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# Study of UV Vis and FTIR Absorption Spectroscopy in ayurvedic cancer cure medicinal plants

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**Abstract:** Medicinal plants play a crucial role in the preparation of ayurvedic medicines and are therefore vital to the healthcare sector. In this study, the focus is on the leaves of the medicinal plant, *Nerium oleander*, which were collected from various locations, including Bidar, Kalaburgi, Yadgir, Raichur, Bijapur and Bagalkot districts. These plants have traditionally been used in the treatment of various types of cancer. For the analysis, a single-beam ultraviolet-visible (UV-Vis) and Fourier-transform infrared (FTIR) spectroscopy were employed. The vibrational and absorption spectra of the leaves from the selected *Nerium oleander* plants were examined using these techniques. The findings indicated the absorption and presence of characteristic functional groups such as O-H, C-H, C-O, N-H, C-N, $NO_2$ and C-CL.

**Key Words:** Medicinal plant, Nerium oleander, Standards, Ultraviolet-visible (UV) and Fourier Transform Infrared spectroscopy (FTIR).

## INTRODUCTION

Ayurvedic medicine, a traditional system of healing originating from India, employs a variety of plant-based formulations for treating ailments, including cancer [1]. These medicinal plants contain numerous bioactive compounds with potential anti-cancer properties[2]. To validate their therapeutic efficacy and ensure quality control, it is essential to understand the chemical composition and bioactive constituents of these plants. Spectroscopy techniques, particularly UV-Vis (Ultraviolet-Visible) and FTIR (Fourier Transform Infrared) absorption spectroscopy, play a crucial role in this analysis[3]. UV-Vis spectroscopy measures the absorption of ultraviolet and visible light by a sample, providing information about electronic transitions in molecules[4]. This technique is used to identify and quantify various pigments, flavonoids and phenolic compounds in medicinal plants, which often exhibit characteristic absorption peaks in the UV-Vis region. On the other hand, FTIR spectroscopy measures the absorption of infrared radiation, resulting in vibrational transitions that reveal detailed information about molecular structures and functional groups[5,6]. FTIR is instrumental in identifying alkaloids, terpenoids, saponins and other bioactive

molecules. These spectroscopic methods are invaluable for identifying and characterizing the bioactive compounds responsible for the anti-cancer properties of ayurvedic medicinal plants, ensuring consistency and purity in herbal formulations and providing mechanistic insights into their action against cancer cells[7, 8]. By integrating traditional knowledge with modern scientific techniques, spectroscopy significantly advances the study and application of Ayurvedic cancer therapies[9 10]. Spectrophotometer (UV-Vis) is related to the spectroscopy of photons in the UV-visible region[11 12]. This study aims to investigate the absorption peak and functional groups in selected ayurvedic medicinal plant such as *Nerium oleander* using UV-Vis and FTIR spectroscopy.

## Materials and methods

### Collection of plant materials

The leaves of *Nerium oleander* were collected from Bidar, Kalaburgi, Yadgir, Raichur, Bijapur and Bagalkot in North East Karnataka region. The collected leaves were cleaned with tap water and distilled water. The leaves were dried at room temperature in clean lab and was powdered in grinder. The powdered leaves sample was then stored in airtight containers.

### Sample preparation and analysis

The sample is diluted to 1:10 ratio with the same solvent. Sample is kept in cuvette and subjected to UV analysis. The FTIR spectra was recorded in KBR by sophisticated computer controlled FTIR Perkin Elmer spectrometer with He-Ne laser as reference. The powdered plant material sample of *Nerium oleander* leaves were scanned at room temperature and at a spectral range of 4000-400$cm^{-1}$.

## Result and discussion

### UV-VIS spectrum analysis plant material

The UV-Vis spectral profile of plant extracts can provide qualitative and quantitative information upon the presence of different types of biological constituents[13] that are the most common phytochemicals present in the plant. The UV-Vis absorption spectra of their plant extracts were acquired in the range 200 – 400 nm. The obtained spectra profiles are presented in Figure (1). One absorption band was observed in the range from 290 to 250 nm. Broad absorption band is located

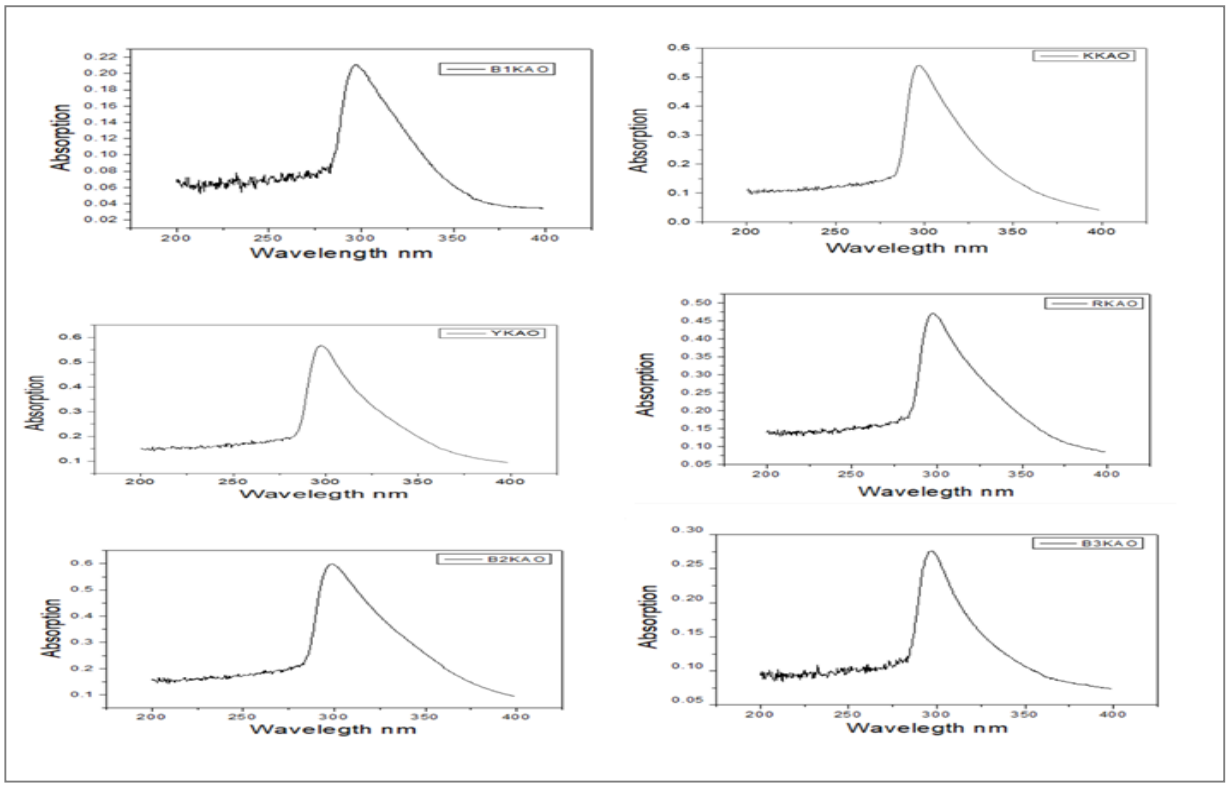
between 290 and 300 nm. These absorption bands are related to different phenolic compounds present in the plant extracts that contain Phenolic acids having UV absorption at 270–280 nm and 305–330 nm, while flavonoids possess the absorption of UV in 270–280 nm and 310–350 nm[14]. Conversely, peptide bond of proteins shows UV absorption at 220 nm[15, 16].

**FTIR Spectrum analysis**

The FT-IR spectra of plant parts like leaf of *Nerium oleander* Linn are shown in Figures 1 and 2. The absorption bands, the wave number (cm–1) of dominant peak obtained from absorption spectra are presented in Table 1 and 2.

**Figure 1**

**UV absorption spectra in Neriun Oleander medicinal plant leaves**

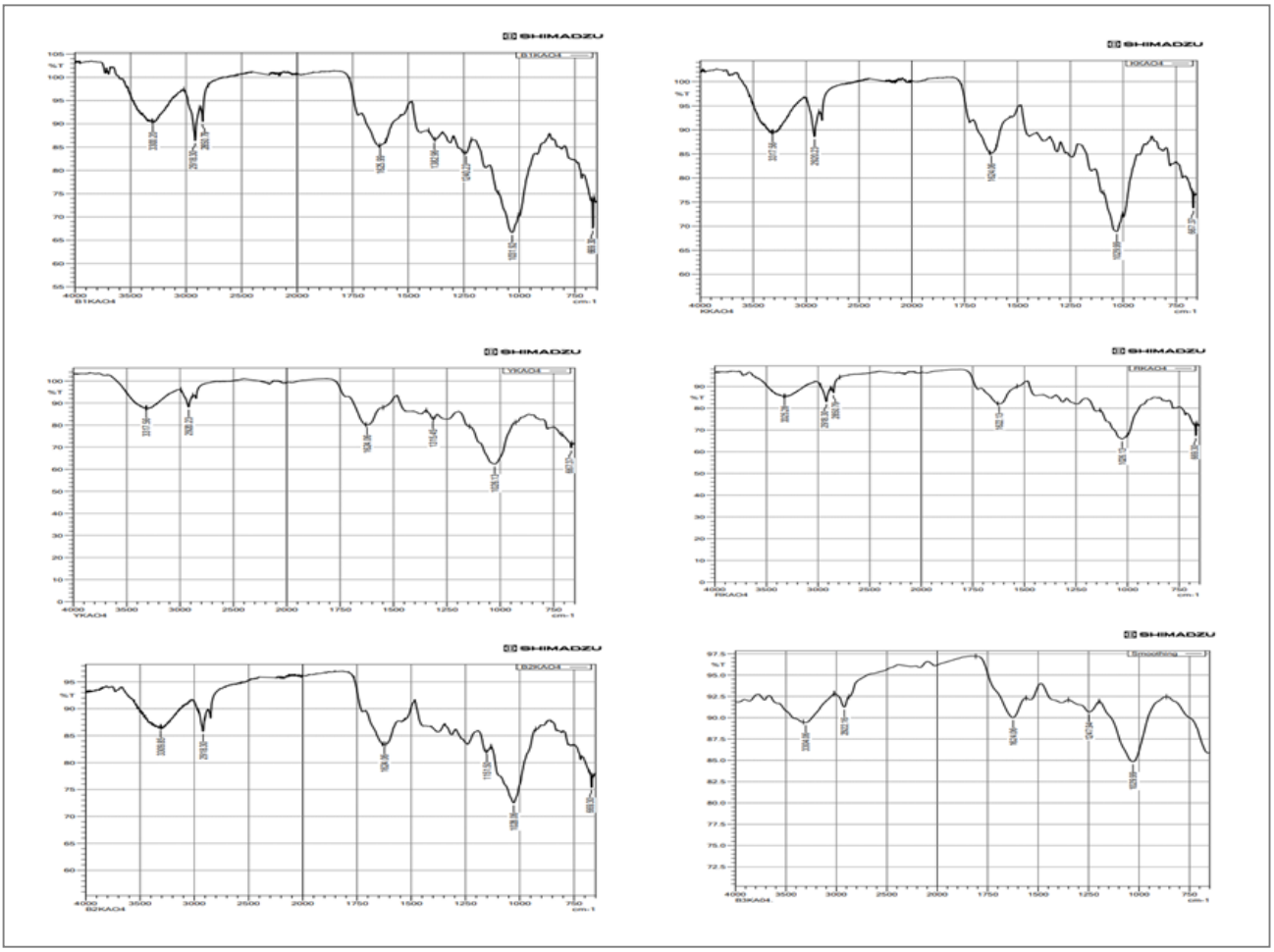



The functional group is identified by FTIR analysis and the active components based on the peak value in the region of infrared radiation. The methanol extract of *Nerium oleander* is passed into the FTIR spectroscopy and the functional groups of the components are separated based on the peak ratio. The results of FTIR analysis confirm the presence of functional groups such as non

bonded, O-H stretch, carboxylic group, acidic, C-H stretch, vibration, C-N (stretch), O-H bend, C-N stretch, C-O stretch and C-H bending.

**Figure 2**

**FTIR Spectrum in Neriun Oleander medicinal plant leaves**



The very strong absorption band observed around 3300.20–3400 cm–1 observed may be due to the absorption at 3300.20 cm–1, which shows the presence of amino acids in the two plants. The very strong absorption band appearing in the region 2918.30-2850.79 cm–1 is for *Nerium oleander* leaves[11]. The C–H asymmetrical stretching methylene group appears near 2918 cm–1. The bands observed at 2850.79 cm–1 represent C–H symmetric stretching of methylene groups in aliphatic compounds [17,18].

**Table 1**

**FTIR peak values of Nerium oleander leaves collected from three different districts of North Karnataka region**

| B1KAO | | | KKAO | | YKAO | |
|---|---|---|---|---|---|---|
| S.NO | **Functional groups** | **Wave number** | **Functional groups** | **Wave number** | **Functional groups** | **Wave number** |
| 1 | O-H | 3300.20 | O-H | 3317.56 | O-H | 3317.56 |
| 2 | C-H | 2918.30 | C-H | 2920.23 | C-H | 2920.23 |
| 3 | C-H | 2850.79 | $NO_2$ | 1624.06 | $NO_2$ | 1624.06 |
| 4 | NO2 | 1625.99 | | - | | - |
| 5 | C-N | 1382.96 | | - | C-N | 1315.45 |
| 6 | C-N | 1240.23 | | - | | - |
| 7 | C-O | 1031.92 | C-O | 1029.99 | C-O | 1026.13 |
| 8 | C-CL | 669.30 | C-CL | 667.37 | C-CL | 667.37 |

**Table 2**

**FTIR peak values of Nerium oleander leaves collected from three different districts of North Karnataka region**

| RKAO | | B2KAO | | B3KAO | |
|---|---|---|---|---|---|
| **Functional groups** | **Wave number** | **Functional groups** | **Wave number** | **Functional groups** | **Wave number** |
| O-H | 3325.28 | O-H | 3309.85 | O-H | 3304.06 |
| C-H | 2918.30 | C-H | 2918.30 | C-H | 2922.16 |
| C-H | 2850.79 | C-H | 1624.06 | NO2 | 1624.06 |
| NO2 | 1622.13 | - | - | - | - |
| - | - | - | - | - | - |
| - | - | C-O | 1151.50 | C-O | 1247.94 |
| C-O | 1026.13 | C-O | 1028.06 | C-O | 1029.99 |
| C-CL | 669.30 | -C-CL | 669.30 | - | - |

A symmetrical stretching of NO2 group observed results in strong absorption in the region 1660–1625 cm–1. The observed absorption band at1630 cm–1 indicates the presence of amines

(protein)[19,20]. The more intense bands occurring at 3300 cm–1, 2918.30 cm–1, 2850.79 cm–1, 1625 cm–1, 1382.96 cm–1, 1240.23 cm–1, 1031.96 cm -1 and 669 cm–1 corresponding to O–H/C-N, C–H, C–O and C-CL stretching / bending vibrations respectively indicate the presence of amino acids, alkenes, nitrates, ethers, organic halogen compounds and carbohydrates in *Nerium oleander* leaves.

## Conclusion

The application of UV-Vis and FTIR spectroscopy to the study of medicinal plants, particularly those used in ayurvedic cancer treatments provides valuable insights into their chemical composition and bioactive constituents. UV-Vis spectroscopy identifies and quantifies various pigments, flavonoids, and phenolic compounds by analyzing their characteristic absorption peaks in the ultraviolet and visible light regions. This helps in understanding the presence and concentration of these compounds, which are often associated with antioxidant and anti-cancer properties. On the other hand, FTIR spectroscopy reveals detailed information about the molecular structures and functional groups present in the bioactive compounds through the absorption of infrared radiation, leading to vibrational transitions. This technique is instrumental in identifying key bioactive molecules such as alkaloids, terpenoids, and saponins. Together, these spectroscopic methods ensure the consistency, purity and efficacy of herbal formulations, validate traditional medicinal practices and provide mechanistic insights into the therapeutic actions of these plants against cancer. By integrating traditional ayurvedic knowledge with modern scientific techniques, UV-Vis and FTIR spectroscopy significantly advance the validation, quality control, and development of plant-based cancer therapies.

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