are very active to regulate menstrual disorders and stabilizes the hormonal imbalance.

Hence it is concluded that combinations in Sample being used by Chenchu healers are working effectively against several menstrual disorders.

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References

1. Ahmad, I., Mehmood, Z., & Mohammad, F. (1998). Screening of some Indian medicinal plants for their antimicrobial properties. Journal of Ethnopharmacology, 62(2), 183–193.
2. Alam, M. S., Jain, N., Kamil, M., & Ilyas, M. (1987). Mesuein: A novel flavanone glycoside from *Mesua ferrea*. Chemistry & Industry, 16, 565–566.
3. Ambasta, S. P. (1992). The useful plants of India. Publication and Information Directorate
4. Ambedkar, G., Pragalathan, S., Arumugam, S., Gandhimaniyan, K., Dineshkumar, S., & Balamurugan, V. (2019). FTIR spectrum analysis and antibacterial activity of *Tribulus terrestris* leaves extract.
5. Anurag Mishra, A., Mishra, V. K., Dwivedi, D., & Dwivedi, K. N. (2015). A FT-IR spectroscopic study of phytoconstituents of Asparagus racemosus Willd root tuber. World Journal of Pharmaceutical Research, 4(8), 2754–2763.
6. Asha, J., & Satyavati. (2016). FT-IR studies of ethanolic extract of Saraca asoka. Indo American Journal of Pharmaceutical Sciences, 3(2).
7. Ashok Kumar, R., & Gayathiri, M. S. (2011). Spectroscopy studies on the status of aloin in *Aloe vera* and commercial samples. Journal of Experimental Sciences, 2(8).
8. Bala, K. R., & Seshadri, T. R. (1971). Isolation and synthesis of some coumarin components of *Mesua ferrea* seed oil. Phytochemistry, 10(5), 1131–1134.
9. Bhattacharyya, P., Chatterjee, D., Chakrabarti, A., & Chakraborty, D. P. (1979). Synthesis of mesuagin, a plant antibiotic from *Mesua ferrea*. Indian Journal of Chemistry, 17B(2), 111–112.
10. Chahar, M. K., Sanjaya Kumar, D. S., Lokesh, T., & Manohara, K. P. (2012). In-vivo antioxidant and immunomodulatory activity of mesuol isolated from *Mesua ferrea* L. seed oil. International Immunopharmacology, 13(4), 386–391.
11. Chakraborty, D. P., & Das, B. (1966). Structure of mesuol. Tetrahedron, 46, 5727–5730.

12. Chaithanya, K. K., Gopalakrishnan, V. K., Hagos, Z., Ponce-Noyola, P., Palleti, J., Rao, D., & Konuku, K. (2018). Isolation and structural characterization of bioactive anti-inflammatory compound Mesuaferrin-A from *Mesua ferrea*. Analytical Chemistry Letters.
13. Chhatre, S., et al. (2014). Phytopharmacological overview of *Tribulus terrestris*. Pharmacognosy Reviews, 8(15), 45–51. [https://doi.org/10.4103/0973-7847.125530]
14. Chopra, R. N., Chopra, I. C., & Verma, B. S. (1969). Supplement to the glossary of Indian medicinal plants. Council of Scientific and Industrial Research.
15. Chopra, R. N., Nayar, S. L., & Chopra, I. C. (1956). Glossary of Indian medicinal plants. Council of Scientific and Industrial Research.
16. Dastidar, S. G. (1986). Phytochemical studies on Indian medicinal plants [Doctoral dissertation, University of Calcutta]. Shodhganga.
17. Dhandapani, S., & Sabna, B. (2008). Phytochemical constituents of some Indian medicinal plants. Ancient Science of Life, 37(4), 1–7.
18. Evans, W. C., & Trease, G. E. (1996). Pharmacognosy (14th ed.). WB Saunders.
19. Harborne, J. B. (1973). Phytochemical methods. Chapman and Hall.
20. Harborne, J. B. (1998). Phytochemical methods: A guide to modern techniques of plant analysis (3rd ed.). Springer.
21. Huang, G. H. (1987). Physiology and morphology of *Nelumbo nucifera*. In China lotus (pp. 38–45). Academia Sinica.
22. IR frequencies of stretching organic compounds. (n.d.). Sigma-Aldrich. [https://www.sigmaaldrich.com/technical-documents/articles/biology/ir-spectrum-table.html]
23. Jain, S. K., & Goel, A. K. (1987). Proforma for field work. In S. K. Jain (Ed.), A manual of ethnobotany (pp. 142–153). Scientific Publishers.
24. Kevalia, J., & Patel, B. (2011). Identification of fruits of *Tribulus terrestris* Linn. and Pedalium murex Linn.: A pharmacognostical approach. Ayu, 32(4), 550–553. [https://doi.org/10.4103/0974-8520.96132]
25. Kokate, C. K. (1998). Qualitative chemical examination of plant constituents. Vallabh Prakashan.
26. Lakshmi, P. (2014). Analysis of IR–spectroscopy using different *Nelumbo nucifera* samples. International Journal of Pharmaceutical Research & Analysis, 4, 14–19.
27. Mandal, R. N., Saha, G. S., & Mukhopadhaya, P. K. (2007). Lotus: An aquatic plant of versatile qualities. Aquaculture Asia, 12(1), 11–13.
28. National Medicinal Plants Board. (n.d.). Standards for good field collection practices of medicinal plants. Ministry of AYUSH.
29. Parekh, J., & Chanda, S. (2008). Phytochemical screening of some plants of Western region of India. Plant Archives, 8, 657–662.
30. Pavia, D. L., Lampman, G. M., Kriz, G. S., & Vyvyan, J. R. (2015). Introduction to spectroscopy (5th ed.). Cengage Learning.

31. Rahimi, R., Sarvestani, T., Rezazadeh, S., & Dolatabadian, A. (2012). Morphological and physiological characters of *Aloe vera* subjected to saline water irrigation. Journal of Herbs, Spices & Medicinal Plants, 18, 222–230. [https://doi.org/10.1080/10496475.2012.671802]
32. Rajendar, G., Bagyanarayana, G, & Mohammad, K., (2020). Phytochemical screening of traditional medicine and its constituent plants used for regulating the menstrual cycle disorders. Journal of Information and Computational Science, 10(10), 568–575.
33. Rajendar Gubba. Ethnomedicinal Practices of Chenchu Tribes in Nallamala Forest, Telangana, for Managing Menstrual Disorders. Int. J Adv. Std. & Growth Eval. 2024;3(11):56-59.
34. Saleem, R., Faizi, S., Deeba, F., Siddiqui, B. S., & Qazi, M. H. (1997). New bisbenzopyran from Aloe barbadensis roots. Planta Medica, 63, 454–456.
35. Selvaraju, R., & Sulochana, S. (2016). In-vitro growth and inhibition studies of *Tribulus terrestris* on calcium oxalate monohydrate crystals.
36. Shen-Miller, J. (2002). Sacred lotus: The long-living fruits of China antique. Seed Science Research, 12(3), 131–143.
37. Silverstein, R. M., Webster, F. X., Kiemle, D. J., & Bryce, D. L. (2014). Spectrometric identification of organic compounds (8th ed.). Wiley.
38. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2014). Principles of instrumental analysis (7th ed.). Cengage Learning.
39. Sofowara, A. (1993). Medicinal plants and traditional medicine in Africa. Spectrum Books.
40. Sigma-Aldrich. (n.d.). IR spectrum table & chart. [https://www.sigmaaldrich.com/technical-documents/articles/biology/ir-spectrum-table.html
41. Tho, N. T. M., et al. (2013). Green synthesis of silver nanoparticles using *Nelumbo nucifera* seed extract and its antibacterial activity. Acta Chimica Slovenica, 60(3), 673–678.
42. Trease, G. E., & Evans, W. C. (1989). Pharmacognosy (11th ed.). Macmillan.
43. Trease, G. E., & Evans, W. C. (2002). Pharmacognosy (15th ed.). Saunders.
44. Wong, C. F. (1987). Origin and historical record of *Nelumbo nucifera*. In China lotus (pp. 1–8). Academia Sinica.