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## Fourier transform infrared spectroscopy (FTIR), a powerful tool for detection of various functional groups in *Rusulla delica* Fr.

Renu Parmar, Dinesh Kumar and Vijay Singh

**Abstract**

Seventeen peaks were observed in FTIR spectra of *Rusulla delica* Fr. between 4000-600  $\text{cm}^{-1}$ . These corresponds to thirteen various functional groups. *R. delica* contains alcohols, phenols, alkanes, alkynes, nitro compounds, aromatics and aromatic compounds, carboxylic acid, ethers, esters, aromatic & aliphatic amines and alkyl halides which were reported to have essential phytochemical properties. Presence of these compounds indicates that this macro fungus can be beneficial in various pharmaceutical and curative purposes. The study is the first report from Himachal Pradesh, India.

**Keywords:** Macro-fungi, mushroom, delicacy, therapeutic, FTIR

**Introduction**

Mushrooms are one of the useful, delicious and mysterious members on the earth and attracted the attention of mankind by their beauty, fleshy construction, taste and nutritive value. There have been references regarding the use of mushrooms in the ancient Indian, Greek, Roman, Chinese, and other literature. Mushrooms are considered as good source of protein and minerals and found to be substitute for meat and fish. From ancient time macro-fungi are consumed by human for their delicacy, taste and pleasing flavour <sup>[1]</sup>. Naturally these fruiting bodies grow on tree trunk, roots as well as on decaying organic matter <sup>[2]</sup>. Wild mushrooms are having nutritional value with high content of proteins, vitamins, carbohydrates, minerals, fibres, trace elements, low/no calories and cholesterol <sup>[3-5]</sup>. Mushrooms have been a food supplement in various cultures for a long time. Mushrooms are useful because of having anti hypertension, hypercholesterolemia, antitumor, cytostatic, antioxidant and also having antibacterial and antiviral properties due to their chemical composition <sup>[6-12]</sup>. They have been considered as strong analgesic, anti-inflammatory and antipyretic activity <sup>[13-16]</sup>.

In the present paper, presence of various functional groups in *R. delica* was determined by using Fourier transform infrared spectroscopy (FTIR). This is the reliable and sensitive method for detection of bio-molecular composition in different plant materials <sup>[17]</sup>.

**Material and Methods**

Samples of macro-fungi were collected from Solan (Pandah), Kullu (BijliMahadev), Mandi (Ghatasani), Kinnaur (Roghi) and Chamba (Kalatop) district of Himachal Pradesh from August to October month during 2013 and 2014 in conifer forests. This area surveyed was located between 30° 22' to 30° 12' North latitude and 75° 47' to 79° 4' East longitude (Figure 1). Soil was full of organic matter and having 80% relative humidity. Temperature ranges from 15-25°C, soil of most of the habitat was acidic in nature as per the observation taken by digital pH meter (pH of 6-6.30) (Table 1). Samples photographs were snapped with Canon 10 MP camera Figure 2.

**Collection, identification and analysis:** Samples were carefully handpicked, placed in well labelled paper bags and transported to the laboratory for their identification and processing. Samples were macroscopically identified (Source: [www.mushroomexperts.com](http://www.mushroomexperts.com)) and identification was confirmed by Dr Anand Sagar (Professor, Department of Bio-Sciences, HPU, Shimla). Samples were washed to remove the debris and placed in hot air oven at 40°C for proper drying. Dried samples were grind into fine powder by adding liquid nitrogen. Powdered sample was evaluated with the help of FTIR analysis to identify various components.

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**Fourier-transform infrared spectroscopy (FTIR) analysis:** FTIR is a powerful tool for identifying different functional groups present in the sample. In the present study, FTIR spectra were recorded on Agilent Cary 630 FTIR Spectrophotometer Model no. G8043AA, Cary 630 1B Diamond ATR Module ZnSe. Spectra were recorded in the range 600-4,000  $\text{cm}^{-1}$ .

### Results and Discussion

FTIR spectra of *R. delica* reveal 17 peaks which correspond to thirteen functional groups. Peak 3253  $\text{cm}^{-1}$  corresponds to O-H stretch; 2925  $\text{cm}^{-1}$  and 2854  $\text{cm}^{-1}$  corresponds to C-H stretch; peak 2113  $\text{cm}^{-1}$  corresponds to  $\text{-C}\equiv\text{C-}$  stretch; 1640  $\text{cm}^{-1}$  corresponds to  $\text{-C=C-}$  stretch; peaks at 1566 corresponds to C=C stretch; 1547  $\text{cm}^{-1}$  corresponds to N-O asymmetric stretch; 1402  $\text{cm}^{-1}$  corresponds to C-C stretch; peak at 1380  $\text{cm}^{-1}$  corresponds to  $\text{CH}_3\text{C-H}$  bend; peak at 1320  $\text{cm}^{-1}$  corresponds to C-O stretch; peak at 1253 and 1026  $\text{cm}^{-1}$  corresponds to C-N stretch; peak at 1153  $\text{cm}^{-1}$  corresponds to  $\text{-C-H}$  wag; peak at 937  $\text{cm}^{-1}$  corresponds to O-H bend and 676  $\text{cm}^{-1}$  corresponds to  $\text{-C}\equiv\text{C-H}$  bend (Table 2 & Figure 3). It is found that two peaks (2002 & 2087) observed in the spectra were not correspond to any absorption bands of different functional groups (Figure 3).

FTIR spectroscopy is proved to be a reliable and sensitive method for detection of biomolecular composition in different plant materials [17]. Previously similar study was carried out by Parmar and Kumar [18] from Himachal Pradesh, India. They detected nine functional groups in FTIR spectra of *Pleurotus cornucopiae* (Paulet) which support the present finding. Jin-Zhe *et al.* [19] determined the FTIR spectra of the polysaccharides isolated from four common edible mushrooms. During their study they reported the

monosaccharide composition in these edible mushrooms species. Different functional groups were observed in *Azolla microphylla* by Veerabahu and Theivandran [20]. Barros *et al.* [21] concluded by their study that phenolic compounds are responsible for antimicrobial activities of wild macrofungus. In present study, alcoholic and phenolic group detected in *R. delica* can be of found to be of antimicrobial as well as therapeutic importance.

**Table 1:** Physical characteristic of soil in different localities

Characters	Value
pH	6-6.30
Soil texture	Loam
Annual rainfall	750-1200 mm

**Table 2:** FTIR frequency and functional groups in *Rusulla delica*

Frequency ranges	Functional groups	Frequency observed in the sample
3500-3200 (s, b)	O-H stretch (Alcohol, phenol)	3253
3000-2850 (m)	C-H stretch (alkanes)	2925
3000-2850 (m)	C-H stretch (alkanes)	2854
2260-2100	$\text{-C}\equiv\text{C-}$ stretch (alkynes)	2113
1680-1640 (m)	$\text{-C=C-}$ stretch (alkenes)	1640
1600-1450 (m-s)	C=C stretch (aromatic compounds)	1566
1550-1475 (s)	N-O asymmetric stretch (nitro compounds)	1547
1500-1400 (m)	C-C stretch (aromatics)	1402
1390-1370 (m)	$\text{CH}_3\text{C-H}$ bend (alkanes, alkyls)	1380
1320-1000 (s)	C-O stretch (alcohol, carboxylic acid, esters, ethers)	1320
1335-1250 (s)	C-N stretch (aromatic amines)	1253
1300-1150 (m)	C-H wag (alkyl halides)	1153
1250-1020 (m)	C-N stretch (aliphatic amines)	1026
690-515 (m)	O-H bend (Carboxylic acids)	937
690-515 (m)	C-Br stretch (alkyl halides)	676

\*s-Strong, m-Medium, b-Broad

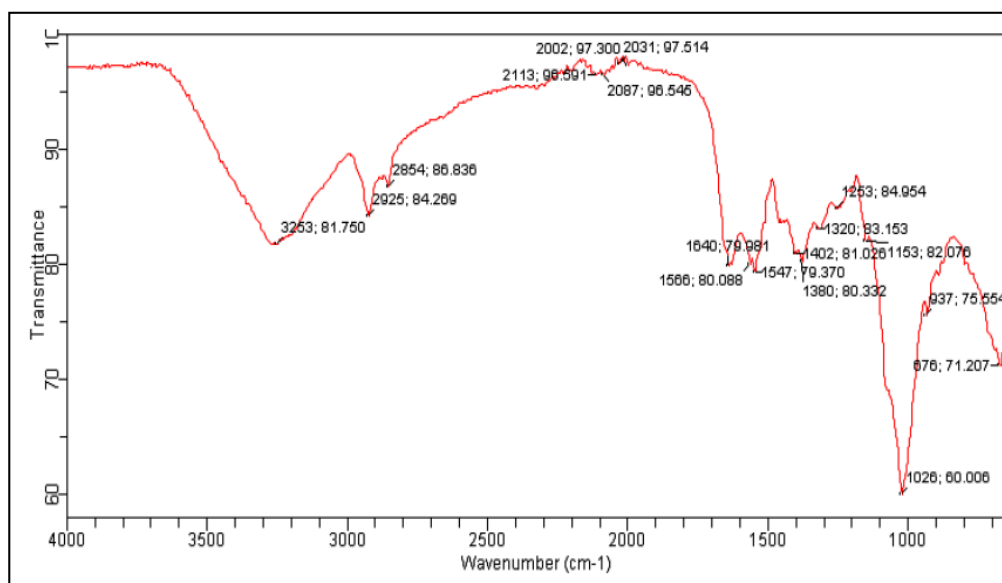


(Source: Google map)

**Fig 1:** Area surveyed for sample collection in Himachal Pradesh



**Fig 2:** Fruiting body of *Rusulla delica* Fr.



**Fig 3:** FTIR spectra of *Rusulla delica* Fr

### Conclusion

Various functional groups were evaluated in *R. delica* which confer its medicinal properties. The detected functional groups can play a beneficial role for human being because of their natural origin and also found to be safer in therapeutic use with low risk of resistance development by pathogenic microorganisms.

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### Conflicts of Interest

There is no conflict of interest regarding this paper and if any problem arises pertaining to this paper I/we shall be held responsible.

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