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Qualitative and GC-MS analysis of medicinally potent aquatic herb *Pistia stratiotes* L. Assam, India

Research Article

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Abstract

Pistia stratiotes L. belongs to Araceae family, is a free-floating aquatic plant found in rivers, lakes, and ponds. It is commonly known as water cabbage, water lettuce Nile cabbage and shellflower. *P. stratiotes* is commonly cultivated as an ornamental plant in lakes, ponds, aquariums, and gardens. *P. stratiotes* is a well-known Ayurvedic remedy, widely used over the years to treat a variety of ailments. Traditionally *P. stratiotes* used for treat stomach issues, as well as throat and mouth inflammation. Leaf extract of *P. stratiotes* is used in piles, syphilis eczema, ulcer and leprosy. The present study was aimed to carry out the detailed preliminary phytochemical and GC-MS analysis of the leaves and root of *P. stratiotes*. This study indicates that all the plant extracts of *P. stratiotes* are rich sources of metabolites. The preliminary phytochemical analysis of *P. stratiotes* aqueous, methanol, hexane, ethyl acetate extracts indicated the presence of alkaloids, carbohydrates, reducing sugars, glycosides, flavonoids, phenolic, tannins, triterpenoids, saponins, proteins and amino acids. GC-MS analysis was also carried out to detect the phytoconstituents present in the methanolic, hexane and ethyl acetate extract of leaves and root of *P. stratiotes*. The phytochemical analysis of plants is commercially significant and highly valued by pharmaceutical companies for developing new drugs to treat various diseases.

Keywords: *P. stratiotes*, Phytochemicals, GC-MS, Medicinal.

Introduction

Globally herbal drugs are fundamental components in all traditional medicinal systems. Today, a large proportion of the world's population still relies on herbal medicines, drawn to their biomedical benefits and rooted in regional cultural beliefs. India has a long-standing legacy of traditional medicine, dating back to ancient times. In many developing countries, including India, a significant portion of the population depends on indigenous traditional practices for their primary healthcare needs. Many nations, particularly India, China, and countries in Central and Southeast Asia, boast a rich heritage of herbal remedies dating back centuries. Ayurveda, India's ancient medical system, meticulously documents over 800 herbal remedies. The Charaka Samhita and Sushruta Samhita are esteemed sources of knowledge on plant-based medicines, revered worldwide even in modern times (1). Ayurveda, an ancient healing tradition, has been practiced for centuries, drawing upon a vast array of plant-based medicines, Rasa aushadhis, and surgical techniques employing natural elements like plants and metals. Among these, *Pistia stratiotes* stands out as a prominent Ayurvedic remedy, extensively utilized over time for treating a multitude of ailments. Its versatility allows for both internal and external applications, making it an invaluable agent in the holistic approach to health and wellness (2).

Pistia stratiotes L. (Family: Araceae) is a free-floating aquatic plant found in rivers, lakes, and ponds in tropical and subtropical parts of Asia, Africa, and America. It is recognized as Jal kumbhi, water lettuce, Nile cabbage, water cabbage, and shellflower. In Assam it is locally known as “Borpuni”. Its leaves are sessile and form a rosette. The leaves are pale green in color and have whitish hair covering their lower surface (3,4,5,6). Inflorescence is axillary, solitary, spathulated with a single pistillate flower at base and staminated flower above and flower are unisexual, staminates with two stamens, pistillate with unilocular ovary having numerous ovules, a slender style and penicillate stigma (7).

Traditionally, *P. stratiotes* leaves and root are used in treatment of various ailments. *P. stratiotes* is used in medicine such as antiseptic, antitubercular and antidysentric and its extract is used as an anodyne for eyewash and juice of plant is used for relieving ear complaints. The ash derived from *P. stratiotes* is traditionally utilized for treating ringworm when applied to the scalp, while the leaf extract is employed in managing various conditions such as eczema,

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leprosy, ulcers, piles, and syphilis. Additionally, the leaf extract of *P. stratiotes*, when boiled in coconut oil, is applied topically to the skin to alleviate symptoms of chronic dermatitis (8). *P. stratiotes* exhibit utility in addressing "Tridosha," fever, and blood-related ailments. Its root possesses laxative, emollient, and diuretic properties. According to folklore, infusions of its leaves are employed for treating conditions like dropsy, bladder complaints, kidney afflictions, hematuria, dysentery, and anemia (9). Plants are cultivated not only to serves as animal feed but also for their medicinal properties, notably in treating conditions such as swelling and urinary tract infections (2).

In *P. stratiotes* phenolic compound is present which possess properties such as antiapoptosis, antiaging, anticarcinogen, antiinflammation as well as inhibition of angiogenesis and cell proliferation activities (10). Alkaloids, phytosterols, phenols, flavonoids and tannins are present in leaves of *P. stratiotes*. Leaves of *P. stratiotes* are rich in protein, essential amino acids, stigmatane, sito-sterol acyl glycosides and minerals (11). Vicenin and cyaniding-3-glucosides is present in *P. stratiotes*, vicenin is an anticancer agent and cyaniding-3-glucosides is an anthocyanin. *P. stratiotes* contain large amount of di-c-glycosyl-flavones which is similar to vicenin and lucenin and their derivatives, traces of anthocyanin; cyaniding-3- glucoside and a luteolin-7- glycoside, mono-glycosylflavones, vitexin and orientin. Leaves of *P. stratiotes* contain moisture, protein, fat, carbohydrates, fibers, ash, calcium and phosphorous as well as rich in vitamin A, vitamin C, and also contain vitamin B and ash rich in potassium chloride and sulphate (12). Methanolic extract of *P. stratiotes* of GC-MS showed peaked indicates the presence of several chemical and that chemical are Trideutetro Methyl Ethyl Ether, Tetradecane, Trans-2-fluoro-3 trimethylsily, phytol acetate, 2-hexadecan -1-01,3,7,15 tetramethyl, Glycerol 1-palmitate,2,6,10,14,18,22 tetracosahexane (13). The aim to study the preliminary phytochemical screening from *P. stratiotes* L. analysis of components present in it by gas chromatography-mass spectrometry (GC-MS).

Taxonomic Classification:

Division: Magnoliophyta
Class: Liliopsida
Order: Alismatales
Family: Araceae
Genus: *Pistia* L.
Species: *stratiotes*

Materials and Methods

Collection and preparation of voucher specimens

The collection of live specimens from their natural habitat was done at a regular interval of time within the study period i.e. January, 2021 to June 2021. Voucher specimen of the collected specimens was prepared following the standard herbarium techniques. (14).

Preparation of plant extract

The sample of after collection was washed and cleaned with distilled water. Thereafter, the sample was subjected to differential stacking separately into Leaves and Roots. It was allowed to shade dry under controlled environment to prevent the sample from dust. After shade drying of the parts of plants, 50 g of each of the parts i.e. leaves, stem and roots was sequentially extracted in Soxhlet Apparatus at 20 °C for 24 hours. The sequential extraction was done following polarity index of the solvents viz., Hexane, Ethyl Acetate, Methanol and Distilled Water. After extraction, the solvents hexane, ethyl acetate, methanol were separated using Buchi Rotary Evaporator at 40°C under 200 mbar pressure whereas, after the aqueous extraction, the water was removed by using Lyodel Freeze Dryer Lyophiliser at -75°C. The extracts thus obtained were stored in Borosil screw cap glass vials in 4 °C refrigerator for further analysis.

Qualitative phytochemical screening tests of the plant extracts

The qualitative test for preliminary screening of phytochemical in the plant extracts was done by standard protocols with slight modifications. (15).

Detection of alkaloids

Mayer's test: Few mL filtrates was added with 1-2 drops of Mayer's reagent along the sides of test tube; formation of a creamy white or yellow precipitate shows the presence of alkaloids.

Wagner's test: Few mL filtrates was added with 1-2 drops of Wagner's reagent along the sides of test tube; formation of a brown or reddish precipitate shows the presence of alkaloids.

Picric acid test: Few mL filtrates was added with 3-4 drops of picric acid solution along the sides of test tube; formation of an orange precipitate shows the presence of alkaloids.

Iodine test: 3mL extract solution was added with a few drops of iodine solution; formation of a blue colour, which disappears on boiling and reappears on cooling precipitate shows the presence of alkaloids.

Detection of Carbohydrates

1 mL of aqueous extract was added with 5mL 5% KOH solution; formation of a canary yellow colouration shows the presence of carbohydrates.

Detection of Reducing sugars

Benedict's test: Equal volume of filtrate was added with Benedict's reagent and boiled for 2 min in water bath. Formation of green / yellow / red colour shows the presence of reducing sugar.

Fehling's test: 1mL each of Fehling's solution A and Fehling's solution B was added with 1mL filtrate and boiled for 2 min in water bath. A red precipitate formation shows presence of reducing sugar.

Detection of Glycosides

Borntrager's test: 2mL filtrated hydrolysate was added with 3mL Chloroform and shaken vigorously to

separate the chloroform layer. 1mL Ammonia solution (10%) is added to it. Formation of pink colour shows presence of glycosides.

10% NaOH test: 2mL dilute H_2SO_4 was added to 1mL extract and boiled for 15min in water bath. After cooling, it was neutralized by adding 1mL NaOH (10%) and 1mL of Fehling's solution A & B. A brick red precipitate shows the presence of glycosides.

Aqueous NaOH test: Crude extract was dissolved in 1mL of water and a few drops of aqueous NaOH solution was added to it. Formation of yellow colour shows the presence of glycosides.

H_2SO_4 test: 2ml plant extract was added with 1mL glacial acetic acid. A few drop of 5% $FeCl_3$ solution and concentrated H_2SO_4 was added to it. Formation of brown ring shows the presence of glycosides.

Detection of Cardiac Glycosides

Keller-Killani test: 1mL filtrate was added with 1mL glacial acetic acid. 1 drop each of 5% $FeCl_3$ and concentrated H_2SO_4 was poured along side of the test tube. Formation of blue colour in acetic acid layer shows the presence of cardiac glycosides.

Detection of Proteins and Amino acids

Ninhydrin test: 2mL filtrate was added with 2 drops of Ninhydrin solution (1mg ninhydrin in 20mL acetone). Formation of purple colour solution shows the presence of proteins and amino acids.

Xanthoproteic test: Few drops of concentrated nitric acid was added to 1 mL of plant extract solution. Formation of yellow colour shows the presence of proteins and amino acids.

Detection of Flavonoids

Alkaline reagent test: 1mL of plant extract was added with a few drops of 10% NaOH solution. Formation of yellow colour shows the presence of flavonoids.

Ammonia test: 1mL filtrate was added with 2mL dilute NH_3 solution and 1mL concentrated H_2SO_4. Formation of yellow colour shows the presence of flavonoids.

H_2SO_4 test: 1 mL of plant extract filtrate was added with 1mL concentrated H_2SO_4. Formation of orange colour shows the presence of flavonoids.

Detection of Phenolic compounds

Iodine test: 1mL plant extract filtrate was added with a few drops of dilute iodine solution. Formation of red colour shows the presence of phenolic compounds.

Gelatin test: 2mL plant extract filtrate was added with 1mL of 1% gelatin solution and a few drops of 10% NaCl. Formation of white precipitate shows the presence of phenolic compounds.

Potassium dichromate test: 1mL plant extract filtrate was added with a few drops of potassium dichromate solution. Formation of dark precipitate shows the presence of phenolic compounds.

Detection of Tannins

10% NaOH test: 1mL plant extract filtrate was added with 2mL 10% NaOH and shaken well. Formation of emulsion shows the presence of hydrolysable tannins.

Detection of Phlobatannins

HCl test: 2mL of aqueous extract was added with 2mL of 1% HCl and boiled for 5 min in water bath. Formation of red precipitate shows the presence of phlobatannins.

Detection of Saponins

Foam test: 1mL plant extract filtrate was added with 2mL water and shaken vigorously in vortex. Formation and persistence of foam for 5 min shows the presence of saponins.

$NaHCO_3$ test: 1mL plant extract filtrate was added with 1mL of sodium bicarbonate solution and 1mL distilled water. Shaken vigorously in vortex. Formation and persistence of foam for 5 min shows the presence of saponins.

Detection of Phytosterols

Salkowski's test: 1mL plant extract filtrate was added with a few drops of concentrated H_2SO_4. Shaken well in vortex and formation of red colour in lower layer shows the presence of phytosterols.

Hesse's test: 2mL aqueous extract was added with 1mL chloroform and 1mL concentrated H_2SO_4. Pink or red colour ring in lower chloroform layer shows the presence of phytosterols.

Detection of Triterpinoides

Salkowski's test: 1mL plant extract filtrate was added with a few drops of concentrated H_2SO_4. Shaken well in vortex and formation of golden or yellow colour in lower layer shows the presence of triterpinoides.

Detection of Lignins

Labat test: 1mL plant extract filtrate was added with a few drops of gallic acid solution. Formation of olive green colour shows the presence of lignins.

Detection of Quinones

Alcoholic KOH test: 1mL plant extract filtrate was added with a few drops of alcoholic potassium hydroxide. Formation of red or blue colour shows the presence of quinones.

Detection of Anthocyanins

HCl test: 1mL plant extract filtrate was added with 1mL of 2N HCl and a few drops of ammonia. Formation of pink or red solution which turns blue or violet after addition of ammonia shows the presence of anthocyanins.

Detection of Leucoanthocyanins

Isoamyl alcohol test: 1mL plant extract filtrate was added with 1mL isoamyl alcohol. Formation of red

colour in upper layer shows the presence of leuconthocyanins.

Detection of Coumarins

NaOH test: 1mL plant extract filtrate was added with 1mL of 10% NaOH and 1mL chloroform. Formation of yellow colour shows the presence of coumarins.

Detection of Emodins

Benzene test: 1mL plant extract filtrate was added with 1mL of NH_4OH and 2mL benzene. Formation of red colour shows the presence of emodins.

Detection of Gums and Mucilages

Alcohol test: 100mg plant extract is dissolved in 10mL distilled water. 25mL absolute alcohol was added to it and shaken well in vortex (constant stirring). Formation of white or cloudy precipitate shows the presence of gums and mucilages.

Detection of Resins

Turbidity test: 2mL extract was added to 5mL of 4% HCl. Appearance of turbidity shows the presence of resins.

Detection of Fixed Oils and Fat

Spot / Stain test: A few mL of plant extract was pressed in between two filter papers. Appearance of oil stain on the paper shows the presence of fixed oils and fat.

Detection of Volatile Oils

Fluorescence test: 2mL of plant extract was put in a micro centrifuge tube and exposed to UV lights in an UV Trans-illuminator. Appearance of bright pinkish fluorescence shows the presence of volatile oils.

Gas Chromatography-Mass Spectrometry (GC-MS) analysis

The Gas Chromatography-Mass Spectrometry (GC-MS) was analyzed using Clarus 680 GC & Clarus 600C MS Liquid Autosampler (PerkinElmer, USA) in the Central Analytical Instrumentation Facility of Guwahati Biotech Park. The carrier gas, helium, is used at a 1 ml per min flow rate in split mode (10:1) v/v. The extract was injected into the column (60.0 m × 250 µm) at 280 °C injector temperature. The initial temperature of the oven started at 60 °C and was held for 1 min. Then, it was gradually raised at a rate of 10 °C per min to 300 °C. Holding was allowed for 5 min. The ion sources temperature was maintained at 180 °C. The source and detector temperature were maintained at 150 °C. The detector operates in scan mode ranging from 50–600 atomic mass units. The compounds identification was made by direct spectrum comparison of the extract's retention times with Turbo-mass NIST 2008 (National Institute of Standard and Technology) library software.

Results

Identification of the specimen

Voucher specimen was prepared and herbarium was deposited to the Herbarium of Gauhati University (GUBH), located in Department of Botany, Gauhati University, Assam, India. The specimen was identified as *Pistia stratiotes* L. (Accession number: 019665).

Qualitative phytochemical screening tests of the plant extracts

The qualitative screenings of the active phytoconstituents in *P. stratiotes* was done to determine the richness of which phytoconstituents presence in different part of the specimen. Followings are the *P. stratiotes* plant parts extract showing its phytoconstituents richness in (table 1)

Table 1: Qualitative phytochemical screening tests of the plant extracts

Detection of Alkaloids	**Sample**	**PSLAq**	**PORAq**						
	Mayer's Test	-	+						
	Wagner's Test	-	+						
	Picric Acid Test	+	+						
	Iodine Test	-	-						
Detection of Carbohydrates	**Sample**	**PSLAq**	**PSRAq**						
	Starch Test	+	+						
Detection of Reducing Sugars	**Sample**	**PSLAq**	**PSRAq**						
	Benedict's Test	+	+						
	Fehling's Test	-	+						
Detection of Glycosides	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Borntrager's Test	+	+	+	+	+	+		
	10% NaOH Test	-	-	+	-	+	+		
	Aqueous NaOH Test	-	+	-	-	+	-		
	Conc H_2SO_4 Test	+	+	-	-	+	-		
Detection of Cardiac Glycosides	**Sample**	**PSLAq**	**PSRAq**						
	Keller-Killani Test	-	-						
Detection of Proteins and Amino Acids	Sample	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**	**PSLAq**	**PSRAq**
	Xanthoproteic Test	+	+	-	-	+	+	+	+
	Ninhydrin Test	+	-	-	-	+	+	-	-

Detection of Flavonoids	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Alkaline Reagent Test	+	+	+	+	+	+		
	Ammonia Test	+	+	-	+	+	+		
	Conc H_2SO_4 Test	+	-	-	-	+	+		
Detection of Phenolic Compounds	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Iodine Test	+	-	+	+	+	+		
	Potassium Dichromate Test	+	-	+	-	+	+		
	Gelatin Test	+	-	+	+	+	+		
Detection of Tannins	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	10% NaOH Test	-	+	-	-	+	-		
Detection of Phlobatannins	**Sample**	**PSLAq**	**PSRAq**						
	HCl Test	-	-						
Detection of Saponins	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Foam Test	+	-	+	+	-	+		
	$NaHCO_3$ Test	-	-	+	+	+	+		
Detection of Phytosterols	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**	**PSLAq**	**PSRAq**
	Salkowski's Test	-	-	-	-	-	-	-	-
	Hesse's Test	-	-	-	-	-	-	-	-
Detection of Triterpinoids	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Salkowski's Test	+	+	+	+	-	+		
Detection of Lignins	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Conc HCl Test	-	-	+	-	-	+		
	Alcoholic KOH Test	-	-	+	-	-	+		
Detection of Anthocyanins	**Sample**	**PSLAq**	**PSRAq**						
	HCl Ammonia Test	-	-						
Detection of Leuconthocyanins	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**			
	Isoamyl Alcohol Test	-	-	-	-	-			
Detection of Coumarins	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	NaOH Test	-	-	-	+	-	+		
Detection of Emodins	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Benzene Test	-	-	-	-	-	-		
Detection of Gums and Mucilages	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Alcohol Test	-	-	-	-	-	-		
Detection of Resins	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Turbidity Test	-	-	-	-	-	-		
Detection of Fixed Oils and Fats	**Sample**	**PSLHx**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**		
	Spot and Stain Test	-	-	-	-	-	-		
Detection of Volatile Oils	**Sample**	**PSRHx**	**PSLEa**	**PSREa**	**PSLMe**	**PSRMe**	**PSLHx**		
	Fluorescence Test	-	-	+	-	-	+		

(+: Detected; −: Not Detected) Leaf Aqueous Extract (PSLAq), *Pistia stratiotes* Root Aqueous Extract (PSRAq), *Pistia stratiotes* Leaf Methanol Extract (PSLMe), *Pistia stratiotes* Root Methanol Extract (PSRMe), *Pistia stratiotes* Leaf Ethyl Acetate Extract (PSLEa), *Pistia stratiotes* Root Ethyl Acetate Extract (PSREa), *Pistia stratiotes* Leaf Hexane Extract (PSLHx) and *Pistia stratiotes* Root Hexane Extract (PSRHx)

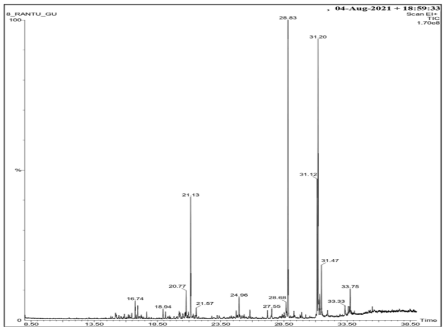
Table 6: GCMS profiling and identification of bioactive anti diabetic compounds present in the extracts of *P. stratiotes*

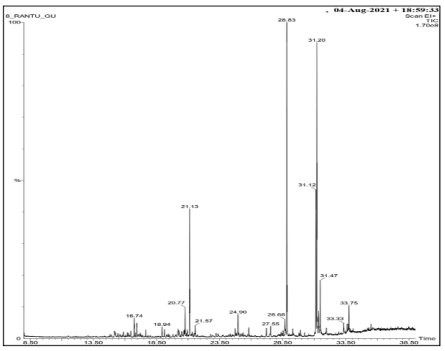
Retention Time	Peak Area (%)	Compound name	Molecular Formula	Molecular Weight
10.704	10.46	Silacyclopentane	C4H10Si	86
10.895	2.52	3,4-altrosan	C6H10O5	162
14.161	1.97	Succinic acid	$C_4H_6O_4$	224
15.541	2.94	Benzofuran	C_8H_6O	120
15.927	2.42	D-Mannitol	C6H14O6	182
28.827	3.62	Triacontanoic Acid	C31H62O2	466
31.123	6.11	Methyl 9,10-Octadecadienoate	C19H34O2	294
31.338	4.50	Phytol	C20H40O	296
31.468	2.07	Heptacosanoic Acid, 25-Methyl-, Methyl Ester	C29H58O2	438
35.249	4.03	Stigmasterol	C29H48O	412
36.211	3.41	Vitamin E	C29H50O	430
37.056	2.56	Ginkgolide C	C20H24O11	728

Figure 1: GC-MS chromatogram of *P. stratiotes* methanolic leaf extract (Compounds such as Methyl 9,10-Octadecadienoate and Triacontanoic Acid were detected from *P. stratiotes* methanolic leaf extract based on their retention time).

Figure 2: GC-MS chromatogram of *P. stratiotes* methanolic root extract (Compounds such as Ginkgolide C and Triacontanoic Acid were detected from *P. stratiotes* methanolic root extract based on their retention time).

Figure 3: GC-MS chromatogram of *P. stratiotes* ethyl acetate leaf extract (Compounds such as Stigmasterol was detected from *P. stratiotes* ethyl acetate leaf extract based on their retention time).





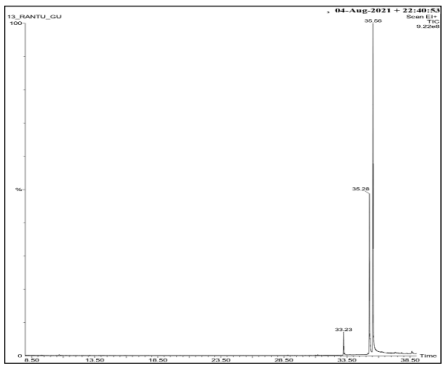
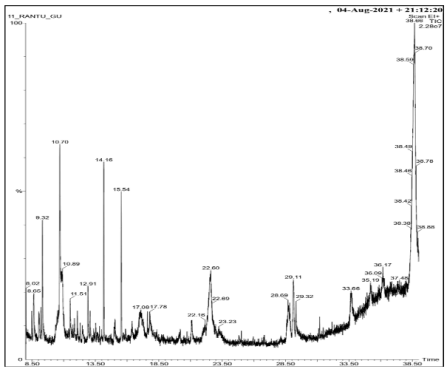
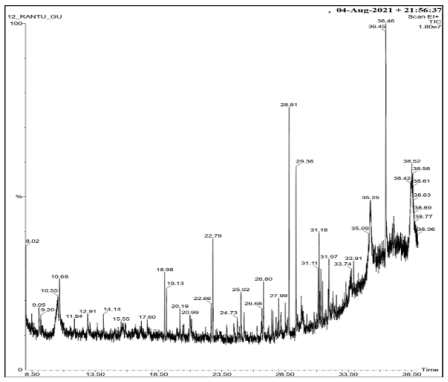


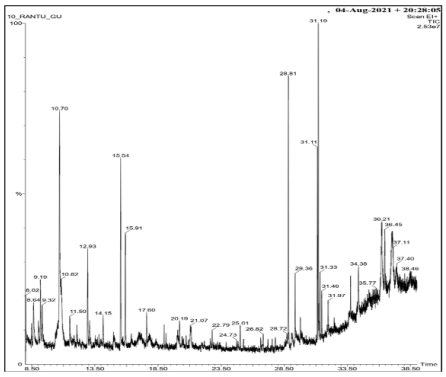
Figure 4: GC-MS chromatogram of *P. stratiotes* ethyl acetate root extract. (Compounds such as Silacyclopentane, 3,4-altrosan, Succinic acid, Benzofuran and Vitamin Ewere detected from *P. stratiotes* ethyl acetate root extract based on their retention time).

Figure 5: GC-MS chromatogram of *P. stratiotes* hexane leaf extract (Compounds such as Benzofuran, Triacontanoic Acid and Phytol were detected from *P. stratiotes* hexane leaf extract based on their retention time).

Figure 6: GC-MS chromatogram of *P. stratiotes* hexane root extract (Compounds such as Silacyclopentane, Succinic Acid, Benzofuran, D- Mannitol, Triacontanoic Acid, Phytol, Heptacosanoic Acid 25-Methyl-Methyl Ester and Vitamin E were detected from *P. stratiotes* hexane root extract based on their retention time)







Discussion

The quantity of phytochemicals was measured using the described methods, and the values are expressed accordingly. The results indicate that all the plant extracts are rich sources of metabolites. In present study *P. stratiotes* extracts revealed that the plant is a super plant with richness in alkaloids, carbohydrates, reducing sugars, glycosides, flavonoids, phenolic, tannins, triterpenoids, saponins, proteins and amino acids. It has also trace amount of coumarins, quinones and volatile oils. But the plant has absence of phytoconstituents like cardiac glycosides, phlobatannins, phytosterols, anthocyanins, leuconthocyanins, lignins, emodins, resins, gums and mucilages, fixed oils and fats. Phytochemical analysis of *P. stratiotes* for qualitative detection of alkaloids, flavonoids, reducing sugars glycosides, tannins, saponins, anthraquinones, volatile oils, resins, deoxysugars and steroids (16, 17). The presence of compounds having anti-diabetic properties like Silacyclopentane, Altrosan, Succinic acid, Benzofuran, D-Mannitol, Triacontanoic Acid, Octadecadienoate, Phytol, Heptacosanoic Acid, Stigmasterol, Vitamin E and Ginkgolide C has been identified by GC-MS chromatographic technique. These compounds support the claim of the present work on medicinally potential of *P. stratiotes (18,19,20,21,22,23)*. The GC-MS analysis of *P. stratiotes* leaves revealed the presence of some major compounds: n-Hexadecanoic acid, Hexadecanoic acid, ethyl ester, 9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z) , 2-hydroxy-1-(hydroxymethyl) ethyl ester , Diisooctyl phthalate , Stigmasterol and L-Glutamine (24). Future

studies should focus on exploring the pharmacological activities of the plant extracts, along with fractionation and isolation of bioactive compounds. These endeavors hold promise for uncovering new medicinal compounds and advancing our understanding of their potential therapeutic applications.

Conclusion

The preliminary phytochemical analysis of *P. stratiotes* indicated the presence of alkaloids, carbohydrates, reducing sugars, glycosides, flavonoids, phenolic, tannins, triterpinoids, saponins, proteins and amino acids. Compounds like Silacyclopentane, Altrosan, Succinic acid, Benzofuran, D-Mannitol, Triacontanoic Acid, Octadecadienoate, Phytol, Heptacosanoic Acid, Stigmasterol, Vitamin E and Ginkgolide C are present in *P. stratiotes* which have a Overall, our findings support the notion that *P. stratiotes* is a potent plant rich in active phytoconstituents. This characteristic could prove beneficial for both the pharmacological industry and the human healthcare system, potentially leading to the development of novel therapeutic agents.

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