

**INFRARED SPECTROSCOPIC STUDIES IN SOME *CLEOME SPECIES*****VISHAL T. APARADH* AND B. A. KARADGE**

IR spectroscopic study was conducted on the leaves of five species of *Cleome* (viz. *Cleome viscosa* L., *C. chelidonii* L.f., *C. gynandra* L., *C. speciosa* Raf and *C. simplicifolia* (Camb.) Hook f. & Thoms). All studied species showed similar nature of absorption peak at different transmission percentage. Most of the functional groups observed as per their peaks are similar in all five species with little bit difference in wavenumbers. CH₂ Stretching, C=O Stretching, N-H Bending, PO₂⁻ Stretching, C-O Stretching, C-H Stretching, OH and C-H Stretchings are the various functional groups observed. Protein, lipid, amino acid and nucleic acids composition of five *Cleome* species investigated appears to be almost alike which has been evidenced from the present IR spectroscopic studies. This can be taken as one of the parameter for chemotaxonomic support of position of species in the genus *Cleome*.

KEYWORDS : IR spectroscopic study, *Cleome species*, India

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1. INTRODUCTION

Present investigation have carried out for studying relationship among selective species of *Cleome* viz. *Cleome chelidonii* L.f., *C. speciosa* Raf., *C. gynandra* L., *C. simplicifolia* (Camb.) Hook f. & Thoms and *C. viscosa* L.. All these species are herbs growing at same locality but in different soil types as *Cleome chelidonii* grows vigorously in moist places and also in the rocky regions, while *C. simplicifolia* and *C. viscosa* grow luxuriantly in the black soil in rainy season. *Cleome simplicifolia* has very short life cycle up to 3-4 months only. *C. viscosa* and *C. gynandra* grow throughout the year but more vigorously during rainy season. *C. gynandra* grows predominantly in waste places along waste water. *C. speciosa* is cultivated species growing widely in shadow places in the red soil particularly during rainy season. It is famous for its beautiful showy inflorescence and hence cultivated in gardens.

2. MATERIALS AND METHODOLOGY

The spectrum of a dried leaf powder of *Cleome* species as sample was determined by an alkali halide pellet method [1]. About 1-3 mg of substance and same amount of KBr were homogenized in mortar with pestle. Dried this mixture for removing moisture and then pressed under high pressure (4-5 ton) at room temperature into a small disc. Pellets were formed. It was kept under IR Spectroscopy to get entire spectrum. As KBr does not absorb infrared radiation in the region 400-4000 cm^{-1} a complete spectrum of dried powder was obtained.

3. RESULTS

IR spectroscopic study was conducted on the leaves of five species of *Cleome* (Table 1 and Fig 1) (*Cleome viscosa* L., *C. chelidonii* L.f., *C. gynandra* L., *C. speciosa* Raf and *C. simplicifolia* (Camb.) Hook f. & Thoms). The data obtained was analyzed according to Kaur [2].

Cleome viscosa and *C. simplicifolia* have shown protein component having functional groups N-H stretching and O=C-N bending. Instead of O=C-N bending, there is a protein component having C=O bending functional group in *C. chelidonii*. However, in *C. speciosa* leaf protein component has many functional groups (N-H stretching, C=O stretching, C-N stretching, N-H bending and C=O bending) except O=C-N bending. This criterion may be helpful for interspecies differentiation.

In IR spectroscopy, the lipids samples show many different functional groups such as asymmetrical CH_2 stretching, asymmetrical $(\text{CH}_3)_3\text{N}^+$ bending, CH_2 wagging band progression, asymmetrical CO-O-C Stretching and asymmetrical PO_2^- stretching. In all *Cleome* species, asymmetrical CH_2 stretching, asymmetrical $(\text{CH}_3)_3\text{N}^+$ bending and CH_2 wagging band progression are the

common functional groups of lipids. However, lipids having asymmetrical CO-O-C stretching and asymmetrical PO_2^- stretching as functional groups appear to be helpful in taxonomy of species. In *Cleome viscosa* and *C. speciosa* these two functional groups of lipids are absent. While in *C. gynandra* there is presence of lipids containing CO-O-C stretching functional group. Lipids having asymmetrical PO_2^- stretching as a functional group appear to be present in *C. chelidonii* and *C. simplicifolia*.

IR spectroscopy of biological sample shows both essential and nonessential type of amino acids having many different functional groups. The IR spectroscopy of *Cleome* species showed the presence of Serine having O-H Bending functional group, Lysine with NH_3^+ and NH_3^+ bending type and Glutamic acid having symmetric CO_2^- stretching as functional groups. Lysine with NH_3^+ bending and glutamic acid with symmetric CO_2^- are common functional amino acids observed in all *Cleome* species. Serine with O-H Bending functional group is present in *C. viscosa*, *C. gynandra* and *C. speciosa* species. In *Cleome gynandra* there is presence of only lysine with NH_3^+ functional group. However, there is absence of above two uncommon functional groups in *Cleome chelidonii* and *Cleome simplicifolia*.

Nucleic acids, DNA (deoxyribonucleic acid) and RNA [ribonucleic acid] and proteins make up the most important macromolecules. Nucleic acids are now known to be found in all life forms including bacteria, archaea, mitochondria, chloroplasts, viruses and viroids. All living cells and organelles contain both DNA and RNA, while viruses contain either DNA or RNA, but usually not both (Brock and Madigan, 2009). The basic component of biological nucleic acids is the nucleotide, each of which contains a pentose sugar (ribose or deoxyribose), a phosphate group, and a nucleobase. All these are having CH_2 stretching, C=O stretching, N-H bending, symmetric and asymmetric RNA PO_2^- stretching, different RNA ribose C-O stretching with different wavenumbers and DNA ribose C-O stretching as functional groups. In *Cleome* species, CH_2 stretching, C=O stretching and N-H bending, functional groups of nucleic acids are common. Asymmetric RNA PO_2^- stretching functional group of nucleic acid is found only in *Cleome chelidonii* and *Cleome simplicifolia*. However nucleic acid containing symmetric RNA PO_2^- functional group is observed only in *Cleome speciosa*. In case of nucleic acid with RNA ribose C-O stretching functional groups two different wavenumbers are observed (1015 and 1038), it is 1016.14 in *C. viscosa*, 1035.06 in *C. chelidonii* and 1033.92 in *C. simplicifolia* with different wavenumber. In *C. viscosa* there is also presence of DNA ribose C-O stretching at 1016.14 wavenumber. It is absent in other species.

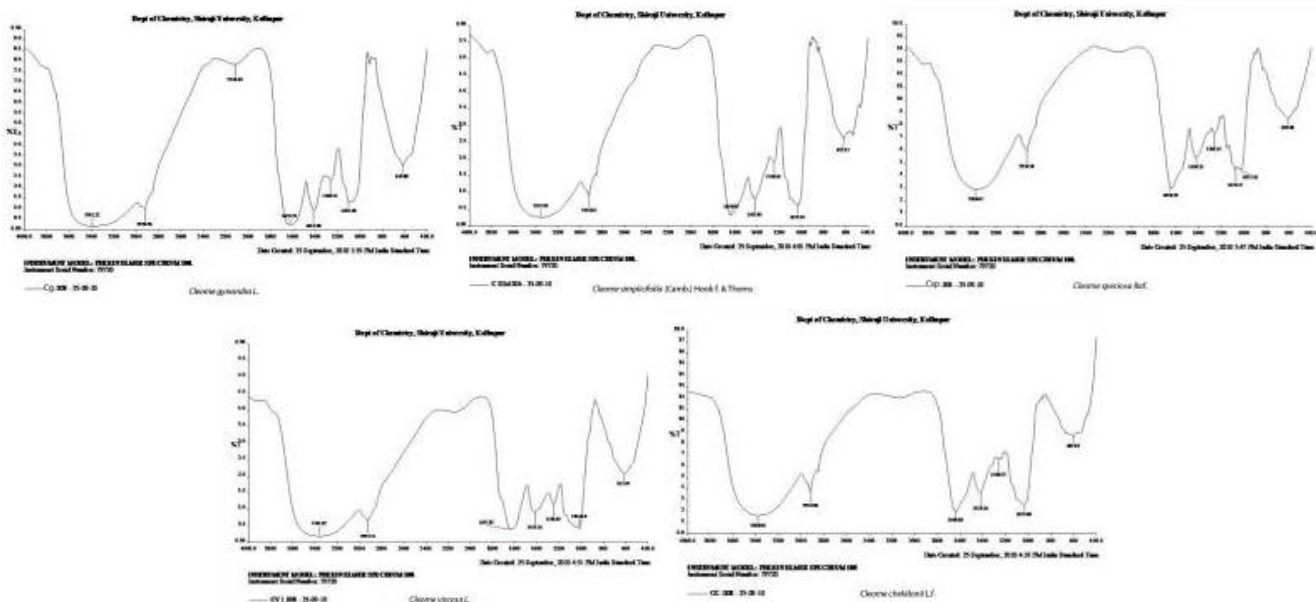


Fig. 1 Comparative infrared spectrum studies in some cleome species

Table 1: IR Spectroscopic characteristics of leaves of some *Cleome* species

Compounds	Functional group	Std wavenumber range cm^{-1}	Wavenumber as per species (cm^{-1})				
			Cleome viscosa L.	Cleome chelidonii L.f.	Cleome gynandra L.	Cleome speciosa Raf	Cleome simplicifolia (Camb.) Hook f. & Thoms
Proteins	N-H Stretching	3300	3361.02	3380.96	3391.21	3380.62	3353.93
	C=O Stretching	1653	-	-	-	1650.79	-
	C-N Stretching	1653	-	-	-	1650.79	-
	N-H Bending	1653	-	-	-	1650.79	-
	O=C-N Bending	627	615.43	-	619.08	-	622.92
	C=O Bending	600	-	603.02	-	605.06	-
Lipids	CH ₂ Stretching as	2920	2922.71	2914.96	2926.58	2926.58	2918.83
	(CH ₃) ₃ N ⁺ Bending as	1405	1419.16	1419.16	1415.28	1424.21	1423.03
	CH ₂ Wagging Band Progression	1400-1200	1264.15	1248.65	1260.27	1264.15	1248.65
	CO-O-C Stretching as	1170	-	-	1101.50	-	-
Amino acids	PO ₂ -Stretching as	1228	-	1248.65	-	-	1248.65
	Serine O-H Bending	1350-1250	1264.15	-	1260.27	1264.15	-
	Lysine NH ₃ ⁺	1100	-	-	1101.50	-	-
	Glutamic acid CO ₂ ⁻ Stretching s	1415	1419.16	1419.16	1415.28	1424.21	1423.03
Nucleic acids	Lysine NH ₃ ⁺ Bending	1645-1610	1637.03	1640.04	1627.75	1650.79	1638.09
	CH ₂ Stretching	2960-2850	2922.71	2914.96	2926.58	2926.58	2918.83
	C=O Stretching	1660-1655	1637.03	1640.04	1627.75	1650.79	1638.09
	N-H Bending	1660-1655	1637.03	1640.04	1627.75	1650.79	1638.09
	RNA PO ₂ ⁻ Stretching as	1244	-	1248.65	-	-	1248.65
	RNA PO ₂ ⁻ Stretching s	1084	-	-	-	1074.27	-
	RNA ribose C-O Stretching	1038	-	1035.06	-	-	1033.92
	DNA ribose C-O Stretching	1015	1016.14	-	-	-	-
Other	C-H Stretching	3350	3361.02	3380.96	3391.21	3380.62	3353.93
	OH	3350	3361.02	3380.96	3391.21	3380.62	3353.93
	C-H Stretching	2100	-	-	2116.68	-	-

as = asymmetric; s = symmetric

4. CONCLUSIONS

It was found that all the species studied showed similar nature of absorption peaks but at different transmission percentage. Most of the functional groups observed as per their peaks are similar in all five species with little bit difference in wavenumbers. CH₂ stretching, C=O stretching, N-H bending, PO₂⁻ stretching, C-O stretching, C-H stretching, OH and C-H stretching are the various functional groups observed. Protein, lipid, amino acid and nucleic acids composition of five *Cleome* species investigated appears to be almost alike which has been evidenced from the present IR spectroscopic studies. This can be taken as one of the parameters for chemotaxonomic support of position of species in the genus *Cleome*.

5. REFERENCES

- [1] Kalsi PS. Spectroscopy of Organic Compounds, 6th Ed. New Age International Publisher. 2007.
- [2] Kaur H. Instrumental Method of Chemical Analysis. Pragati Prakashan, Meerut, India. 2010.