



Assessment of soil physico chemical parameters and ftir study on soil and leaves of elaeocarpus ganitrus roxb in Sim's park, Coonoor

K Chitra

Assistant Professor, Department of Botany, Bharathiar University, Coimbatore, Tamil Nadu, India

Abstract

Soil is necessary for the growth of the plants. It acts as a reservoir for minerals. Minerals play a vital role and they are an important source for plants growth. *Elaeocarpus ganitrus* Roxb. is an economically important tree. It is otherwise called as rudraksha tree. In Sim's park *Elaeocarpus ganitrus* Roxb. was planted in the year 1905. Slope soil was collected for research purpose. It is 115 years old. So the soil status positively correlated with the growth and survival of *Elaeocarpus ganitrus* Roxb. Soil texture and type were analysed for physical parameters. Chemical parameters such as pH, EC, organic carbon, macronutrients and micronutrients were studied. Macronutrients were present in higher amount. Micronutrients were present in sufficient level. FTIR study on soil showed that many functional groups were present. They were responsible for soil fertility. FTIR study on leaves showed that many functional groups were present in *Elaeocarpus ganitrus* Roxb. This study observed that, it has many medicinal values. There was an absence of cyanide group. So the endangered plant was free from toxic substance. This study concluded that, soil was good in fertility and the presence of functional groups in leaves confirmed that its medicinal value and it was suitable to cure many diseases.

Keywords: slope soil, soil parameters, fertility, FTIR study, cyanide, medicinal value

1. Introduction

Elaeocarpus ganitrus Roxb. is an average sized evergreen tree. It has spreading attractive crown, found in tropical and subtropical areas at the altitude ranging from the sea coast to 2,000 meters more than the sea level. Common name as Rudraksha in Sanskrit and Rudraki in Hindi for *Elaeocarpus ganitrus* Roxb. They are growing in Himalayan region in India for its medicinal properties and attractive fruit stones. Rudraksha is called it as the King of herbal medicineworking effectively and positively. They are measured to be sacred and have many spiritual and medicinal values both as defensive and remedial. On hill slopes, it prevents soil erosion.

Soil play a crucial role in determining the vegetation. Soil composition and properties are controlled by various environmental factors like slope, climate, landscape, microclimate, topography and vegetation^[13, 14]. Soil characters such as water retaining capacity, biodiversity, supporting agriculture, prevents soil erosion, land slides and flooding are influenced by soil characters^[1]. Soil quality is a promising factor for the sustainability of environment and biosphere. Soil maintenance is a critical phenomenon. Agricultural soils^[2, 3, 4], forests soils^[5, 6, 7], and grassland soils^[8, 9] were taken into consideration for previous research by many researchers. Due to increasing awareness in environmental conservation issues, particularly slope soil restoration and stabilization considerable documentation produced for ecological restoration^[10, 11, 12].

Nutrient deficiency may result in decreased plant productivity and fertility. Nutrients deficiency often cause stunted growth, death of plant tissue, reduced production of chlorophyll leads to yellowing of leaves. Plant quality also depends on nutrients. Nutrient deficiency results in the reduction of biodiversity, because plants serve as the producers and they support most food webs^[15].

Soil organic matter is an important factor, which determines soil nutrient supply capacity. Plants depend on soil organic matter mineralization for nutrient supply. FTIR study is an inexpensive method for characterization of soil organic matter composition in soil. It provides quality of soil organic matter based on the presence of chemical building blocks, responsible for soil organic matter. FTIR spectroscopy measures absorbance at frequencies, that are specific to organic matter bond type and excitation leads to stretching, bending upon absorption. It gives more information, and it is alternative method for expensive soil analyses methods. Midinfra-red region (4000-400 cm^{-1}) referred as a fingerprint for composition of soil organic matter^[21].

1.1 Extinction of plants

About a third of the world's vascular plant species face the threat of extinction due to a variety of devastating activities, including, over-harvesting and over exploitation, destructive agricultural and forestry practices, urbanization, environmental pollution, land-use changes, exotic invasive species, global climate change, and more. *Elaeocarpus ganitrus* Roxb. is an endemic plant. So the present study has been made to identify the main functional groups in various phytochemicals in the leaves of this endemic medicinal plant by FTIR analysis.

In plants both primary and secondary metabolic processes are responsible for large spectrum of biochemical substances. These biochemical substances or metabolites play vital role in defense mechanism, cell signalling, and interfere with enzymatic and hormonal activities. The secondary metabolites function like a medicine to cure diseases. Medicinal plants are validated for their phytochemical compounds using different scientific techniques and methods. Various plants parts are used in

FTIR analysis for identification and characterization of functional groups. It is an effective tool for biological materials to analyse the chemical bonds. The importance of FTIR technique is proved by earlier studies on Indian medicinal plants [17, 18, 19, 20]. Functionally active secondary metabolites were present in plants and they were a good source of essential nutrients [22, 23]. So the present study has been made to identify the main functional groups in various phytochemicals in the leaves of this endemic medicinal plant by FTIR analysis.

2. Materials and Methods

2.1 Study area

Coonor is at an altitude of 6,100 feet above sea level. Sim's park is situated at an elevation of 5,800 - 5,900 feet, Sim's Park is the major attraction in Coonor. It was founded in 1874 by Mr. J.D. Sims and Major Murray as an amusement park. It covers an area of 12 acres of undulating land, the park spread across a ravine, has been developed into a botanical garden partly in Japanese style.

2.2 Sample collection

Soil sample was collected at a depth of 0 – 15 cm after removing grasses, litter and also plant residues from the soil surface. Soil collection tools were used for sample collection. The sample was collected in clean polythene bag. The polythene bag was sealed and labelled for further studies. The soil sample was air dried, grind and screened using a 2 mm sieve. The processed soil sample was analysed for physico chemical properties by standard methods. The leaves were also collected in polythene bags for FTIR analysis.

2.3 FTIR study on soil

The functional group identification is made by Fourier Transform Infrared (FTIR) Spectroscopic analysis and the active components based on the peak value in the region of infrared radiation. The soil of *Elaeocarpus ganitrus* Roxb. was analysed in FTIR spectroscopy. The soil was made as a

pellet with KBr. Then it is passed into the FTIR spectroscopy and the functional groups of the components are separated based on the peak ratio. *Elaeocarpus ganitrus* Roxb. leaves were powdered and made into pellet with the help of KBr. Then it is passed into the FTIR spectroscopy and the functional groups of the components are separated based on the peak ratio.

2.4 FTIR study on leaves

The powdered leaf sample was used. For FTIR analysis the powdered leaf sample was made into pellet using KBr. The data was referred for a wave number ranged from 4000 cm^{-1} to 500 cm^{-1} . The spectral values were compared with reference values for the identification of functional groups existing in the sample.

3. Results

Table 1: Physical parameters

S. No	Parameters	Comment
1.	Soil texture	Sandy loam
2.	Soil type	Brown black
3.	Lime status	Lime status

Table 2: Chemical parameters

S. No	Parameters	Value	Unit	Comment
1	pH	5.35	-	Strongly acidic
2	EC	0.24	ds m^{-1}	Non-saline
3	Organic carbon	9.28	%	High
4	Nitrogen	742	kg ha^{-1}	High
5	Phosphorus	136.9	kg ha^{-1}	High
6	Potassium	795	kg ha^{-1}	High
7	Zinc	1.41	ppm	Sufficient
8	Copper	13.60	ppm	Sufficient
9	Ferrous	61.05	ppm	Sufficient
10	Manganese	27.28	ppm	Sufficient
11	Boron	1.18	ppm	Sufficient

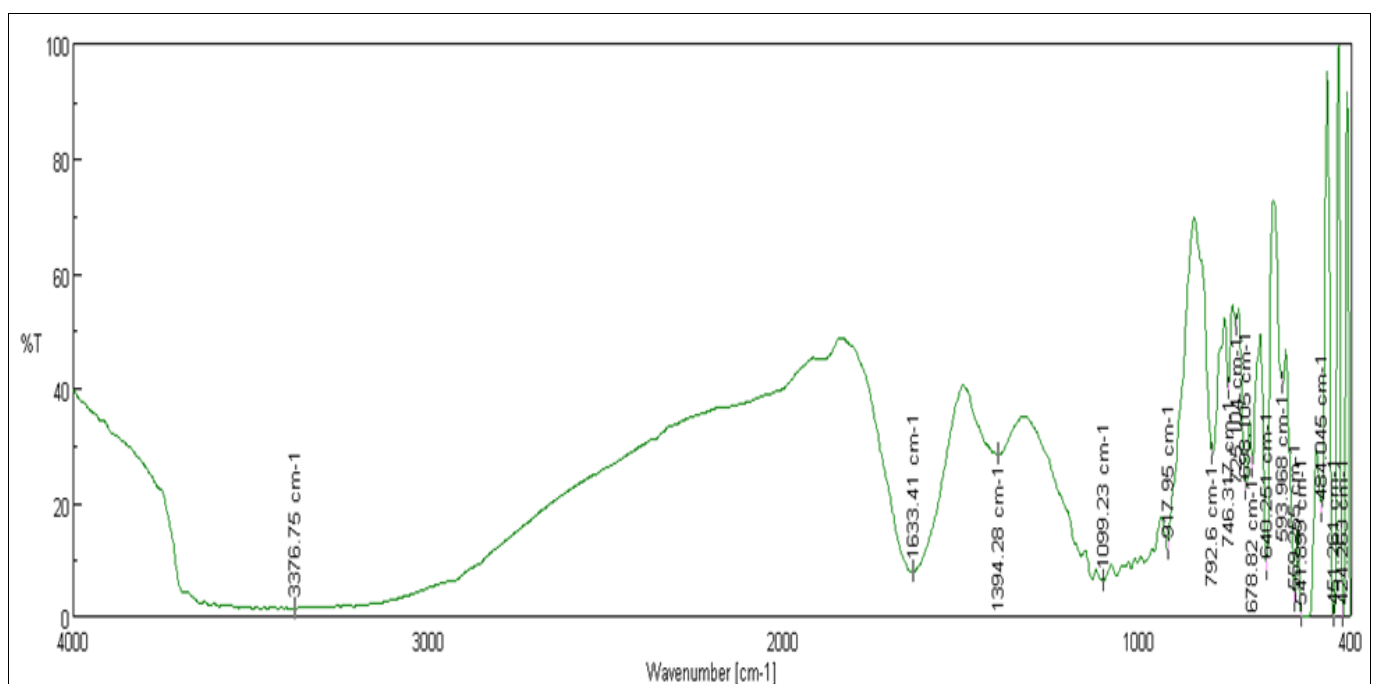


Fig 1: FTIR spectra on soil of *Elaeocarpus ganitrus* Roxb.

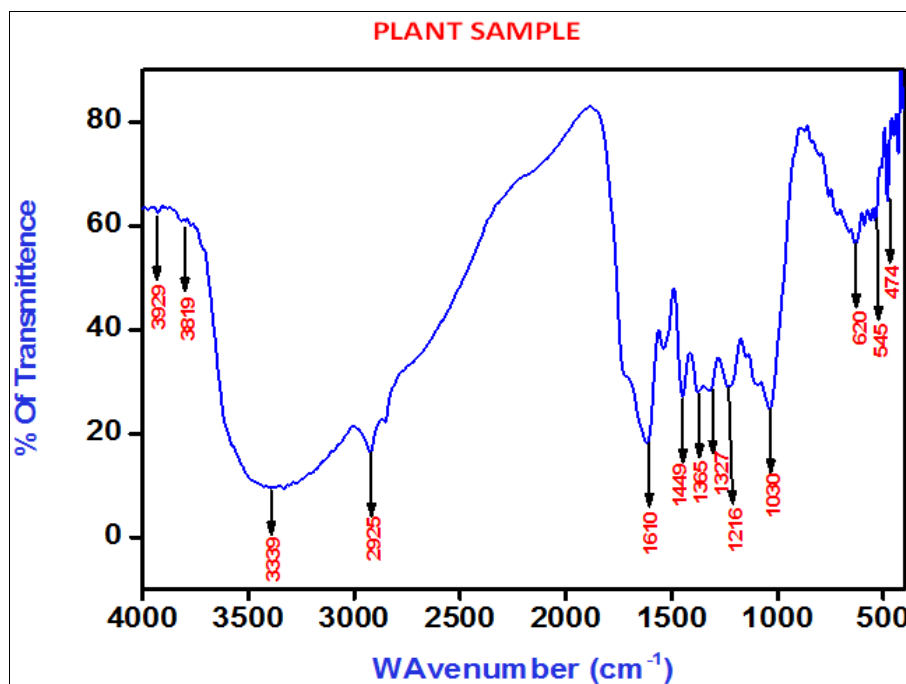


Fig 2: FTIR spectra on leaves of *Elaeocarpus ganitrus* Roxb.

Table 3: The results of FTIR analysis confirm the presence of functional groups such as

S.No	Wavelength cm ⁻¹	Test sample	Wavelength cm ⁻¹	Reference value	Functional Groups	Expected phytochemicals identified
1	3929			Non-stretch bond	O-H	Hydroxyl groups
2	3810			Non-stretch bond	O-H	Hydroxyl groups
3	3339			3300-3600	O-H	Poly hydroxyl compound
4	2925			2850-3000	C-H	Saturated aliphatic compounds - lipids
5	1610			1550-1650	C=O	Ketone compound
6	1449			1400-1500	C-C	Aromatics
7	1365			1310-1410	O-H alcoholic group	Phenol or tertiary alcohol
8	1327			1250-1335	C-N stretch	Aromatic primary amine
9	1216			1250-1335	C-N stretch	Aromatic primary amine
10	1030			1000-1100	PO ₃	Phosphate compound
11	620			515-690	C-Br stretch	Aliphatic bromo compounds
12	545			515-690	C-Br stretch	Aliphatic bromo compounds

4. Discussion

The pH was strongly acidic in nature. Acidic nature of soil is due to high rain fall. It leads to leaching of bases from the soil. The EC of the soil was 0.24 dsm⁻¹. The result showed that the soluble salts were not accumulated in the soil. Due to high rainfall there might be sufficient leaching and flushing of salts in the study area. It was non-saline in nature. Organic content of the soil sample was 9.28%. It was high amount. Falling leaves increase the soil organic carbon. Organic manures also increase the organic carbon. Nitrogen content was 742 kg ha⁻¹. Nitrogen is necessary for building proteins, produces carbohydrates, and is essential for plant growth. Phosphorus content was 136.9 kg ha⁻¹. Phosphorus maintains root growth, seed formation, and plant maturity. Potassium was 795 kg ha⁻¹. Potassium play a key role in disease resistance, fruit formation, and effects plant enzymes. All the macro nutrients were present in higher amount. Zinc - 1.41 ppm. It is important for the transformation of carbohydrates. Consumption of sugar is regulated by zinc. It regulates plant growth, because it is the part of enzyme system. Copper - 13.60 ppm. For reproductive growth copper is very important. It take part in root metabolism and helps in the utilization of proteins. Ferrous 61.05 ppm. It play a vital role in the formation of chlorophyll. Manganese 27.28 ppm. Its function

is with enzyme system. It play a key role in breakdown of carbohydrates, and nitrogen metabolism. Soil is a source of manganese. Boron - 1.18 ppm. It helps in the use of nutrients and regulates other nutrients. It is important for seed and fruit development. Organic matter and borax are the main sources of boron. The micronutrients were sufficient amount in the soil (Table 2).

FTIR study was used to find out the soil fertility. It provides overall chemical profile of soil. It gives information on both organic and minerals components present in soil. It is an inexpensive and conventional method. Infrared spectroscopy is a suitable tool for the identification of functional groups in chemical compounds. Carbon, nitrogen and phosphorus were evaluated through this study. It was mainly done for soil management and crop production. Mid infrared spectrum (400 – 4000 cm⁻¹) of soil divided into four regions. The nature of a group frequency determined by based on their regions. In (2500 - 4000cm⁻¹) region are mainly for O-H, C-H, N-H stretching. N-H stretching is usually occur in (3600-3700cm⁻¹) region. In this soil sample, it was occur in 3376.75cm⁻¹. C=C stretching occur in 1633.41cm⁻¹. 1500- 2500 cm⁻¹ region is for principal bands. It is due to C=C, C=O stretching. Around 1650cm⁻¹ C=C stretching was occur. It is weak stretching. Finger print region is occur in (400-1000 cm⁻¹) region. In this region

many vibrations may vary by hundreds of wave numbers^[16]. (Fig 1).

The FTIR study on leaves of *Elaeocarpus ganitrus* Roxb. Indicated that the presence of biochemical contents. It ensures different functional groups. The spectra obtained for the region of 4000-400cm⁻¹. The frequency ranges from 3929 cm⁻¹, 3810 cm⁻¹ represented the O-H group, which is responsible for carbohydrates and amino acids. The frequency 3339 cm⁻¹ confirmed the presence of poly hydroxyl compound. The frequency 2925 cm⁻¹ represented the C-H group for saturated aliphatic compounds, mainly lipids. The frequency from 1610 cm⁻¹ confirmed the functional group C=O, ketone compound. The frequency from 1449 cm⁻¹ represented the functional group C-C, for aromatics. The frequency from 1365 cm⁻¹ indicated the functional group O-H, alcoholic group for phenol or tertiary alcohol. The frequencies from 1327 cm⁻¹ and 1216 cm⁻¹ represented the C-N functional groups indicated the presence of aromatic primary amines. The frequency from 1030 cm⁻¹ represented the functional group PO₃ indicated phosphate compound. The frequencies from 620 cm⁻¹, 545 cm⁻¹ indicated the functional group C-Br, represented the aliphatic bromo compounds^[24, 25], (Fig 2), (Table 3).

5. Conclusion

This study clearly indicates the plant growth and soil management. They use organic fertilizers for the growth of the plants. Organic content was high in the soil. Macro and micro nutrients are sufficiently present in the soil. In Sim's park *Elaeocarpus ganitrus* Roxb. is a best example for ex-situ conservation of endangered plants. It is 115 years old. So the soil parameters positively correlated with the growth and survival of *Elaeocarpus ganitrus* Roxb. This results were confirmed by FTIR analysis on soil parameters. The functional groups which are present in soil confirmed the soil fertility. The present study was also undertaken with a view to identify the functional groups present in the leaves of the plant taken with the help of FTIR analysis. It helps to identify the chemical constituents, elucidate the chemical structure and also effort was taken to understand the significance of functional groups as bio active constituents for the treatment of various diseases. The results of FTIR analysis confirmed the presence of alcohol, phenol, aldehyde, aromatic compound, secondary alcohol, aromatic amines, phosphate compound and aliphatic bromo compound. There is no absorbance in between the region 2220- 2260 cm⁻¹ indicates that there are no cyanide groups in the medicinal plants taken. This shows that sample taken for the study does not contain any toxic substances.

6. Acknowledgment

The author is thankful to UGC – SAP, for their financial support to carry out this project research work.

7. References

- Cardoso EJBN. Soil health: looking for suitable indicators. What should be considered to assess the effects of use and management on soil health? *Sci. Agr.* 2013; 70:274-289. [Google Scholar]
- Álvaro-Fuentes J, Arrúe JL, Gracia R, López MV. Soil management effects on aggregate dynamics in semiarid Aragon (NE Spain). *Sci. Total Environ.* 2007; 378:179-182. [PubMed] [Google Scholar]
- Ciric V, Manojlovic M, Nestic L, Belic M. Soil dry aggregate size distribution: effects of soil type and land use. *J. Soil Sci. Plant Nut.* 2015; 12:689-703. [Google Scholar]
- Wang Y, Zhang JH, Zhang Z. H. Influences of intensive tillage on water-stable aggregate distribution on a steep hillslope. *Soil Till. Res.* 2015; 151:82-92. [Google Scholar]
- Bruland GL, Bliss CM, Grunwald S, Comerford NB, raezt DA. Soil nitrate-nitrogen in forested versus non-forested ecosystems in a mixed-use watershed. *Geoderma.* 2018; 148:220-231. [Google Scholar]
- De Vos B. Benchmark values for forest soil carbon stocks in Europe: Results from a large scale forest soil survey. *Geoderma*, 2015, 251-252. [Google Scholar]
- Machado AI. Cation export by overland flow in a recently burnt forest area in north-central Portugal. *Sci. Total Environ*, 2015, 524-525. [PubMed] [Google Scholar]
- Askari MS, Holden NM. Indices for quantitative evaluation of soil quality under grassland management. *Geoderma.* 2014; 230-231. [Google Scholar]
- Wang D, Wu GL, Zhu YJ, Shi ZH. Grazing exclusion effects on above- and below-ground C and N pools of typical grassland on the Loess Plateau (China). *Catena.* 2014; 123:113-120. [Google Scholar]
- Esmaili M, Arbabi B. Railway embankments stabilization by tied back-to-back system. *Comput. Geotech.* 2015; 67:110-120. [Google Scholar]
- Katz O, Reichenbach P, Guzzetti F. Rock fall hazard along the railway corridor to Jerusalem, Israel, in the Soreq and Refaim valleys. *Nat Hazards.* 2011; 56:649-665. [Google Scholar]
- Xu C. Landslides triggered by the 20 April 2013 Lushan, China, Mw 6.6 earthquake from field investigations and preliminary analyses. *Land slides.* 2015; 12:365-385. [Google Scholar]
- Chen ZS, Hsieh CF, Jiang FY, Hsieh TH, Sun IF. Relationships of soil properties to topography and vegetation in a subtropical rain forest in southern Taiwan. *Plant Ecology.* 1997; 132:229-241.
- Tsui CC, Chen ZS, Hsieh CF. Relationships between soil properties and slope position in a lowland rain forest of southern Taiwan. *Geoderma*, 2004, (123):131-142.
- Morgan JB, Connolly EL. Plant-Soil Interactions: Nutrient Uptake. *Nature Education Knowledge.* 2013; 4(8):2
- Changwen Du, Jianmin Zhou. Evaluation of soil fertility using infrared spectroscopy: a review, *Environ Chem Lett.* 2009; 113:7-97. DOI 10.1007/s10311-008-0166-x
- Ashokkumar R, Ramaswamy M. Phytochemical screening by FTIR spectroscopic analysis of leaf extracts of selected Indian Medicinal plants. *International Journal of Current Microbiology and Application Science.* 2014; 3(1):395-406.
- Annette N, Lukas K, Andrea K, Hansjoerg H, Hartwig S. Discrimination of Solanaceae Taxa and Quantification of Scopolamine and Hyoscyamine by ATR-FTIR Spectroscopy. *Planta Medica.* 2014; 80(15):1315-1320.

19. Anil Kumar VS, Sunila AV, Murugan K. Micromorphological and FTIR Spectral Analysis Of Solanum Trilobatum L. (Solanaceae) - A Medicinally Valued Thorny Creeper From South India. International Journal of Advanced Research. 2016; 4(1):1249-1257.
20. Charushila D, Swaroopa P. FTIR Spectroscopic Screening of Phytochemicals of Two Medicinally Important Species of Solanum Used in Preparation of Dashmula Formulation. International Journal of Pharmaceutical Sciences Review and Research. 2016; 36(2):112-120.
21. FTIR indicators of soil organic matter quality across a landscape of organic management, Jackson Soil and Root Ecology Lab, University of California.
22. Khan MI, Sri Harsha PSC, Giridhar P, Ravishankar GA. Pigment identification, antioxidant activity, and nutrient composition of *Tinosporacordi folia* (willd.) miers ex hook. f&thoms fruit. Int J Food Sci Nutr. 2011; 62:239-249. doi: 10.3109 / 09637486.2010.529069. [PubMed] [CrossRef] [Google Scholar].
23. Khan MI, Sri Harsha PSC, Giridhar P, Ravishankar GA. Pigment identification, nutritional composition, bioactivity, and *in vitro* cancer cell cytotoxicity of *Rivinahumilis* L. berries, potential source of betalains. LWT Food Sci Technol. 2012; 47:315-323. doi: 10.1016 / j.lwt.2012.01.025.
24. Arockiasahayaraja P, Gowri J, Dharmalingama V, Shobanaa R, AngelinPrema A. Phytochemical screening by FTIR spectroscopic analysis of leaf and stem Extracts of wedeliabiflora, International Journal of Nano Corrosion Science and Engineering. 2015; 2(5):322-334.
25. Dharmasoth Rama Devi, Ganga Rao Battu. Qualitative Phytochemical Screening and Ftir Spectroscopic Analysis Of *Grewia Tilifolia* (Vahl) Leaf Extracts, Int J Curr Pharm Res. 2019; 11(4):100-107.