



Research Article

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Phytochemical screening and functional group analysis of four medicinally important plants

Vignesh Subramanian, Ishita Basu, Pranav R. and Rajendran N.

School of Bio-Science and Technology, VIT University, Vellore, Tamil Nadu, India

ABSTRACT

The objective of this work is to screen phytochemical and functional groups for analysis of four medicinally important plants namely paddy's lucerne, castor, datura and Indian beech. The stem powders of these four plants were extracted with acetone, chloroform and water and these extracts were then used for phytochemical analysis to find out the presence of various compounds like alkaloids, flavonoids, tannins etc. The stem powders were also put through FTIR to find out the different functional groups present in the plants in order to understand their medicinal properties and activities better. Phytochemical analysis was performed to confirm the presence of seven phytochemical groups which are Saponins, Terpenoids, Flavonoids, Phenols, Sterols, Tannins, and Phytosterols in the four mentioned plants. Paddy's lucerne and castor showed the presence of all the phytochemicals whereas datura and Indian Beech showed the absence of Phenol and Saponins respectively but showed the presence of rest all other phytochemicals. FTIR results showed the presence of various functional groups like amine, alkane, alkene, alcohol etc which aids to each of their medicinal properties. It can be concluded that presence of various pharmacological compounds gives them various characteristics and the presence of various functional groups aids their medicinal properties.

Keywords: Paddy's lucerne, castor, datura, Indian beech, FTIR.

INTRODUCTION

India has a long traditional history with Ayurveda. From the times of Sushruta and Thiruvalluvar, Ayurveda had been the therapeutic alternative for Indians. The basis of Ayurveda is medicinal plants. Paddy's lucerne, castor, datura and Indian beech are four medicinally important plants, are commonly found in South India especially Kerala and have been used to solve many health related problems. Paddy's Lucerne (*Sida rhombifolia*) is a commonly found weed in India, Australia and Cuba. Although its availability is common but its medicinal properties were incredibly uncommon. In Ayurveda, it has been used to treat asthma, tuberculosis, sore throat and other chest ailments. Castor (*Ricinus communis*) is commonly found plant in India, whose seed is generally used to produce castor oil which has many roles in industries, but other than that it is also a medicinally important plant used to treat epilepsy, rheumatism, rashes etc. Stems were made into paper and wallboard. [1] Datura (*Datura stramonium*) is believed to have Asiatic origin, has been used to treat not only gastrointestinal problems, asthma, but also aches, abscesses, headaches, haemorrhoids, rattlesnake bites, sprains, swellings, arthritis, boils and tumors. [2] It has sedative properties when taken in large doses and as a stimulant in high doses. Datura is an antibiotic, anodyne, narcotic and antispasmodic. *D. stramonium* contains hyoscyne, hyoscyamine, atropine, apohyoscyne, and meteloidine. Thus it is poisonous and hallucinogenic as well as acting as a pain killer. [3] Indian Beech (*Millettia pinnata*) is native in tropical and temperate Asia. Incorporation of the plant parts is very common in Ayurveda and Siddha Indian medicinal practises. The juice obtained from the plant is antiseptic and resistant to pests. Stem extracts are used to reduce fever and sedate the central nervous system. In this study, phytochemical and functional group analyses of these medicinally important plants have been carried out.

EXPERIMENTAL SECTION

Collection

The stem powder of paddy's lucernae, castor, datura and Indian beech were obtained from Bangalore City, Karnataka, India. The stems were washed thoroughly using tap water to remove any dirt and then air dried. These plant materials were homogenized in to fine powder.

Extraction

The stem powders of all the four plants were extracted with three different solvents acetone, chloroform, and water. 1g of the air dried powder of the medicinal plants was taken separately with 15 ml of each solvent in centrifuge tubes and allowed to extract. After allowing for sufficient amount of time the solvent was filtered, and the filtrate was evaporated. The dried extracts were used for further studies.

Phytochemical Analysis

The chemical tests for the identification of phytochemicals in the medicinal plants under study were carried out in the extracts using as per the standard procedures.

Test for Saponins

Powdered sample of approx. 2g of each plant was boiled with 20ml of distilled water in a water bath and then filtered. 10ml of the filtrate was mixed with 5ml of distilled water in a test tube and vigorously shaken to obtain a stable persistent froth. 3 drops of olive oil was then mixed with the frothing. Formation of emulsion indicated the presence of saponins. [8]

Test for Terpenoids

Aqueous extract (5ml) of each plant sample was mixed along with 2ml of CHCl_3 in a test tube and 3ml of concentrated H_2SO_4 was carefully added to the mixture to form a layer. At the interface reddish brown coloration was formed which indicated presence of terpenoids. [8]

Test for Flavonoids

Extracts were mixed with a few drops of sodium hydroxide solution. Intense yellow colour was formed, which becomes colourless when dilute acid was added, which indicated the presence of flavonoids. [9]

Test for Phenols

The extract (500 mg) was mixed with 5 ml of distilled water. Few drops of neutral 5% ferric chloride solution were added to that. A dark green coloration indicated the presence of phenolic compounds. [9]

Test for Sterols

A 2 ml of test solution and minimum quantity of chloroform were added with 3-4 drops of acetic anhydride and one drop of concentrated H_2SO_4 . Formation of purple colour changed into green colour that indicated the presence of steroids.

Test for Tannins

Powdered sample (0.5gm) of sample plant was boiled with 20ml of distilled water in a test tube, filtered and 0.1% FeCl_3 was then added to the filtered samples and brownish green or a blue black coloration was observed which showed the presence of tannins. [8]

Test for Phytosterols

Salkowski's test: Extracts were treated with chloroform and filtered. The filtrates were treated with few drops of Conc. Sulphuric acid, shaken and allowed to stand. Appearance of golden yellow colour indicated the presence of triterpenes.

FTIR spectrum Analysis

The powdered samples of the plants were subjected to FT-IR spectrum analysis. The samples were mixed with KBr (Potassium bromide) salt, and compressed into a thin pellet. Infrared spectra were then recorded.

RESULTS AND DISCUSSION

Phytochemical screening of seven different bioactive compounds in three extracts of paddy's lucerna, castor, datura and Indian beech were carried out and the results were presented in the table 1, 2, 3,4. In these screening saponins,

terpenoids, flavonoids, phenols, sterols, tannins, and phytosterols showed variations for each plant and each solvent used.

Table 1: Phytochemical screening of paddy's lucernae

Extracts	Saponins	Terpenoids	Flavonoids	Phenols	Sterols	Tannins	Phytosterols
Acetone	-	-	+	+	-	-	-
Chloroform	-	+	+	-	+	-	+
Water	+	-	-	-	-	+	-

In the acetone extract (Table 1), phytochemicals like flavonoids and phenols were present while rest of the compounds were found to be absent. Whereas in the aqueous extract only saponins and tannins were present and the others were found to be absent. Chloroform extract contained four different compounds like terpenoids, flavonoids, sterols and phytosterols but saponins, phenols and tannins was not present. (Table1).

Table 2: Phytochemical screening of castor

Extracts	Saponins	Terpenoids	Flavonoids	Phenols	Sterols	Tannins	Phytosterols
Acetone	-	-	-	-	-	-	-
Chloroform	-	+	+	-	+	-	+
Water	+	-	-	-	-	+	-

The acetone extract did not have any phytochemicals whereas in the aqueous extract only saponins and tanins were present and the others were found to be absent. In the chloroform extract terpinoids, flavonoids, sterols and phytosterols were present and the rest were found to be absent (Table 2).

The results obtained by the screening of castor were similar to that of paddy's lucernae, except the acetone extract which did not show presence of any phytochemicals.

The chloroform extract showed the presence of maximum of number of phytochemicals in both these plants.

Table 3: Phytochemical screening of datura

Extracts	Saponins	Terpenoids	Flavonoids	Phenols	Sterols	Tannins	Phytosterols
Acetone	-	-	+	+	-	-	-
Chloroform	-	+	+	-	+	-	+
Water	+	-	-	-	-	+	-

In the acetone extract phytochemicals like flavonoids and phenols were present while rest of the compounds were found to be absent. In the chloroform extract, terpenoids, flavonoids, sterols and phytosterols were present and the rest were found to be absent. In the aqueous extract only saponins and tannins were present and the others were found to be absent (Table 3).

Chloroform extracts of paddy's lucernae, castor, datura was found to have terpenoids, flavonoids, sterols and phytosterols. The acetone extracts of paddy's lucernae, datura was found to have only flavonoids and phenols and the rest were found to be absent.

Table 4: Phytochemical screening of Indian beech

Extracts	Saponins	Terpenoids	Flavonoids	Phenols	Sterols	Tannins	Phytosterols
Acetone	-	-	-	+	-	-	-
Chloroform	-	+	+	-	+	-	+
Water	-	-	-	-	-	+	-

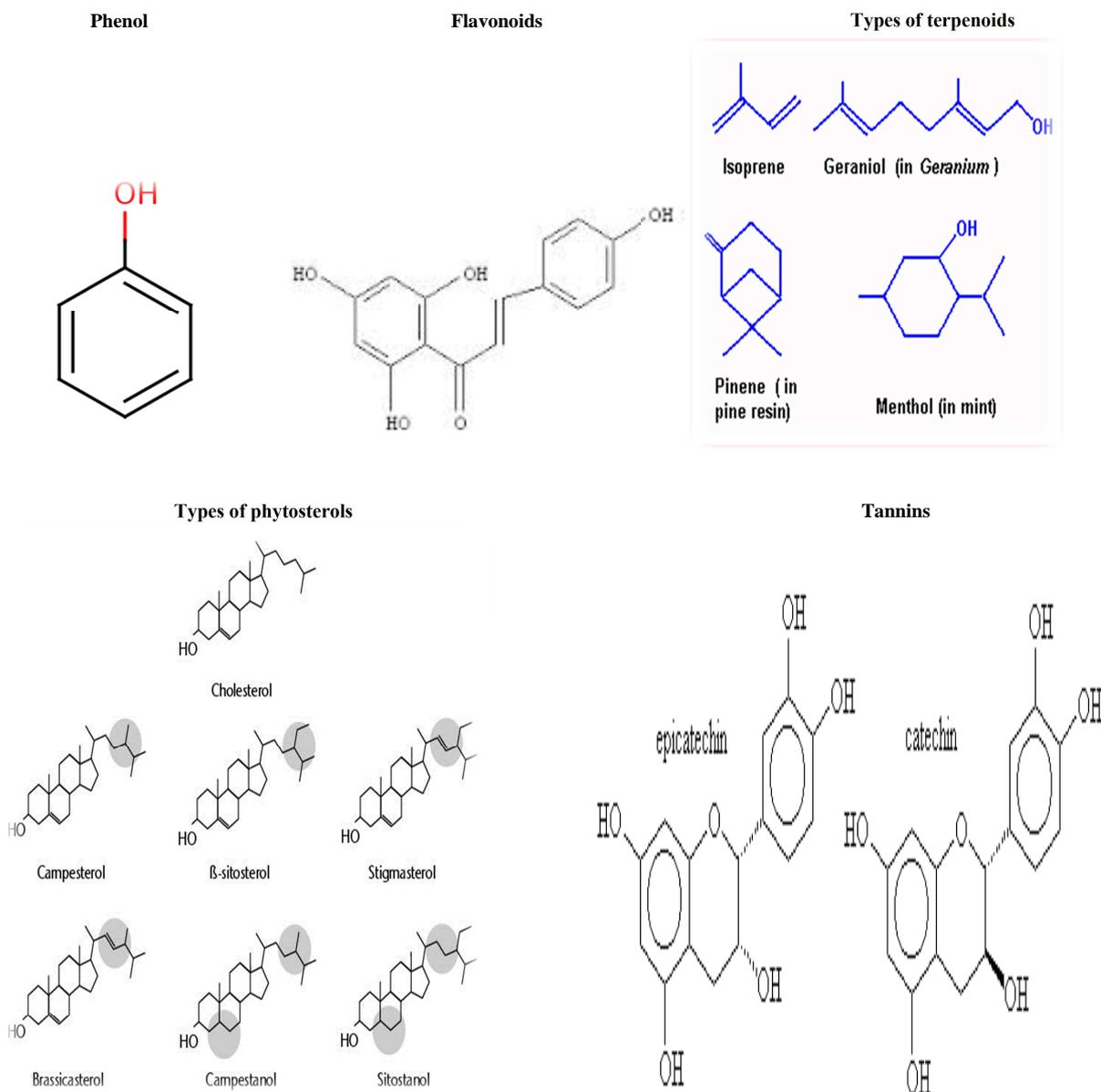
In the acetone extract, only phenols were to be present and the rest were absent. In the chloroform extract, terpenoids, flavonoids, sterols and phytosterols were present.

The aqueous extract showed the presence of only tannins whereas the other compounds were found to be absent (Table 4).

Acetone and aqueous extracts of Indian beech showed the presence of one compound each i.e. phenols and tannins respectively while in the acetone extracts of paddy's lucernae and castor flavonoids were present along with the phenols and in the aqueous extracts saponins and tannins were found to be present.

The above results indicate that of the three solvents used chloroform was a very potent solvent as it extracted most of the compounds from the plants examined. However water helped in extraction of saponins in all the plants except for Indian beech. Castor showed absence of phenol in all the extracts whereas Indian beech showed the absence of saponins.

Chemical Structures of the phytochemicals analysed



Functional groups present in the plant samples

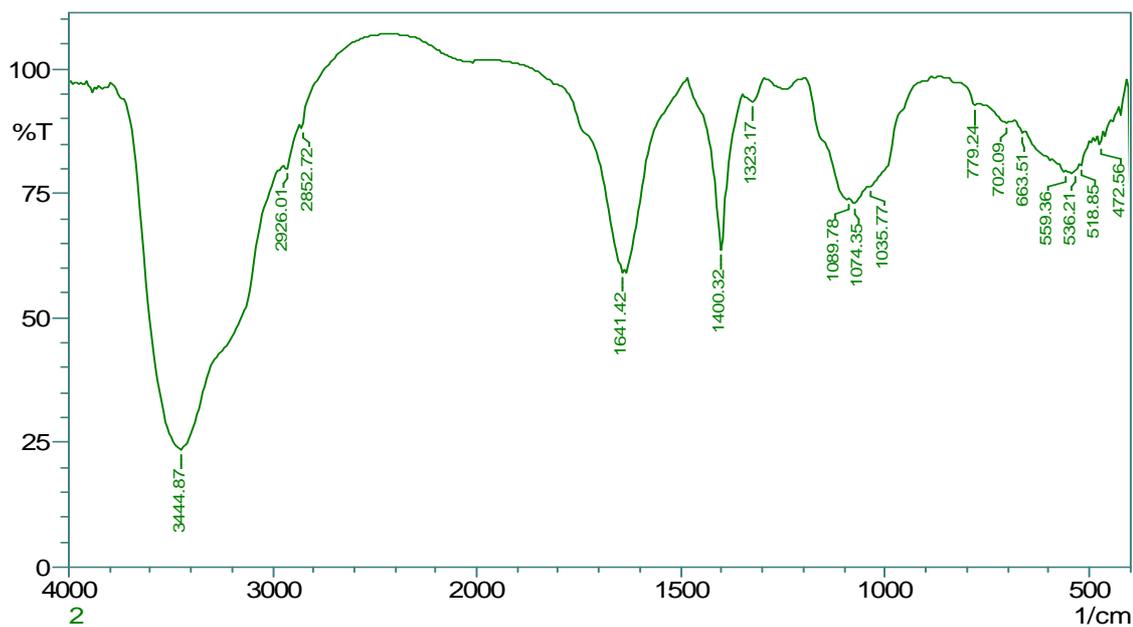
1) Paddy's lucernae (*Sida rhombifolia*)

Fig. 1- FT-IR spectrum of paddy's lucernae

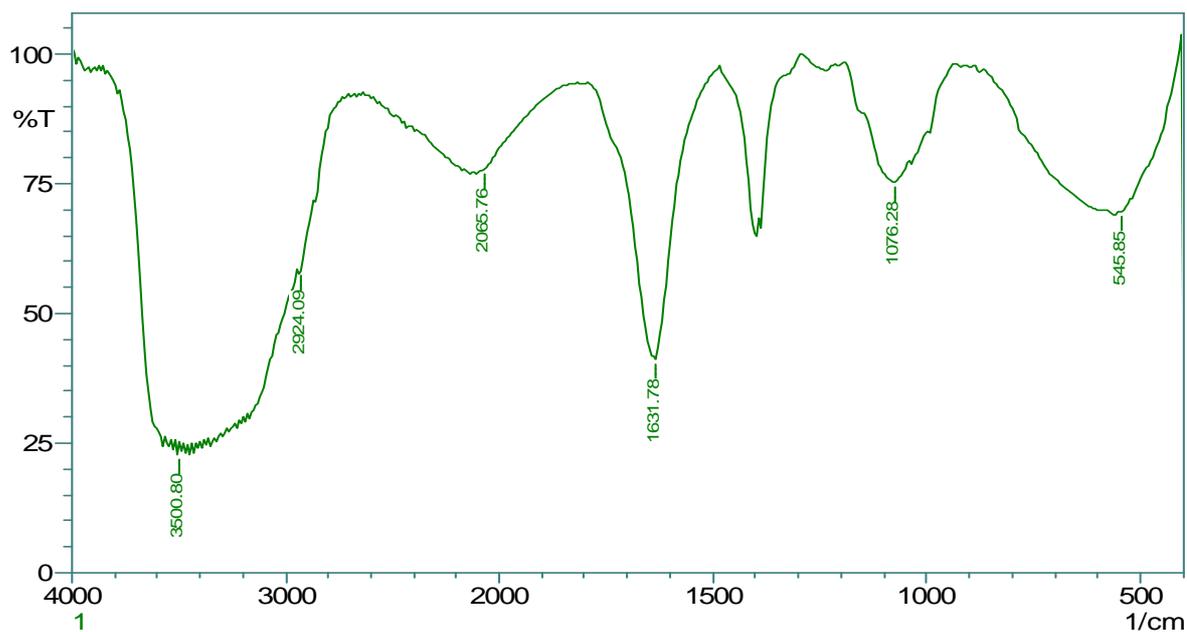
2) Castor (*Ricinus communis*)

Fig. 2 - FT-IR spectrum of castor

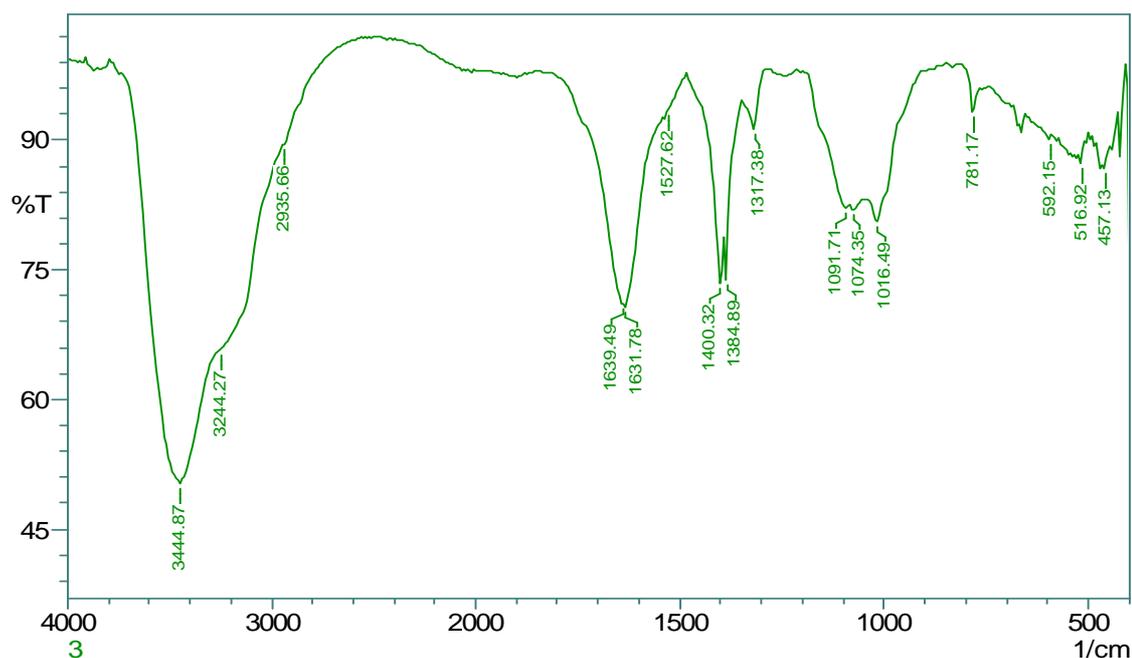
3) Datura (*Datura stramonium*)

Fig. 3- FT-IR spectrum of datura

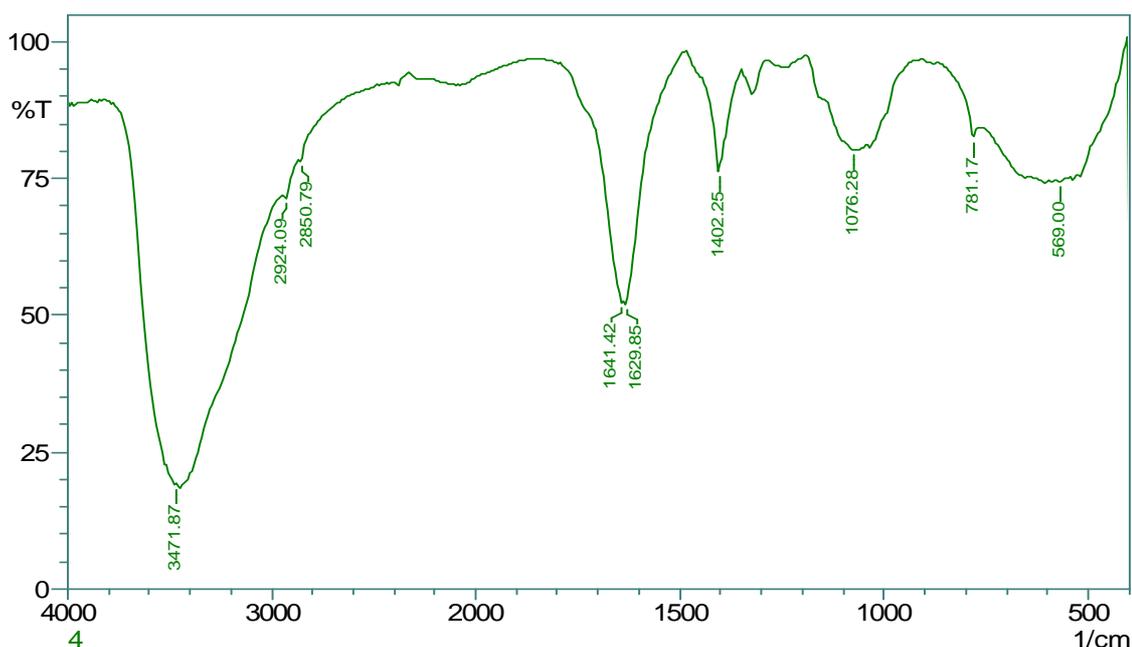
4) Indian beech (*Melletia pinnata*)

Fig. 4- FT-IR spectrum of Indian beech

The functional groups and the range of wavelength obtained from absorption spectra were presented in table 5.

The totals of 11 different functional groups were analysed and the wavelength were ranged from 510 nm-3500 nm. Paddy's lucernae and castor showed similarity with the presence as well as the absence of various functional groups in which aromatic (C-H stretch) being the only exception as it was found to be present in paddy's lucernae but absent in castor. The commonly present functional groups in both the plants were found to be amide, alkanes, alkenes, alcohol and alkyl halides. Datura showed the presence of maximum number of functional groups whereas the aldehyde and aromatic (C-H stretch) were found to be absent. While in Indian beech, alkene, aromatic (nitro) and sulfonates were found to be absent. Datura and Indian beech showed similarity with the presence of six common functional groups which were amide/amine, alkane, alcohol, nitro/imine, alkyl halide and phosphines.

Table 5: Showing functional groups present in the four plant samples

Wavelength	Functional group	Paddy's lucerne	Castor	Datura	Indian Beech
3500-3180	Amide/Amine	+	+	+	+
2950-2800	Alkane	+	+	+	+
1690-1630	Alkene	+	+	+	-
~2850 & ~2750	Aldehyde	-	-	-	+
1260-1000	Alcohol	+	+	+	+
1690-1640	Nitro or Imine	-	-	+	+
785-540	Alkyl halide	+	+	+	+
1550-1490&1355-1315	Aromatic (Nitro)	-	-	+	-
3020-3000	Aromatic (C-H stretch)	+	-	-	+
2320-2270	Phosphines	-	-	+	+
1000-750	Sulfonates	-	-	+	-

Paddy's lucerne and Indian beech showed the presence of five common functional groups and the absence of two functional groups (Table 5). Castor and Indian beech showed similarity due to the presence of four common functional groups and absence of two common functional groups (Table 5). Five common functional groups were found to be present in castor and datura and absence of only one common group (Table 5). Similarity was found between paddy's lucerne and datura in having five common functional groups and in the absence of two common functional groups (Table 5).

DISCUSSION

The medicinal properties of the plants are determined by the components present in them. Components like phenol, sterols, phyto-sterols, tannin, and flavonoids, all contribute to its medicinal and aesthetic quality. Paddy's lucerne showed presence of all the seven phytochemicals and it showed presence of amide, alkanes, alkenes, alcohol, aromatic (C-H stretch) but it lacked aldehyde, nitro or imine, aromatic (nitro), phosphines and sulfonates. Castor showed the same trend as paddy's lucerne but it showed lack of phenol and has all the same functional groups except aromatic (C-H stretch) which it lacked along with aldehyde, nitro or imine, aromatic (nitro), phosphines and sulfonates.

Datura had all the seven phytochemicals and most number of functional groups like amide, alkanes, alkenes, alcohol, nitro or imine, aromatic (nitro), phosphines and sulfonates except aldehyde and aromatic (C-H stretch). Datura has very high medicinal value and industrial usability. Datura is an antispasmodic, anodyne, antibiotic and has narcotic effect. The pains of rheumatism gets relieved and sciatica when it is used and applied as an ointment, and it relieves spasms of Parkinson's disease are unproven accounts of Jimson weed's effect.[2]

Indian beech showed presence of all the phytochemicals except saponins, and as water is a universal solvent used to extract most of the phytochemicals and the other three plants also showed positive for saponin in water extract. It was found that saponins were absent in Indian beech but further studies required to confirm the absence of saponin. The functional groups present in Indian beech were amide, alkanes, aldehyde, alcohol, nitro or imine, aromatic (C-H), phosphines whereas aldehyde, aromatic (nitro) and sulfonates were absent.

Phytosterols were present in all the plants. Phytosterols were another important component with many benefits. Some health benefits of phytosterols include anti-inflammatory [4] anti-cancer [5] and immune regulatory effects [6]. Phenolic compounds were present in paddy's lucerne, datura and Indian beech except castor. Phenolic compounds were found to have contributed to increasing the quality and nutritional value in terms of modifying and better colour, taste, aroma, and flavour and provide beneficial effects to the health. They also aid to plant defence to counteract reactive oxygen species (ROS) for surviving and prohibiting molecular damage and damage because of microorganisms, insects and herbivores [3].

Flavonoids are another important components, present in all the plants examined, as it has various pharmacological effects like anti-oxidant activity, free-radical scavenging, anti-cancer and anti-aging [10] etc. Tannins are anti-cancerous in nature [11] and found to be present in all the four plants.

Significant variation in the composition of the functional groups indicated that these functional groups might play a vital role on the application of these plants for health cures. Furthermore paddy's lucerne and castor showed similarities in both presence and absence of common functional groups. Interestingly, both the plants are used to treat rheumatism. But both these plants show differences in the functional groups as paddy's lucerne is being used to treat asthma and headache whereas castor is being used to treat rashes, epilepsy etc. There were similarities in terms of functional groups between datura and Indian beech. Both have one thing in common, their toxicity. Both

are toxic and datura is anti-microbial whereas Indian beech shows insecticidal properties. Datura and castor also shows similarities as both are used to produce oils which are of medicinal values.

CONCLUSION

It can be concluded that the all four plants have medicinal values as all the four plants show presence of various pharmacological compounds and their medicinal properties can be attributed to the presence of various phytochemicals and functional groups. Thus, these plants can be used for further studies to find more about their pharmacological benefits and their potential against fighting various ailments and diseases.

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