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Ftir Characterization Analysis of the Siddha Formulation Pathiri Ver Chooranam (PVC)

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ABSTRACT

The aim of the study is to characterize the siddha formulation Pathiriverchooranam using FT-IR analysis. Fourier transform infrared spectroscopy is a fast and nondestructive analytical method. The FT-IR spectroscopy applied in the mid infra red region 3000cm^{-1} to 500cm^{-1} revealed the presence of functional groups like Flavonoids, Phenolic compounds, terpenoids, alkaloids, glycosides, proteins and polyphenolic compounds. These classes of compounds are extensively reported in literature for their antidiabetic activities, acting through complementary mechanisms such as antioxidant defense, enzyme inhibition, insulin sensitization, and lipid regulation. This study highlights the modern standardizing techniques for bringing herbal formulation into focus.

I. INTRODUCTION

Siddha is a holistic medical system that has been practiced in India. Siddha system is considered to be one of the ancient system of medicine in the world. It is one among the AYUSH system in India. Siddha Materia Medica is classified into three categories which include herbal, mineral and drugs from animal origin. Pathiriverchooranam is a Siddha formulation. It is indicated as a good drug for Madhumega Noi (Diabetes mellitus) mentioned in classical Siddha literature. There is no scientific proofs are available regarding this formulation. FT-IR was done for this Siddha formulation to evaluate functional groups identification. It is an excellent tool for qualitative analysis. Siddha herbal medicinal preparations has increased tremendously over the fast three decades. Although this treatment therapy showed good effectiveness on the other hand many of them remain untested.There are several external factors that can affect the quality of herbal medicines, such as geographical area, time of growth and the method of the manufacturing process. This paper summarizes FT-IR is used to quantify different quality and secondary metabolite from Pathiriver Chooranam. Fourier Transform Infrared Spectroscopy is one of the most widely used for quality control in the pharmaceutical industries. Recently FT-IR spectroscopy has developed quickly due to its low noise, rapid speed, high repeatability, easy operation, low expensive..FT-IR has become increasingly useful in the fields of evaluating herbal qualities.

II. MATERIALS AND METHODS

The herbal formulation PVC formulation was taken from Siddha text Gunapadam (Mutharpagam- mooligaivagupu) (Madhumeganoi)-Page no: 665. Author name-K.S.Murugesamuthaliyaar. The Root of Stereospermum Chelonoides was collected from in and around ,Tirunelveli district, Palayamkottai, Tamilnadu. The raw drug was identified and authenticated by Gunapadam department in Government Siddha Medical College, Palayamkottai-627002, Tamil nadu.

INGREDIENTS OF PVC

S.No	Tamil Name	Botanical Name	Family	Part used
1	PATHIRI VER	STEREOSPERMUM CHELONOIDES	BIGNONIACEAE	Root

DOSAGE:1 to 2 gram
ADJUVANT: Hot water

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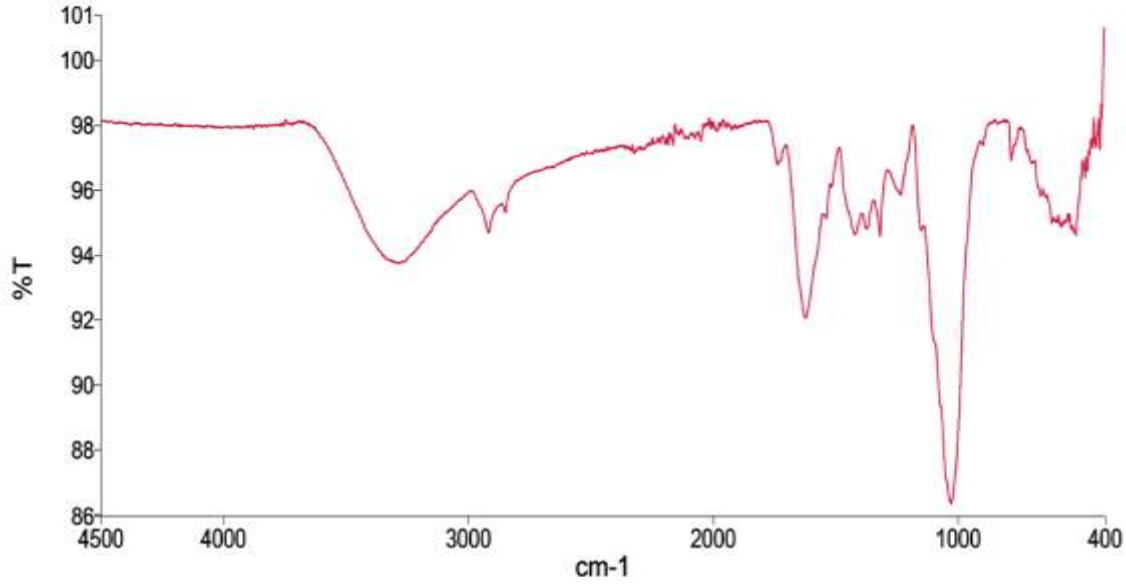
FTIR ANALYSIS

Sample processed using Bruker Alpha-E by ATR module (attenuated total reflectance). Sample positioned on the Crystal platform with perfect alignment of keeping anvil in up position. To ensure that the sample makes good contact angle with the crystal prior to start of the IR radiation exposure. Spectra measurement was achieved with desired wavelength and the corresponding observational peaks/ waves were recorded with wavenumber were subjected to further interpretation. Software used for the analysis is OPUS version 7 for functional group analysis. Signal detection processed through DTGS detector. Baseline correction adjusted as per the requirement.

III. RESULTS AND DISCUSSION

FT-IR SPECTRUM OF SAMPLE PVC



FT-IR PEAK TABLE

Observed Peak (cm^{-1})	Probable Functional Group(s)	Group Type	Description
~3280	O–H stretching (hydroxyl) / N–H stretching	Polar functional group	Phenols, alcohols, secondary amines (from plant polyphenols, flavonoids, proteins)
~2920 & ~2850	C–H stretching	Aliphatic hydrocarbon	$–CH_2–$ and $–CH_3$ groups, possibly from fatty acids or terpenoids
~1735	C=O stretching	Carbonyl functional group	Ester, aldehyde, ketone or carboxylic acid (phytoconstituents)
~1620	C=C stretching / N–H bending	Aromatic / amide	Flavonoids, aromatic ring systems or proteins
~1420	C–H bending	Alkanes	Methyl/methylene bending vibrations
~1260–1020	C–O stretching / C–N stretching	Ether, alcohol, phenol, amine	Sugars, glycosidic linkages, flavonoid cores
~890–670	Aromatic C–H bending / out-of-plane deformation	Aromatic	Substituted benzene rings (common in polyphenolic compounds)

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IV. DISCUSSION

The FTIR spectrum of the Pathiriverchooranam extract revealed several absorption bands indicative of diverse functional groups associated with phytoconstituents that are pharmacologically relevant in the management of diabetes mellitus. A broad absorption around ~3280 cm^{-1} corresponded to hydroxyl (O–H) and amine (N–H) stretching vibrations, suggesting the presence of polyphenols, flavonoids, and proteins. Hydroxyl-rich compounds are widely recognized for their strong antioxidant potential, which plays a central role in counteracting oxidative stress—a major pathological factor in diabetes that contributes to pancreatic β-cell dysfunction, impaired insulin secretion, and the progression of diabetic complications. Flavonoids, in particular, have been documented to scavenge free radicals and enhance endogenous antioxidant enzyme activities, thereby exerting a protective effect against oxidative damage.

Absorption peaks observed at ~2920 and ~2850 cm^{-1} were attributed to aliphatic C–H stretching of $–CH_2$ and $–CH_3$ groups, indicative of fatty acids and terpenoids. Terpenoids have been shown to exhibit hypoglycemic properties by stimulating insulin secretion from pancreatic β-cells and by modulating key enzymes involved in carbohydrate and lipid metabolism. Similarly, the distinct peak at ~1735 cm^{-1} indicated C=O stretching vibrations, characteristic of esters, aldehydes, ketones, and carboxylic acids. Carbonyl-bearing phytoconstituents such as flavonoids, tannins, and glycosides are of particular interest in diabetes research, as they are known to inhibit carbohydrate-hydrolyzing enzymes including α-amylase and α-glucosidase. By slowing the breakdown and absorption of dietary carbohydrates, these compounds help reduce postprandial hyperglycemia, which is critical for maintaining glycemic control in diabetic patients.

The prominent band at ~1620 cm^{-1} reflected both aromatic C=C stretching and amide (N–H) bending, indicating the presence of aromatic ring systems and proteins. Aromatic flavonoids play a significant role in enhancing insulin sensitivity and improving glucose uptake by peripheral tissues through activation of insulin-signaling pathways, such as upregulation of glucose transporter type 4 (GLUT4). The peak at ~1420 cm^{-1} was assigned to C–H bending vibrations, consistent with alkanes and potentially reflecting the presence of phytosterols or lipophilic secondary metabolites. These compounds may contribute to correcting lipid abnormalities often associated with diabetes, thereby offering cardioprotective benefits alongside glycemic regulation.

Strong absorptions in the ~1260–1020 cm^{-1} region corresponded to C–O and C–N stretching vibrations, confirming the presence of ether, alcohol, phenolic, and glycosidic linkages. Such structural features are characteristic of glycosides and flavonoid cores, which not only possess antioxidant potential but also modulate glucose metabolism by delaying carbohydrate digestion and improving insulin sensitivity. Finally, absorptions in the ~890–670 cm^{-1} region were indicative of aromatic C–H out-of-plane bending vibrations, consistent with substituted benzene rings found in polyphenolic compounds. Polyphenols are well established for their multifunctional antidiabetic effects, including inhibition of digestive enzymes, antioxidant protection, modulation of inflammatory pathways, and preservation of β-cell function.

V. CONCLUSION

The FTIR spectrum of the polyherbal formulation reveals the presence of key functional groups corresponding to hydroxyl (O–H), carbonyl (C=O), aliphatic (C–H), aromatic (C=C), amine (N–H), and ether or glycosidic (C–O) bonds. These functional signatures indicate the presence of diverse poconstituents such as flavonoids, phenolic compounds, terpenoids, alkaloids, and carbohydrates. The broad O–H stretch and aromatic ring vibrations are particularly suggestive of polyphenolic compounds, while the aliphatic and carbonyl peaks support the occurrence of lipid-like and esterified components. Overall, the spectral data confirm the chemically heterogeneous and bioactive nature of the formulation, reflecting its complex polyherbal composition. Therefore, the spectrum provides chemical evidence supporting the potential role of the extract as a natural therapeutic agent in the management of diabetes mellitus.

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