

Study on Morphological, Anatomical Characters and Preliminary Phytochemical Investigation from Leaves of *Pistia Stratiotes* L. (Water Lettuce)

Myat Sandar Tun¹, Aye Aye Naing²

Abstract

The plant *Pistia stratiotes* L. is belonging to the family Araceae. This plant is commonly known as ye-salat in Myanmar and water-lettuce in English. The plant was collected from the pond of Pyay University, Pyay Township of Bago Region. The whole plant has long been employed in ancient Chinese prescriptions. It is applied to boils and in many skin complaints. Mixed with rice and coconut milk they are given in dysentery and with rose-water and sugar in cough and asthma. In this research, morphological, anatomical characters and preliminary phytochemical investigation were carried out. The collected specimens were classified, identified and photographed to record the data. In morphological study, the plants were aquatic herb, pubescent hairs present. Leaves were simple, alternate, few or many of nerves. Flowers were inconspicuous and cluster on small fleshy stalk nearly hidden in leaf axils. In anatomical study, the multicellular trichomes were found in the upper surface and lower surface of epidermis. Rosette crystals were composed and many vascular bundles were scattered in cortex. In preliminary phytochemical study, alkaloid, carbohydrate phenolic compound, reducing sugar, glycoside, saponin, tannin and flavonoid were present. The dried powder of leaves has been examined and their diagnostic characters have been presented as a standard for medicinal purposes. According to the results in the present study, water lettuce may be a source of traditional medicine to be used.

Key Words: *Pistia stratiotes* L., Araceae, multicellular trichomes, Rosette crystals

Introduction

Pharmacognosy is the study of crude drug of vegetable and animal origin. The designation *Materia Medica* is used to refer to not only crude drugs but all other substances used in medicine, e.g pure chemical compounds and biological preparation such as vaccines and sera (Denston, 1951). Man's life needs food, clothes and shelters. All of these are natural resources from plants. In a tropical country like Myanmar, the population since ancient time has household traditional remedies, which constituted mostly herbal plants category. Myanmar has richness in varieties of medicine as well as aromatic plants due to the presence of different climate zones in the country. In some races, materials of inorganic or animal origin may also be present (WHO, 1998). The plant *Pistia stratiotes* L. is belonging to the family Araceae. About 110 genera, 1800 known species (A.L.de jussice 1789). *Pistia stratiotes* L. is distributed in the tropical and sub-tropical Asia, Africa and America (Arthur Cronquist, 1981). The members of Araceae are predominantly tropical, only about 10 genera occur in temperate regions of the Northern Hemisphere (Armen Takhtajan; 2009). *Pistia stratiotes* L. is aquatic weed and mostly growing in tropical and sub-tropical countries.

This growing plant is a good source for animals and one of the rich sources of organic resources (Mohapatra and Patraa, 2014). The whole plant has long been employed in ancient Chinese prescriptions. A decoction of the leaves is used in La Reunion as a diuretic and prescriptions. It is applied to boils, syphilitic eruptions and in many skin complaints (Kirtikar and Basu, 1634). Mixed with rice and coconut milk they are given in dysentery and with rose-water and sugar in cough and asthma. The ashes are applied to ringworm of the scalp.

¹ Daw, Demonstrator, Department of Botany, Pyay University

² Dr, Associate Professor, Department of Botany, Pyay University

Nowadays, the Union of Myanmar also encourages for development of scientific research on herbal and traditional medicine. To contribute such health policy of country, this project attempted to demonstrate regarding the evaluation and investigation of effective plant. Thus, the aim of this study is to examine the medicinal plant scientifically which have effective medicinal values. To fulfillment this aim, the main objectives are to identify and study the morphological and anatomical characteristics of water lettuce; to perform the preliminary phytochemical analysis from the leaves of water lettuce.

Materials and Methods

The specimens used in this research were collected from the pond of Pyay University, Pyay Township of Bago Region. Fresh specimens of the vegetative and floral parts were used to study its morphology. The taxonomic identification of the plant was made according to the method used in Department of Botany, Pyay University to get correct family, genus and species with help of reference Literatures, such as Hundley and Chit Ko Ko, 1987; Backer, 1963, Flora of Ceylon, 1987, John Kress, 2003, and Flora of Thailand, 2012.

The microscopical characters of samples were examined by preparing free hand section. Chloralhydrate solution used as clearing reagents, phloroglucinol and conc. HCl used for testing lignin, iodine solution for testing starch. The anatomical characters of fresh specimens and powders were studied according to the literature of Esau (1965), Lawrence A. Hurst and Cathy A. Beck (1988), Pandey (1988) and Trease and Evans (2002).

Preliminary phytochemical tests were conducted at Department of Botany, Pyay University. Colour reaction tests were done by applying the method of Finar (1973), Trease and Evans (1978), Marini-Bettolo and *et.al.* (1981), Robinson (1983), and Harbone (1984).

Results

Morphological characters of *Pistia stratiotes* L.

Scientific Name	- <i>Pistia stratiotes</i> L.
Common Name	- Water lettuce, Nile cabbage, water cabbage, tropical duckweed.
English Name	- Water lettuce
Myanmar Name	- Ye-salat
Family	- Araceae

The plant is aquatic herb, floating roots are hanging submerged beneath floating leaves with a peculiar muriatic odor, the reproduction is vegetatively by offset. Leaves are simple, obovate-cuneate, rounded or retuse at the apex, densely and closely pubescent on both surfaces; 5 basal veins, very short petiole also densely covered with pilose hairs. Inflorescence is spadix form subtended by a large, brightly green coloured spathe. Spathe small, obliquely campanulate, white, gibbous and closed below, contracted about the middle, dilated and nearly orbicular above. Male inflorescence a whorl of a few sessile stamens below the apex of the spadix, with a whorl of minute neuter below it; anther vertical dehiscence. Female inflorescence a solitary, oblong, 1-celled ovary, obliquely adnate to the spadix for nearly whole length, the tip free with a discoid stigma; ovules many, crowded on a parietal placenta. Fruit is a berry with many seed.

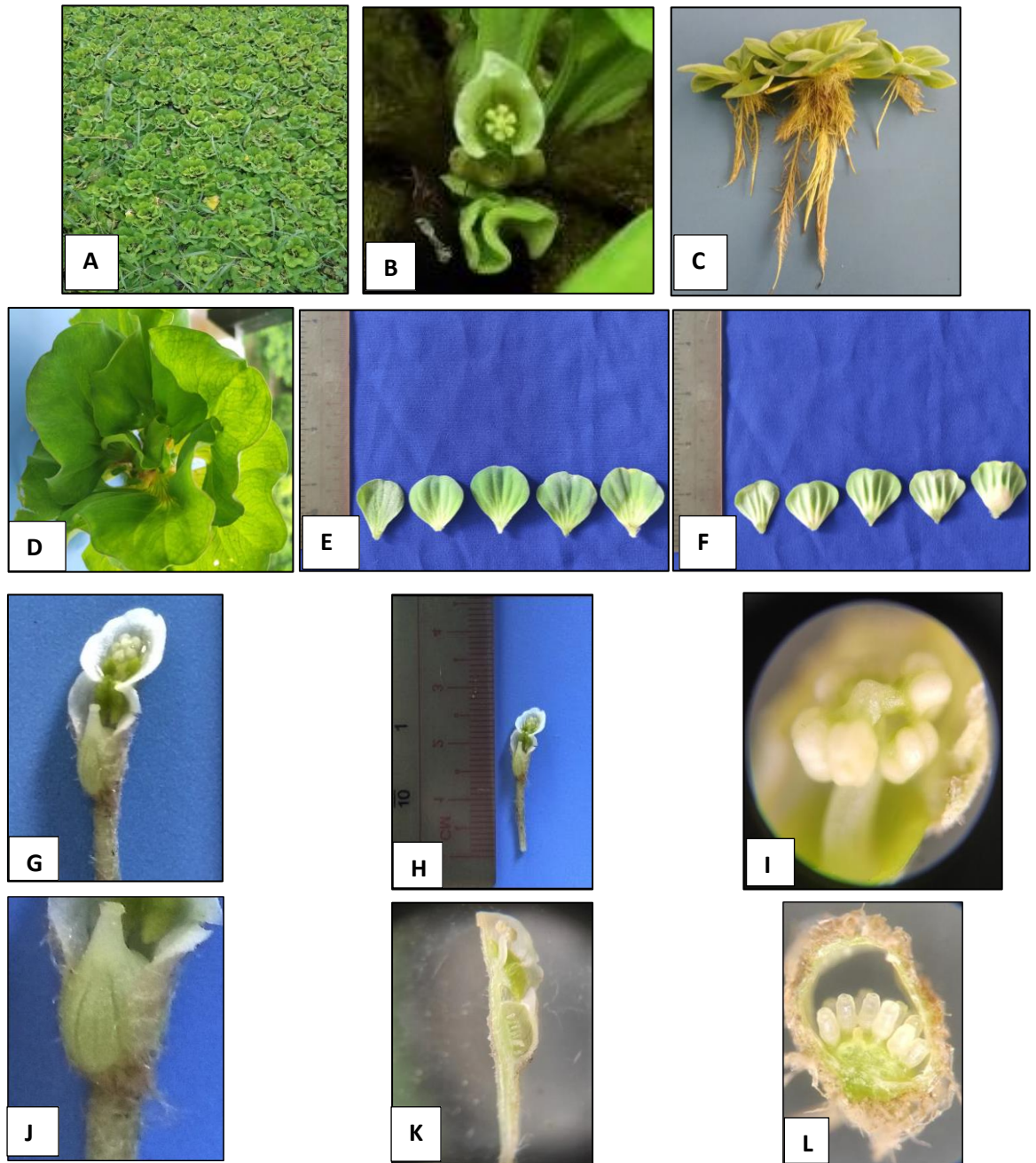


Figure 1. Morphological Features of *Pistia stratiotes* L.

- A. Habit**
- B. Nature of flower**
- C. Plant with offset**
- D. Rosette of leaves**
- E. Upper surface of leaves**
- F. Lower surface of leaves**
- G. Inflorescence**
- H. Flower**
- I. Androecium**
- J. Gynoecium**
- K. L.S of Flower**
- L. T.S Ovary**

Microscopical characters of *Pistia stratiotes* L.

Lamina

The lamina was 425-875 μ m in thick, typically dorsiventral type. In surface view, the epidermal cells of both surfaces are parenchyma and irregular shape. Many multicellular trichomes were absolutely covered on both surfaces of epidermis. Stomata were absent in both surfaces. In transverse section, one layer of rectangular cells was present in both epidermis. Palisade mesophyll was 1-2 layers and 5-9 spongy mesophyll were aerenchyma, abundant chloroplasts in palisade mesophyll. The cells contain raphide or acicular type of crystals. Vascular bundle was collateral type. Many starch grains were found in parenchyma. Multicellular covering trichomes in both surfaces.

Midrib

In surface view, the parenchymatous tissues were thin-walled, epidermal cells were rectangular shaped and compactly arranged. Multicellular trichomes were abundant. In transverse section, the midrib was cylindrical shape in outline, one layer of barrel-shaped epidermal cells, multicellular trichomes were found in surface. The cells are small and closely arranged. Large air cavity present. Vascular bundle was collateral type and collenchyma were below the vascular bundle.

Petiole

In surface view, epidermal cells were thin-walled parenchymatous, rectangular to polygonal shaped and elongated. Rosette crystals were abundant in surface. In transverse section, the petiole is oval shaped in outline. Epidermal cells were 1 layer. The cortex of parenchymatous cells were 13-15 layers and aerenchymatous cells were 6 layers. Rosette crystals were composed and many vascular bundles were scattered in cortex. The multicellular trichomes were found in epidermis.

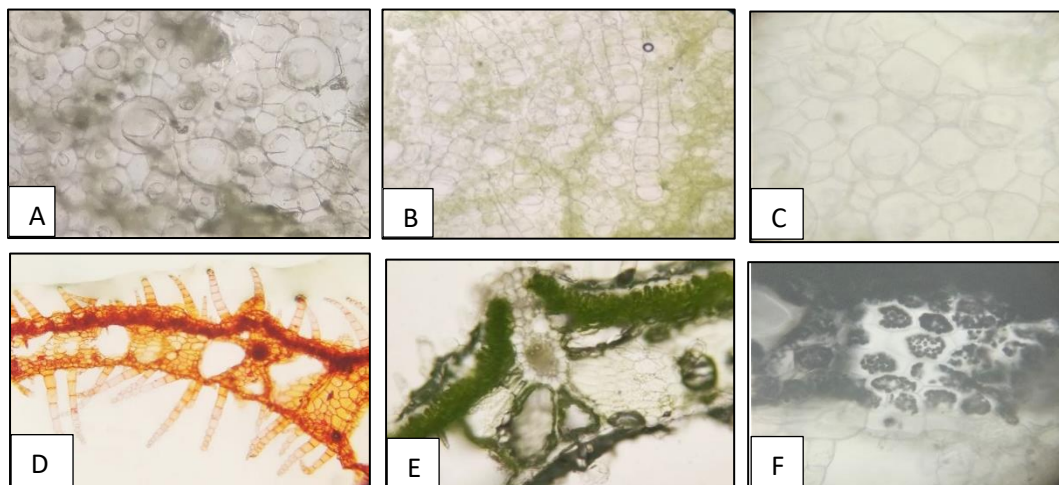


Figure 2. Anatomical characters of lamina of *Pistia stratiotes* L.

- A. Upper surface of lamina**
- B. Upper surface with multicellular trichomes**
- C. Lower surface of lamina**
- D. T.S. of lamina (outline)**
- E. T.S. of lamina showing vascular bundle**
- F. T.S. of lamina showing starch grains**

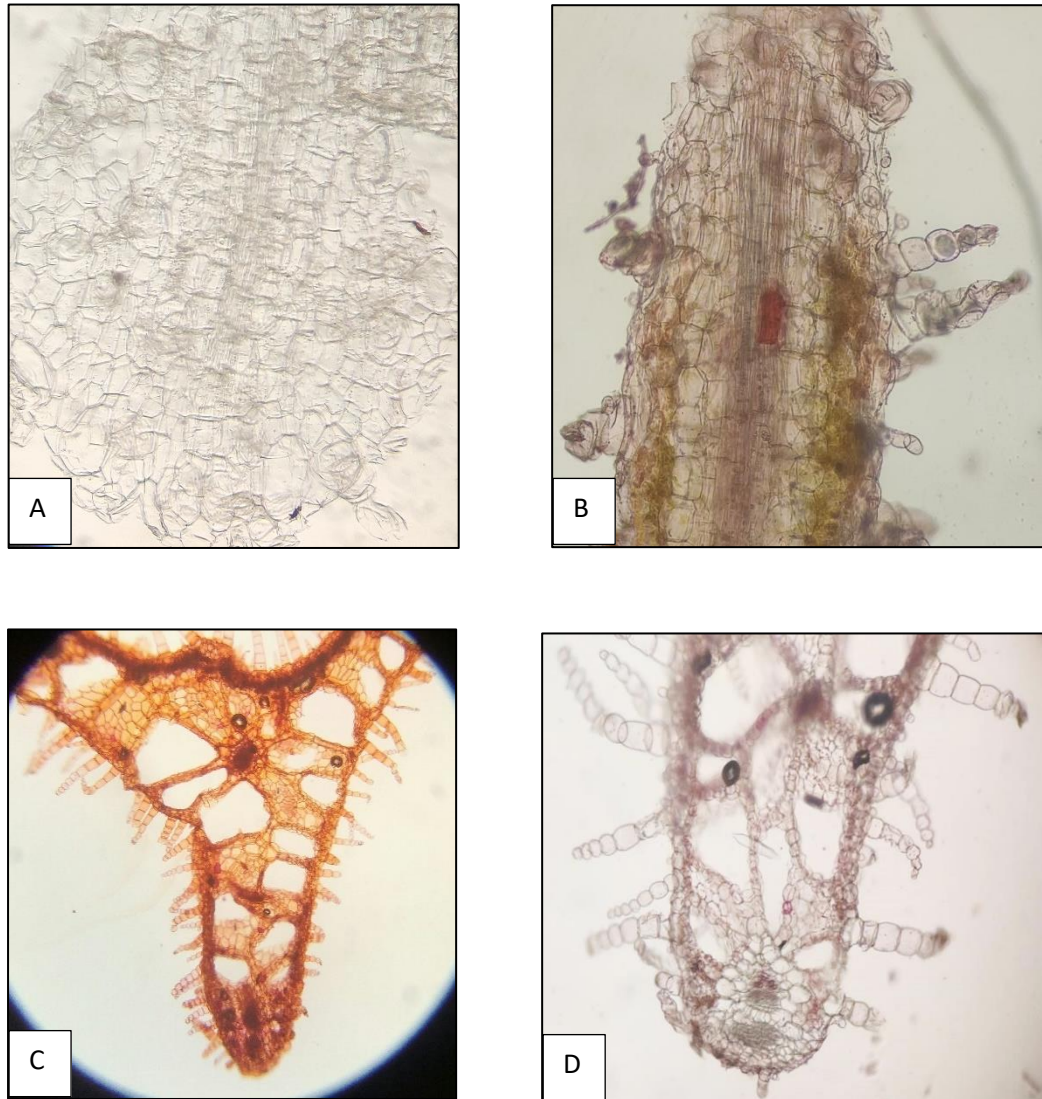


Figure 3. Anatomical characters of midrib of *Pistia stratiotes* L.

- A. Surface view of midrib**
- B. Surface view of midrib showing trichomes**
- C. T.S. of midrib (outline)**
- D. T.S. of midrib showing vascular bundle**

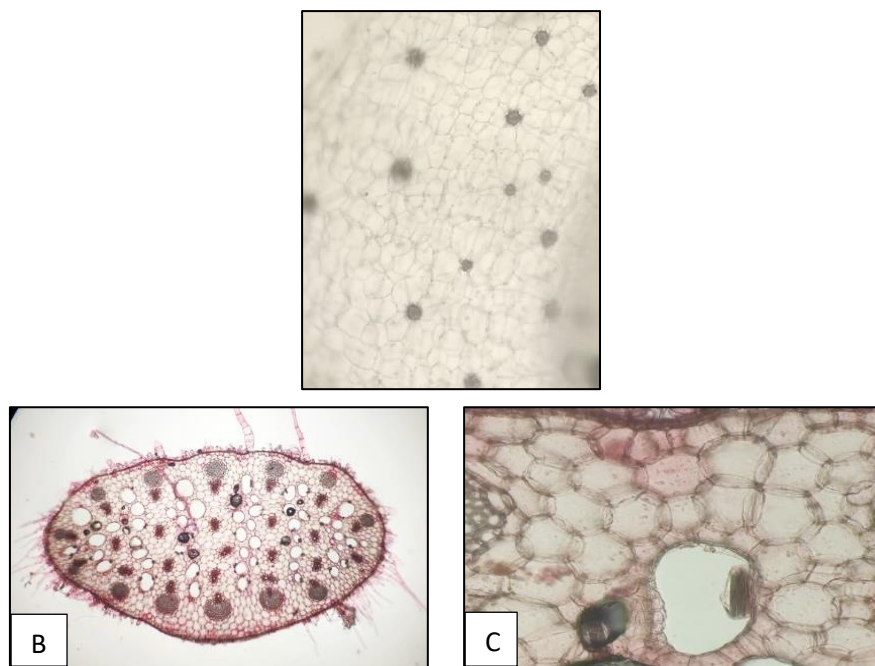


Figure 4. Anatomical characters of petiole of *Pistia stratiotes* L.

A. Surface view of petiole showing rosette crystals

B. T.S. of petiole (outline)

C. T.S. of petiole showing acicular type of crystal

Diagnostic features of leaves powder of *Pistia stratiotes* L.

Sensory characters

Pale-green colour with fibrous texture and slime taste with nauseating odour.

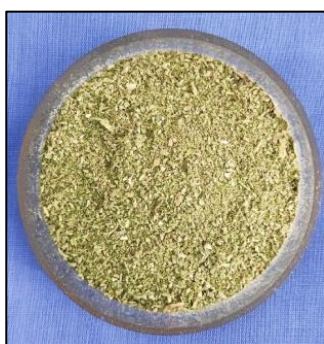


Figure 5. Leaves powder of *Pistia stratiotes* L.

Microscopical characters of powdered leaves of *Pistia stratiotes* L.

Vessels, tracheids and fragments of sample were present in powdered leaves of *Pistia stratiotes* L.. Vessels were found as pitted and tracheids were found as fibre, annular and spiral thickening. Fragments of sample were found as multicellular trichomes and rosette crystals.

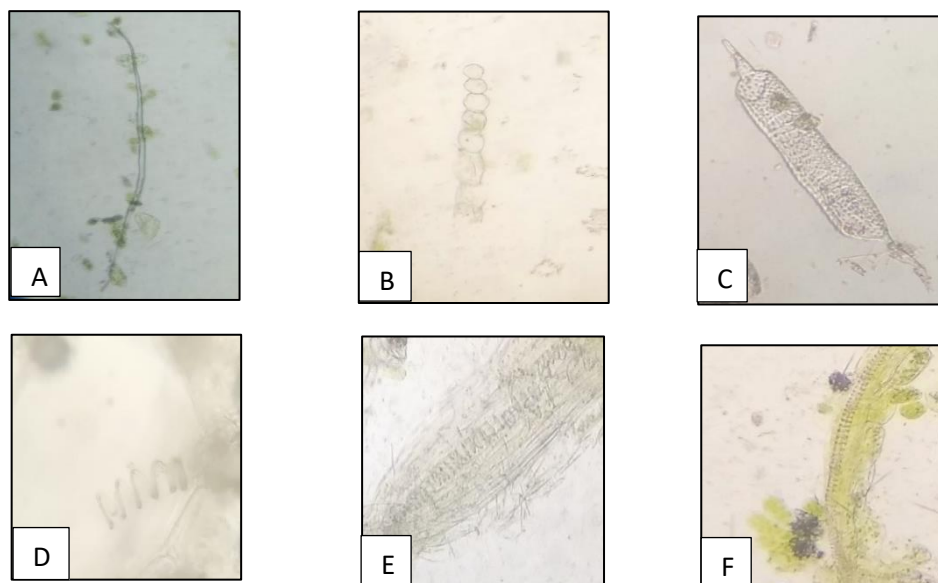


Figure. 6 Microscopical characters of powdered leaves of *Pistia stratiotes* L.

- | | |
|---------------------------|---------------------|
| A. Fibre tracheid | D. Spiral tracheid |
| B. Multicellular trichome | E. Annular tracheid |
| C. Pitted vessel | F. Rosette crystals |

Preliminary phytochemical tests of the leaves of *Pistia stratiotes* L.

The preliminary phytochemical investigation from leaves of *Pistia stratiotes* L. indicated the presence of alkaloids, carbohydrates, phenolic compound, reducing sugar, flavonoid, glycoside, saponin, and tannin. Starch and α -amino acid were absent.

Table. Preliminary Phytochemical test of powdered leaves of *Pistia stratiotes* L.

No	Test	Extract	Test Reagent	Observation	Results
1.	Alkaloid	D.W	1. Mayer's reagent 2. Dragendroff's reagent 3. Wagner's reagent	White ppt Reddish color or ppt Brown ppt	+ + +
2.	α -amino acid	D.W	Ninhydrin reagent	Yellow color or Brown ppt	-
3.	Carbohydrate	D.W	10% of α - naphthol + Conc:H ₂ SO ₄	Red ring	+
4.	Phenolic Compound	D.W	10% of FeCl ₃ solution	Deep blue colour	+
5.	Reducing sugar	D.W	Benedict's solution	Yellowish-green	+
6.	Starch	D.W	Iodine solution	Reddish colour or Brown	-
7.	Flavonoid	D.W	Conc:HCL, Mg burning	Brown colour	+
8.	Glycoside	D.W	10% lead acetate	ppt or yellowish	+
9.	Saponin	D.W	Distilled water	Frothing	+
10.	Tannin	D.W	1% FeCl ₃	Bluish black	+

(+) = Present (-) = Absent (ppt) = Precipitate

Discussion and Conclusion

In this research work, morphological, anatomical characters and preliminary phytochemical investigation from leaves of *Pistia stratiotes* L. have been undertaken. *Pistia stratiotes* L. was floating stemless stoloniferous aquatic herb and pubescent hairs were present. Leaves are Simple, obovate-cuneate, rounded or retuse at the apex, densely and closely pubescent on both surfaces; 5 basal veins; very short petiole also densely covered with pubescent hairs. Inflorescence are represented as a spadix. Spathe was small, obliquely campanulate, white-coloured, gibbous and closed below, contracted about the middle, dilated and nearly orbicular above. Male inflorescence was a whorl of a few sessile stamens below the apex of the spadix, with a whorl of minute neuter below it; anther slits vertical. Female inflorescence was a solitary oblong 1-celled ovary, obliquely adnate to the spadix for nearly whole length, the tip free with a discoid stigma; ovules many, crowded on a parietal placenta. These characters are agreement with those reported by Hooker (1879), Kirtikar and Basu (1935), Baily (1939), Backer (1963), Flora of Ceylon (1987), Lawrence A. Hurst and Cathy A. Beck. (1988). In histological study, Epidermal cells were irregular-shaped and many multicellular trichomes were absolutely covered the whole surface. Although Sundeep Kumar HK, Dinda SC and Raju MVB, 2015 reported that paracytic stomata were present in both surfaces, Lawrence A. Hurst and Cathy A. Beck. 1988 reported that stomata were absent in it. The present research work agreement with Lawrence A. Hurst and Cathy A. Beck. (1988).

In transverse section of lamina, one layer of rectangular cells was composed in both the epidermis. The cells contain raphide or acicular type of crystals. Vascular bundle was collateral type. Multicellular covering trichomes were present in both surfaces. In transverse section of midrib, one layer of barrel-shaped epidermal cells, multicellular trichomes in surface. The cells are small and closely arranged. Large air cavity present. Vascular bundle was collateral type and collenchyma were below the vascular bundle. These characters were accordance with those given by Sundeep Kumar HK, Dinda SC and Raju MVB, (2015). In transverse section of petiole, many vascular bundles were scattered in cortex. Rosette crystals were abundant in the cells. The multicellular trichomes were present in the epidermis. In preliminary phytochemical investigation, alkaloids, carbohydrates, phenolic compound, reducing sugar, glycoside, saponin, flavonoid and tannin were present. α -amino acid was absent. In starch test, it was found in anatomical characteristic study, but not found in preliminary phytochemical study. From the results of current research work, it can be concluded that *Pistia stratiotes* L. showed the presence of many secondary metabolites and phytochemical constituents, which can be a source of traditional medicine to be used.

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