Original Research Article

A study on the Identification and comparison of Functional Components in different species of Passion Fruit Vine Leaves

Abstract

Functional components are found abundantly in plants which are non-nutritive and bio active compounds that prevents the onset of degenerative diseases and protects the body by maintaining the health. The functional components of food can be effectively applied in the treatment and prevention of diseases. The objective of this study is to identify the chemical components of different varieties of passion fruit leaves (*Passiflora edulis* f. *flavicarpa*,*Passiflora edulis*f. *edulis and Passiflora quadrangularis)* available wildly in the hills of Tamil Nadu, India. Young tender passionfruit leaves can be used as a raw leafy green in salads or as a spinach-type cooked green in quiches, curries, stir fries, soups or pastas. They contain vitamin A and niacin. The dried leaves are used for calming teas and herbal remedies. The functional components were identified using Fourier Transform Infrared Spectroscopy FTIR(ATR) spectrophotometer. The leaves contain phytochemicals which has a lot of beneficial effect on human health especially in preventing degenerative diseases. This paves way to use these amazing abundant greens in clinical studies as ayurvedic preparations and treat illness naturally.

Comment [SZ1]: Shorten this intro part and make add more info on the method and results & discussion section.

Comment [SZ2]: Be specific. What are the main functional components observed post analysis?

Comment [SZ3]: What are they??

Keywords: Functional compounds, *Passiflora edulis* f. *flavicarpa*, *Passiflora edulis*f. *edulis and Passiflora quadrangularis*, FTIR(ATR).

Introduction

Plants are an integral part of all the living organisms of earth because they provide food, clothing, shade and shelter. They also provide clean air and natural medicines to treat ailments.[Ram, 2012]. Many scriptures state that from the day life begins plants are used as medicines. Countries such as Egyptian, Assyrian, Chinese, and Indian, have long histories of using medicinal plants [Ramawat, 2008].

Plants are able to produce a large number of diverse bioactive compounds. [Naczk and Shahidi, F, 2006].Plant kingdom mainly contains beneficial phytochemicals may complement the needs of the human body by acting as natural antioxidants[Boots, 2008].These

antioxidants compounds are secondary plant metabolites. Phenolic derivatives are the main phytochemicals present in the most of the species. Several clinical researches showed that antioxidant and their phytochemicals can prevent some chronic diseases [Lebovka et al., 2012; Zhimin and Howard, 2012].

Passion fruit leaves, grow on a fast-climbing vine that can spread 4-6 meters a year and are members of the Passifloraceae family. There are four hundred species within the Passifloraceae family. Nowadays the passion fruit plant which was mainly grown for its fruits is also growing in popularity as an additional crop. The leaves can be used as a culinary ingredient as well.Passion fruit vines are native from Brazil, but now it is cultivated in all parts of the world for the fruits and also as ornamental plants[Sunitha and Devaki, 2009].

Traditionally *P. edulis* leaves are used in the treatment of insomnia and known to produce a restful sleep without any narcotic hangover. The leaves are reported to contain a bitter principle maracugine, resins, acids and tannin exceptionally rich in ascorbic acid. It is also used to treat epilepsy, ulcers and haemorrhoids [Relw and Espig, 1991].The tea prepared by the infusion of these leaves has been recognized for its anti-inflammatory potentialand also there was also an increase in colonic bacteria; therefore, it was associated with increase in SCFA production which promote different aspects of gut microbiome [Da Silva, 2013]. Studies proved that introduction of infusion of *P. edulis* leaves in tea could contribute to prevent damage by reactive species [Montanher et al., 2007].The presence of fructo-oligosaccharides in passion fruit by-products shows a comparable stimulation of folate production was found by the selected bacterial strains [Albuquerque, 2017].

Methodology

The aim of the study is to identify and compare the phytochemicals in three different species of passion fruit leaves using FTIR (ATR) technique. The passion fruit vines of three different species were collected from Horticulture research Station in Thandiyankudisai, Perumbarai, Dindigul district, Tamil Nadu, India in February 2020 at the evening time. The collection place was about 50 km away from the residence. Soon after collection, the samples were washed thoroughly and then dried at room temperatureand under shade for one week as mentioned in figure1. Then, the extract was prepared from the coarse powder with direct methanol by a cold method. It was transferred to the separatory funnel and the extract was stored in sterile vials and taken to the central Instrumentation laboratory of the American college campus for FTIR (ATR) spectrophotometric analysis.

Comment [SZ4]: Confirmation of the species used are needed from botanist via voucher no. etc.

Comment [SZ5]: Temperature? MC of the final dried samples?

Comment [SZ6]: What does it mean by cold method? Solvent-to-solid ratio? Extraction time? Extraction method? Be specific.

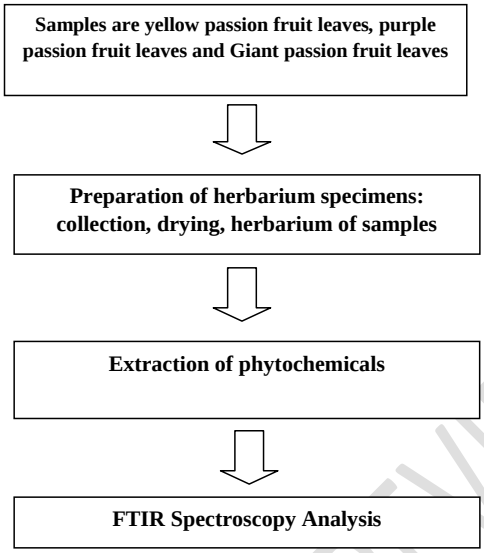

Figure :1.Flowchart of FTIR Spectroscopy analysis process**.**

Fourier Transformed Infrared Spectroscopy (FTIR)

The functional groups of Passiflora species were recorded using Fourier Transform Infrared Spectroscopy using JASCO spectrophotometer (FTIR 4600) ATR techniques. Infrared spectra were recorded between ranges 4000 and 450 cm^{-1}.Attenuated total reflection is developed in order to enhance the surface sensitivity since IR spectroscopy is a bulk method.(Nandiyanto et al., 2019)

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Results and Discussion

FTIR(ATR) analysis was done for the characterization of functional group present in the three different varieties of passion fruit vines namely *Passiflora edulis* f. *flavicarpa*, *Passiflora edulis*f. *edulis and Passiflora quadrangularis*. The interpretation of IR spectra helps to determine the functional groups present within organic compounds. This can be

determined by examining each spectrum for common IR stretches that are characteristics of organic functional groups.

Table 1 and Figure2 show the absorbance spectra recorded for *Passiflora edulis* f. *flavicarpa*

Table 1FTIR values of Passiflora edulis f. flavicarpa leaf

S.No	Frequency range (cm^{-1})	Absorption (cm^{-1})	Intensity	Group	Compound
1	4000 – 3000	3346.85	Strong broad	O-H Stretching	Alcohol
2	3000-2500	2926.45	Weak, broad	O-H Stretching	Alcohol
3	2000-1650	1737.55	Strong	C=O Stretching	Aldehyde
4	1600-1300	1367.28	Medium	O-H Bending	Alcohol
5	1250-1020	1215.9	Medium	C-N Stretching	Amine
6	1400-1000	1016.3	Strong	C-F Stretching	Fluoro compound

"The strong peak frequency observed for Passiflora edulis f. flavicarpa 3346.85 cm^{-1} same to O-H extending and is between the standard frequencies (4000 – 3000 cm^{-1}). The peak frequency observed at 2926.45cm^{-1}corresponds to the O-H stretching and the standard frequency is 3000-2500 cm^{-1}. The strong peak frequency observed at 1737.55cm^{-1} corresponds to the C=O extending and the standard frequency is 2000-1650 cm^{-1}. The peak frequency observed at 1367.28 cm^{-1} corresponds to the O-H bending and the standard frequency is 1600-1300 cm^{-1}. The peak frequency observed at 1016.3 cm^{-1} corresponds to the C-F extending and the standard frequency is 1400-1000 cm^{-1}".

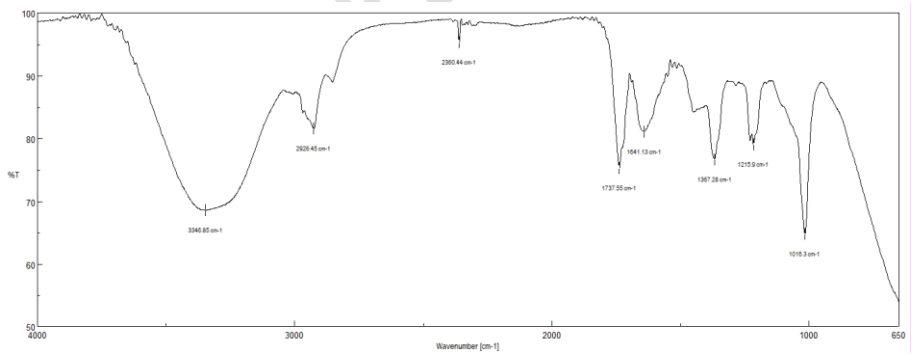

Figure 2 Functional Components in Passiflora edulis f. flavicarpaleaf

Table 2 and Figure 3 show the absorbance spectra recorded for Passiflora edulisf. edulis

Table 2FTIR values of Passiflora edulisf. edulis leaf

S.No	Frequency range (cm $^{-1}$)	Absorption (cm $^{-1}$)	Intensity	Group	Compound
1	4000-3000	3332.39	Strong broad	O-H Stretching	Alcohol
2	3000-2500	2945.73	Weak broad	O-H Stretching	Alcohol
3	3000-2500	2832.92	Weak broad	O-H Stretching	Alcohol
4	2000-1650	1737.55	Strong	C=O Stretching	Aldehyde
5	1400-1000	1368.25	Medium	C-H Bending	Alkane
7	1400-1000	1019.15	Strong sharp	C-F Stretching	Fluoro compound

"The strong peak frequency observed for Passiflora edulisf. edulis 3332.39 cm^{-1} same to O-H extending and is between the standard frequencies (4000 – 3000 cm^{-1}). The peak frequency observed at 2945.73 cm^{-1} and 2832.92 cm^{-1} corresponds to the O-H stretching and the standard frequency is 3000-2500 cm^{-1}. The strong peak frequency observed at 1737.55cm^{-1} corresponds to the C=O extending and the standard frequency is 2000-1650 cm^{-1}. The peak frequency observed at 1368.25 cm^{-1} corresponds to the C-H bending and the standard frequency is 1400-1000 cm^{-1}. The peak frequency observed at 1019.15 cm^{-1} corresponds to the C-F extending and the standard frequency is 1400-1000 cm^{-1}".

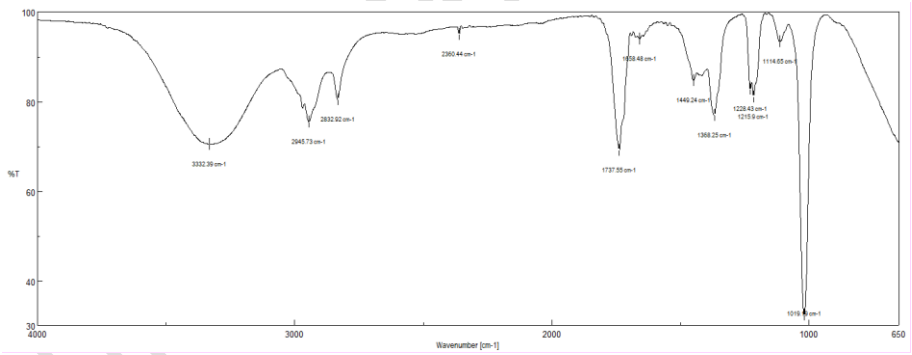

Figure 3 FTIR Spectra of Passiflora edulisf. edulis leaf

Table 3 and Figure 4 show the absorbance spectra recorded for Passiflora quadrangularis

Table 3FTIR valuesof Passiflora quadrangularisleaf

S.No	Frequency range (cm $^{-1}$)	Absorption (cm $^{-1}$)	Intensity	Group	Compound

1	4000-3000	3302.5	Strong broad	O-H Stretching	Alcohol
2	4000-3000	2926.45	Strong broad	N-H Stretching	Amine salt
3	2000-1650	1737.55	Strong	C=O Stretching	Esters
4	1600-1300	1606.41	Strong	C=C Stretching	Unsaturated ketone
5	1600-1300	1448.28	Medium	O-H Bending	Carboxylic acid
6	1400-1000	1369.21	Strong sharp	C-F Stretching	Fluoro compound
7	1400-1000	1068.37	Strong	S=O Stretching	Sulfoxide
8	900-700	777.17	Strong	C-H Bending	Disubstituted

"The peak frequency observed for Passiflora quadrangularis 3302.5cm^{-1} same to O-H extending and is between the standard frequencies (4000 – 3000 cm^{-1}). The strong and broad peak frequency observed at 2926.45 cm^{-1} corresponds to the N-H stretching and the standard frequency is 4000-3000 cm^{-1}. The strong peak frequency observed at 1737.55cm^{-1} corresponds to the C=O extending and the standard frequency is 2000-1650 cm^{-1}. The peak frequency observed at 1606.41cm $^{-1}$ corresponds to the C=Cstretching and the standard frequency is 1600-1300 cm^{-1}. The peak frequency observed at 1448.28 cm $^{-1}$ corresponds to the O-H bending and the standard frequency is 1400-1000 cm^{-1}. The peak frequency observed at 1369.21 cm $^{-1}$ corresponds to the C-F extending and the standard frequency is 1400-1000 cm^{-1}". The peak frequency observed at 1068.37cm $^{-1}$ corresponds to the S=O extending and the standard frequency is 1400-1000 cm^{-1}". The peak frequency observed at 777.17 cm $^{-1}$ corresponds to the C-H bending and the standard frequency is 900-700 cm^{-1}.

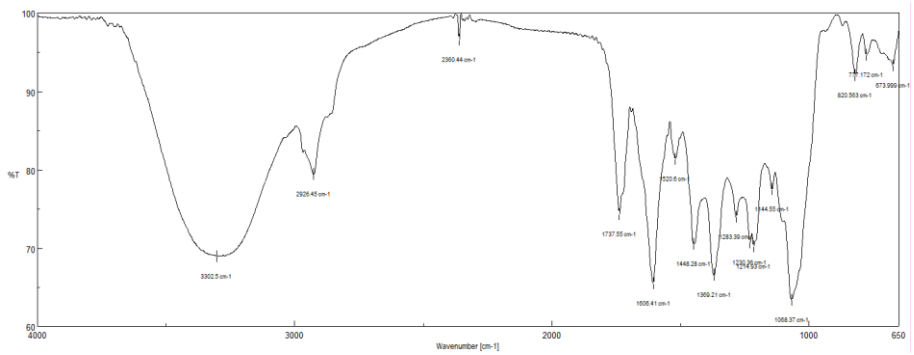

Figure 4 FTIR SpectraofPassiflora quadrangularisleaf

The above results support the previous studies which states that certain biogenic amines (catecholamines) which are produced by the decarboxylation of amino acids or by the amination of aldehydes and ketones. Catecholamines include dopamine, serotonin,

epinephrine, and norepinephrine and are reported to occur in many plants in considerable amounts [Jiwan, 2018]

The aqueous extract of P. edulis leaves showed a significant anti-inflammatory property on mice [Vargas et al., 2007]. The general administration of P. edulis exhibited distinct anti-inflammatory actions which inhibits leukocyte influx to the pleural cavity and associated with marked blockade of myeloperoxidase, nitric oxide, TNFlevels in the acute model of inflammation caused by intra pleural injection of mice. In one experiment, P. edulis was very effective in defeating the TNF levels than dexamethasone [Montanher et al., 2007].

Comment [SZ7]: The FTIR results were just confirming the availability of the functional which it should be able to identify of which phytochemicals are available in the extract. Could it be flavonoids? Phenolic? Alkaloids?? Be specific

Conclusions

The three varieties of passion fruit leaves confirm the presence of different functional components which is a boon to human health maintenance and prevention of certain diseases. Though certain diseases were treated in the hospital other minor ailments such as headaches, stomach upset, colds and fevers are treated by medicinal plants as a home remedy. Passion fruit leaves can be used in both raw and cooked applications such as boiling, sautéing, and frying. Passion fruit leaves can also be cooked into soups, curries, sauté veggies, pasta, and quiches. They are similar in texture and flavour to spinach and can often be substituted in recipes for the green. Tea is the second most popular beverage in the world in addition to cooking, Passion fruit leaves can be boiled and made into a calming tea. The researcher recommend that passion fruit vines can be cultivated at home as grow your own greens and get a lot of health benefits over culinary uses.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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