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Review Article

ESTABLISHING THE CORRECT IDENTITY OF *JALAKUMBHI* IN AYURVEDA: A CRITICAL ANALYSIS BASED ON VARIOUS LITERATURES

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ABSTRACT

Jalakumbhi is an effective Ayurvedic medicinal plant in the indigenous system of medicine which is found abundantly as a spread of a velvety carpet in mushy water bodies. This drug is known to Ayurveda practitioners since the *Nighantu Kala*. *Jalakumbhi* mentioned in Ayurvedic classics can be compared to *Pistia stratiotes* var. cuneata. but it is usually confused with *Eichhornia crassipes* also known as *Pontederia crassipes* thus making it controversial. This could be due to various reasons such as documentation defects in the manuscripts, same synonyms, habitat or morphology. All parts of the plant can be utilized for preparation of medicine for various diseases. The plant shows anti-thyroid, diuretic, antipyretic, anti-hemorrhoid, bronchodilator properties as well as can be used in various bleeding disorders in addition to in individuals suffering from emaciation, *Sangrahani*, *Karnapaka*, prickly heats etc. Here, an attempt is made to review the various therapeutic properties of *Jalakumbhi* along with its etymology, morphology and pharmacological aspects. We will also work to review and differentiate the plant which is confused as *Jalakumbhi* and rule out the reason behind such controversies. Various Ayurvedic and modern texts along with the latest researches have been analyzed and the concept concluded. The study shows both Ayurvedic and modern explanation of this aquatic plant thus, giving correlation on the scientific basis of Ayurvedic drug *Jalakumbhi* and the use of it in various diseases. It will also set strong background for the drug which is mentioned as *Jalakumbhi* in our sacred compendiums.

INTRODUCTION

Ayurveda is being practiced since time immemorial. Numerous plant drugs, *Rasa aushadhis*, surgical practices using plant origin, metals etc. have been mentioned in the texts of Ayurveda for the cure of several diseases. *Jalakumbhi* is one of these long listing of Ayurvedic drugs which was practiced repeatedly to cure diseases. This drug can be used as a versatile agent to cure various diseases internally as well as externally.

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Though, we don't find any references regarding this drug in the *Vedic* or the *Samhita Kala* but *Jalakumbhi* is known to the Ayurveda followers from the *Nighantu kala* which is expected to be from 5th century A.D. where its detailed description can be found. *Jalakumbhi* is a free floating plant and usually confused with *Eichhornia crassipes* commonly known as water hyacinth due to similarity in their habitat. From modern aspect *Eichhornia crassipes* is believed to be the ancient classical *Jalakumbhi* but if we dig deep and view from the classical points written in the traditional compendium we find that the drug is more similar to *Pistia stratiotes* according to nomenclature. The literal meaning of *Pistia stratiotes* is a pan-tropical floating plant forming a rosette of wedge-shaped leaves; a widespread weed in rivers and lakes[1] whereas *Eichhornia crassipes* is a tropical floating

aquatic plant having spikes of large blue flowers and is troublesome in clogging waterways.[2]

Taxonomic Classification

***Pistia Stratiotes var* cuneata Engl**[3]

Kingdom: Plantae
Phylum: Tracheophyta
Class: Liliopsia
Order: Alismatales
Family: Aracea
Genus: Pistia
Species: Pistia stratiotes

***Eichhornia crassipes* (Mart.) Solms (4)**

Kingdom: Plantae
Phylum: Spermatophyta
Class: Monocotyledonous
Order: Pontederiales
Family: Pontederiales
Genus: Eichhornia
Species: Eichhornia crassipes

Synonyms of Scientific Name

Table 1: shows the twenty nine synonyms of *Pistia stratiotes* and nine synonyms of *Eichhornia crassipes*.

Table 1: Synonyms of Scientific names

***Pistia stratiotes* (29)** [3] [6]		***Eichhornia crassipes (9)*** [7]
Aspiospermum obcordatum (Schleid.) Klotzsch[5]	*Pistia minor* Blume	*Eichhornia cordifolia Gand.*
Limnonesia commutata (Schleid.) Klotzsch	*Pistia natalensis* Klotzsch	*Eichhornia crassicaulis* Schltdl.
Limnonesia friedrichsthaliana Klotzsch	*Pistia obcordata* Schleid[5]	*Eichhornia crassipes* (Mart.) Solms
Pistia aegyptiaca Schleid	*Pistia occidentalis* Blume	*Eichhornia speciosa* Kunth
Pistia aethiopica Fenzi ex Klotzsch	*Pistia schleideniana* Klotzsch	*Heteranthera formosa* Miq.
Pistia africana C.Presl	*Pistia spathulata* Michx	*Piaropus crassipes* (Mart.) Raf.
Pistia amazonica C.Presl	*Pistia stratiotes* var. cuneata Engl.	*Piaropus mesomelas* Raf.
Pistia brasiliensis Klotzsch	*Pistia stratiotes* var. linguiformis Engl.	*Pontederia crassicaulis* Schltdl.
Pistia commutata Schleid	*Pistia stratiotes* var. obcoradta (Scleid) Engl.	*Pontederia elongata* Balf.
Pistia crispata Blume	*Pistia stratiotes* var. spathulata (Michx.) Engl	
Pistia cumingii Klotzsch	*Pistia texensis* Klotzsch	
Pistia gardneri Klotzsch	*Pistia turpinii* K.Koch	
Pistia horkeliana Miq.	*Pistia weigeltiana* C.Presl	
Pistia leprieuri Blume	*Zala asiatica* Lour.	
Pistia linguiformis Blume		

Vernacular Names

Table 2: Various Regional Names Given to *Jalakumbhi* Plant

Language	***Pistia stratiotes*** [3] [8] [9]	***Eichhornia crassipes*** [11] [12]
Assamese	Borpuni, *Jalakumbhi*	
English name	Shell flower[10], water lettuce, the wester lettuce, tropical duck weed, nile cabbage, water cabbage	Water hyacinth
Bengali	Takapaan, Jalalumbhi	Kachuripana
Hindi	*Jalakumbhi*	Jalakumbhi, Badi jalakumbhi
Kannada	Antaragange, Kumbika	Antara taavare, Antaragange
Malayalam	Akasathamara, Kodappayal, Mutta payal, Neercheera	Kolavajha
Manipuri	Kangjao, Kabokang	Kabokkang
Tamil	Akashattamarai, Antarattamarai, Kulittamarai, Agasatamaray	Venkayattamarai, Akashathamrai
Telugu	Antaratamara, Budagatamara, Akashatamara, Neeraaku, Nerubudiki, Tudikura, Antaraganga	Budaga Tamara, Gurra pudekka Moka, Pishachithamara

Etymology of Botanical Name

***Pistia*:** Derived from Greek word 'pistos' meaning "drinking water" (pino-drink) referring to the aquatic habitat or to the floating habit. [13]

Stratiotes: Derived from Greek word which means 'Soldier' [14], Army (water soldier), sword like leaves[15]

Eichhornia: New Latin, from Johann A. F. *Eichhorn* †1856 Prussian official + New Latin *–ia*[16]

Pontederia*:* The genus was named by Linnaeus in honour of the Italian botanist Giulio Pontedera[17]

***Crassipes*:** Derived from Latin words crassus ("thick") + pēs ("foot") meaning thick footed[18]

Morphology

Pistia stratiotes[5] [19]is a floating, aquatic plant with many, pendulous roots that appear feathery. The leaves are in rosette with 1.3-10 x 1.5-6 cm in size. The spathe is 5-12mm in size, white in color, hairy. Its flowering is in hot season around May to Nov and its fruits are membranous.

Fig.1 ***Pistia stratiotes (Jalakumbhi)***

Fig. 2 ***Pistia stratiotes (Jalakumbhi)***

Eichhornia crassipes[20] is a floating herb, 0.3-2m in size. It has many long and fibrous roots with very short stem. Leaves are radical with yellowish to greenish petiole which are 10-40cm long, spongy and usually are very much swollen at or below middle. Its flowering is from July to October and fruiting from August to November.

Distribution

Native range– Pistia stratiotes is the native species of India.[6] It is mainly found in tropical and sub-tropical areas[5,6], Assam[3], fresh water bodies, lakes and ponds[5,9].

The origin of *Eicchornia* is S. Tropical America, [7] and was introduced into various countries as an ornamental species to adorn the water bodies. [21]

Parts used – Whole plant of *Jalakumbhi* can be used for medicinal purposes. [9][22][23]

Jalakumbhi in Classical Texts

Jalakumbhi is described in several *Nighantu* under various *Vargas* with different names. It is described by the name *Jalakumbhika* in *Ashtanga Nighantu, Nighantu Adarsha*; *Variparni* in *Bhav Prakash Nighantu*, *Kaiyadeva Nighantu, Saraswati Nighantu; Kumbhi* in *Guna Ratnamala; Kumbhika* in *Paryaya Ratnamala, Shaligram Nighantu* and *Jalakumbhi* in *Priya Nighantu*. It is mentioned under the *Vargas* namely – *Shyamadirgana, Pushpavarga, Aushadha Varga, Vachadi Varga, Sharadi Varga, Upaadivarga, Parishishtyabhaga* in *Ashtanga Nighantu, Bhav Prakash Nighantu & Guna Ratnamala, Kaiyadeva Nighantu, Nighantu Adarsha, Priya Nighantu, Saraswati Nighantu, Shaligram Nighantu* respectively. There is no reference of *Jalakumbhi* in *Charak Samhita, Sushruta Samhita, Raj Nighantu, Dhanwantari Nighantu*. [22][12]

Its classification along with Class and uses are mentioned in Table 3.

Table 3. *Jalakumbhi* in Classical Texts

Classical Compendium	Name	*Varga* (Class)	Uses/ Diseases	References
Samhita				
Charak	-	-	-	-
Sushruta	-	-	-	-
Vagbhata	-	-	-	-
Nighantu				
Abhidhanratnamala	-	-	-	-
Ashtanga Nighantu[10]	*Jalakumbhika*	*Shyamadirgana*	-	A.N. Shyamadirgana
Bhava Prakasha Nighantu[12]	*Variparni*	*Pushpavarga*	*Virechak* *Raktavikar* *Jwara, Shosha*	B.P.N. Pushpavarga: 17-18
Chandra Nighantu/ Madanadi Nighantu	-	-	-	-
Dhanwantari Nighantu	-	-	-	-
Guna Ratnamala [24]	*Kumbhi*	*Pushpa Varga*	-	-
Hridayadipak nighantu	-	-	-	-
Kaiyadeva Nighantu[25]	*Variparni*	*Aushadhi Varga*	*Rakta pitta* *Jwara* *Shosha*	K.N. Aushadhivarga 1467-1469
Laghu nighantu	-	-	-	-
Madanpala Nighantu	-	-	-	-
Nighantu Adarsha[26]	*Jalakumbhika (Jalakumbhi)*	*Vachadi varga*	*Galaganda* *Mutrakrucchra* *Sangrahani* *Kapha & shwas roga* *Mriduvirechak* *karnapaka*	N.A. Vachadi vargapg. 665-667
Nighantu Ratnakar	-	-	-	-
Paryaya Ratnamala[27]	*Kumbhika*	-	-	P.R. kumbhika namani 45
Priya Nighantu[28]	*Jalakumbhi*	*Sharadi Varga*	-	Pr.N. sharadi varga 57
Raja Nighantu	-	-	-	-
Saraswati Nighantu[29]	*Variparni*	*Ulapaadivarga*	-	S.N.

				Ulaapadivarga63
Saushruta Nighantu	-	-	-	-
Shaligram Nighantu[30]	*Kumbhika*	*Parishishtabhaga*	*Hrida vikar, Jwara*	Sh.Ni. Parishishtabhaga Page 917-918
Shankar Nighantu	-	-	-	-
Shodhala Nighantu	-	-	-	-
Sushena Nighantu (Ayurveda Mahodadhi)	-	-	-	-

Synonyms of *Jalakumbhi* in Various *Nighantus*

Several different names have been used for *Jalakumbhi* in classical texts which are *Akashmuli, Dhandhan, Hath, Jalakumbhi, Jalakumbhika, Jalashankhalama, Jalavalkala, Khamulika, Kuli, Kumbhi, Kumbhika, Kumuda, Kutrina, Paniya prushthaja, Pariparni, Parnishaivalam, Toayacchada, Toyakumbhi, Toyavruksha, Varimuli, Variparni, Vrukdhum*.

Its detailed description is given in Table 4.

Table 4. Synonyms of *Jalakumbhi* in various *Nighantus*

***Paryaya* Name**	**Commentators**																				
	A.R. M.	**A. N.** [10]	**B.P. N.**[12]	**C.N./ M.A. N.**	**D. N.**	**G.R. M.** [24]	**H. N.**	**K. V.** [25]	**L. N.**	**M. N.**	**N. A.** [26]	**N. R.**	**PR M** [27]	**P. N.**	**R. N.**	**S. N.** [29]	**S.S. N.**	**S.G. N.** [30]	**Sh. N.**	**Sho. N.**	**Su. N.**
Akashamuli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Dhandhan	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
Hatha	-	-	-	-	-	-	-	+	-	-	+	-	+	-	-	-	-	-	-	-	-
Jalakumbhi	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jalakumbhika	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Jalashankhalama	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Jalavalkala	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Khamulika	-	-	+	-	-	+	-	-	-	-		-	-	-	-	-	-	+	-	-	-
Kuli	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
Kumbhi	-	-	-	-	-	+	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
Kumbhika	-	+	+	-	-	+	-	-	-	-	-	-	+	-	-	+	-	+	-	-	-
Kumuda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Kutrina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Paniya prushthaja	-	-	-	-	-	-	-	+	-	-	+	-	+	-	-	-	-	-	-	-	-
Pariparni	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Parnishaivalam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Toayacchada	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toyakumbhi	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
Toya vruksha	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
Varimuli	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Variparni	-	+	+	-	-	+	-	+	-	-	+	-	+	-	-	+	-	+	-	-	-
Vrukdhum	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-

Abhidhanratnamala- A.R.M; Ashtanga Nighantu- A.N; Bhawa Prakasha Nighantu- B.P.N; Chandra Nighantu/ Madanadi Nighantu- C.N./ M.A.N.; Dhanwantari Nighantu- D.N.; Guna RatnaMala- G.R.M; Hridyadipak Nighantu- H.N.; Kaiyadeva Nighantu- K.V.; Laghu Nighantu- L.N.; Madanpala Nighantu- M.N.; Nighantu Adarsha- N.A.; Nighantu Ratnakar- N.R.; Paryaya Ratnamala- PRM; Priya Nighantu- P.N. ; Raj Nighantu- R.N.; Saraswati Nighantu- S.N.; Saushruta Nighantu- S.S.N.; Shaligram Nighantu- S.G.N.; Shankar Nighantu- Sh. N.; Shodhala Nighantu- Sho.N; Sushena Nighantu- Su. N

Etymology of Sanskrit Names[15]

1) *Jalakumbhi*- Water plant which has *Kumbhavata* anatomy [12]
2) *Jalakumbhika*- Its plant (*Kshupa)* is light in weight and thus floats on water (*Jala*) like a pot (*Kumbha*)
3) *Jalashankhalama* - Petals are bent like a conch[22]
4) *Jalavalkala* – Its *Kshupa* is found in water and its appearance is black/scale (*Valkal*) like.
5) *Kumbhi* – Its *Kshupa* are circular in shape like a pot (*Kumbhawat*)
6) *Kumbhika* – It is circular in shape like a pot (*Kumbha*), *Kshupa* being light in weight floats in water just like a pot (*Kumbhawat*)
7) *Kumuda* – Its appearance is similar to *Kumuda* i.e., *Shweta utpala*
8) *Matkunari - Jalakumbhi* is very useful to get rid of bedbugs (*Matkun*) thus named as *'Matkunari*[22]
9) *Paniya* – Its aquatic herb (*Kshupa*) floats in water (*Paani*)
10) *Paniyaprushthaja* - Its *Kshupa* floats on the surface (*Prushtha Bhaga*) of water (*Pani*)
11) *Prushthaga* – It floats on the surface of water (*Prushthabhaga*)
12) *Toyakumbhi* – Its *Kshupa* is found in water (*Toya*) and it is circular in shape similar to water pot (*kumbha*)
13) *Toyacchada* – Its leaves (*Cchada*) floats on water (*Toya*)
14) *Varimuli* – The roots (*Mula*) of *Kshupa* are found submerged in water (*vaari*)
15) *Variparni* – Its leaves (*Parna*) floats on Water (*Vari*)

Ayurvedic Pharmacology of *Jalakumbhi*

Jalkumbhi is *Katu*, *Tikta* and *Madhura* in *Rasa*; it has *Laghu, Ruksha, Saraguna* and is *Shita* in *Virya* with *Madhurvipak*, it is *Tridoshanashak* though in some it is mentioned as *Tridoshvardhak*[24]; it acts as a laxative[12], and has diuretic[26][12] properties, it is *Anulomaka* and *Kasa-shamak*, *Daha-shamak*. It can be widely used in *Raktavikar*, *Jwara*, *Shosha*, *Mutrakrucchra*, *Arsha*, *Galaganda*, *Charma* etc.[12] Its detail is given in Table 5.

Table 5: *Rasa Panchak* of *Jalkumbhi*

	B.P.N [12]	**G.R.M.**[24]	**K.N**[25]	**N.A**[26]	**Pr.N.** [28]	**Sh.N.**[30]
Rasa	*Katu, tikta (Swadu)*	*Tikta*	*Madhur, Tikta, katu*	-	*Madhur, Tikta*	*Tikta*
Guna	*Laghu, Ruksha*	*Laghu, Sara, Ruksha, Patu (Amla)*	*Laghu, Sarak, Tridoshanashak, Ruksha*	-	*Laghu, Ruksha*	*Laghu, Sarak, Charapari*
Virya	*Shita*	*Shita*	*Shita*	*Shita*	*Shita*	*Shita*
Vipak		*Madhur*	-	-	-	*Madhur*
Doshakarma	*Tridosha shamak*	*Tridoshvardhak*	-	-	-	*Tridoshanashak*
***Prabhav* (Effect)**	Laxative, *Mutrajanan, Anulomak, Kasa shamak*	-	-	*Mutral Mridu Virechak (Mula)*	*Sarak Daha shamak*	-
***Vyadhi* (Disorders)**	*Raktavikar, Jwara, Shosha, Mutra krucchra, Arsha, Galaganda, Charma*	*Jwara, Shosha*	*Raktapitta, Jwara, Shosha*	*Shwas*	*Galaganda*	*Rudhir vikar Jwara*
***Prayogyanga* (Parts used)**	-	-	-	Whole plant	-	-

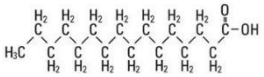
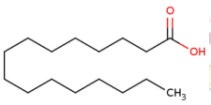
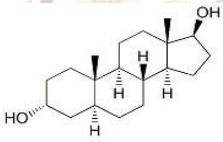
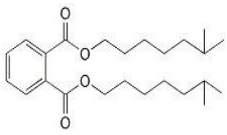
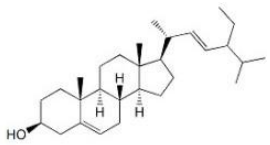
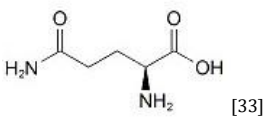
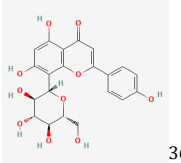
Phytochemical Parameters

The extract of leaves and roots of *Pistia stratiotes* shows the presence of alkaloids, glycosides, steroids, flavonoids, tannins, terpenoids, quinones, anthraquinone, caradic glycosides, sterols, polyphenols, anthrocyanin, and volatile oils and resins; However, saponin, phlobatannin, carotenoids, and proteins were not found.[21] An analysis of leaves and stems revealed moisture 92.9%, protein 1.4%, fat 0.3%, carbohydrate 2.6%, fibers 0.9%, ash 1.9%, calcium 0.2%, phosphorus 0.06%.[31] Leaves are rich in vitamin A and C, and also contain vitamin B.[31] The ash is rich in potassium chloride and sulfate. Stigmasta-4, 22-dien-3-one, stigmasterol, stigmasteryl stearate, and palmitic acids are reported in P. stratiotes.[31]

The plant gave 2-*di*-C-glycosyl flavones of vicenin and lucenin type, anthocyanin-cyanidin-3-glucoside, luteolin-7-glycoside and mono-C-glycosyl flavones— vitexin and orientin.[32]

Chemical Structure and biological activities of some compounds of *Pistia stratiotes* are given in Table 6.

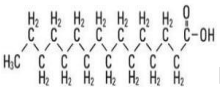
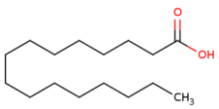
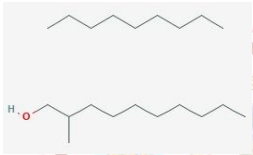
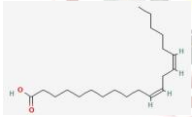
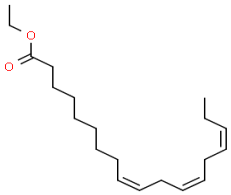
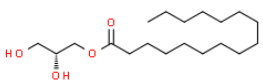
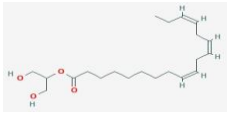
Table 6: Chemical Structure and Biological Activities of Some Compounds from *Jalakumbhi – Pistia stratiotes*[21]

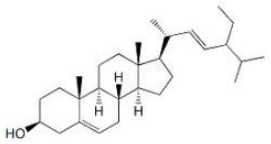
Name of Compound	Molecular formula	Chemical Structure	Compound nature	Biological activities
n- Hexadecanoic acid	C16H32O2	 [33]	Palmitic acid ester	Anti-oxidant, hypocholesterolemic, nematicide, anti-androgenic, hemolytic, pesticide, lubricant, 5-Alpha reductase inhibitor, antipsychotic
Hexadecanoic acid, ethyl ester	C18H36O2	 [34]	Palmitic acid ester	Antioxidant, hemolytic, hypocholesterolemic, flavor, nematicide, anti-androgenic.
9,12,15Octadecatrienoic acid, methyl ester, (Z,Z,Z)	C19H32O2	 [33]	Steroid	Antimicrobial, anticancer, hepatoprotective, anti-arthritic, anti-asthama, diuretic
Hexadecanoic acid, 2-hydroxy-1(hydroxymethyl) ethyl ester	C19H38O4	 [35]	Amino compound	Hemolytic, pesticide, flavour, antioxidant.
Diisooctyl phthalate	C8H4(C8H17COO)2	 [33]	Plasticizer	Antimicrobial, antifouling
Stigmasterol	C29H48O	 [33]	Steroid	Antioxidant, hypoglycemic and thyroid inhibiting properties, precursor of progesterone, antimicrobial, anticancer, anti-arthritic, anti-asthama, anti-inflammatory, diuretic.
L-Glutamine	C5H10N2O3	 [33]	Amino acid	Building block of Protein
Vitexin	C21H20O10	 36]	apigenin flavone glucoside	Platelet aggregation inhibitor, EC 3.2.1.20 (alpha-glucosidase) inhibitor, antineoplastic agent and a plant metabolite.

Water hyacinth is a source of many compounds with radical-scavenging activity, such as vitamins, terpenoids, phenolic acids, lignin, stilbens, alcaloids, sterols, and other metabolites with high antioxidant activity.[21] The leaves contain saponins, flavonoids, tannins and polyphenols.[37] The plant contained an ash content of 14.3 to 20.7% and extractives content from 21.8 to 35.6%; the organic elements detected were potassium (K), chlorine (Cl), calcium (Ca), Sodium (Na), Magnesium (Mg), silicon (Si), aluminium (Al), phosphorus (P), sulphur (S), manganese (Mn), iron (Fe), and titanium (Ti); in addition, low amounts of lignin (12.5 to 25.7%) and holocellulose (26.7 to 37.1%) were obtained.[38]

Chemical Structure and biological activities of some compounds of *Eichhornia crassipes* are given in Table 7

Table 7. Chemical Structure and biological activities of some compounds from Eichhornia crassipes[21]

Name of Compound	Molecular formula	Chemical Structure	Compound nature	Biological activities
n- Hexadecanoic acid	C16H32O2	 [33]	Palmitic acid ester	Antioxidant, hypocholesterolemic, nematicide, anti-androgenic, flavor, hemolytic
E-11-Hexadecanoic acid, ethyl ester	C18H34O2	 [39]	Stearic acid	Antifungal, anti-tumour, antibacterial
Palmitic acid, ethyl ester	C18H36O2	 [34]	Stearic acid	Antifungal, anti-tumour, antibacterial
Phytol	C20H44O	 [40]	Diterpene	Antimicrobial, anti-inflammatory, anticancer, diuretic, antifungal against S. typhi, resistant gonorrhea, joint dislocation, headache, hernia, stimulant and antimalarial
9,12-Octadecadienoic acid, ethyl ester	C20H36O2	 [41]	Polyenoic fatty acid	Hepatoprotective, antihistaminic, hypo-cholesterolemic, anti-eczemic
Linolenic acid, ethyl ester	C20H34O2	 [42]	Linoleic acid ethyl ester	Hypocholesterolemic, nematicide, antiarthritic, hepatoprotective anti-androgenic, hypocholesterolemic, 5-Alpha reductase inhibitor, antihistaminic, anticoronary, insectifuge, anti-eczemic, anti-acne
Hexadecanoic acid, 2hydroxy-1-(hydroxymethyl) ethyl ester	C19H38O4	 [43]	Amino compound	Hemolytic, pesticide, flavor, anti-oxidant
α-Glyceryl linolenate	C21H36O4	 [44]	Fatty Acid Ester	Cosmetic, colouring agent
1-Monolinoleoylglycerol trimethylsilyl ether	C27H54O4Si2	 [45]	Steroid	Anti-arthritic, Hepatoprotective, antimicrobial, anti-inflammatory, antioxidant, anti-diabetic, antiasthma, diuretic

Stigmasterol	C29H48O	 [33]	Steroid	Antioxidant, hypoglycemic and thyroid inhibiting properties, precursor of progesterone, antimicrobial, anticancer, anti-arthritic, antiasthama, anti-inflammatory, diuretic

Pharmacological Properties

P. stratiotes leaves possess antifungal properties[46]. The preliminary studies suggest that the aqueous solution of the dried residue of a 70% methanol extract of P. stratiotes contains a muscle relaxing principal for both smooth (vascular, intestinal and bronchiolar) and skeletal muscle, and this principal appeared to operate via calcium channel blockade; The plant extract was found to be a bronchodilator on isolated guinea pig trachea and lowered blood pressure in anaesthetized rats[47]. The extract produced significant writhing inhibition, tested by acetic acid-induced writhing model in mice thus possessing antinociceptive activity[48]. Antidiarrhoeal activity was tested by using the model of castor oil-induced diarrhoea in mice; the extract caused and increased in latent period and decreased the frequency of defecation as well as the number of total stool count.[48] P. stratiotes is able to lower the level of thyroid hormones and also it showed stronger and broader spectrum of antimicrobial activity.[46] The isolated compound (saponin: sitosterol-3-O-[2,4-di-O-acetyl-6-O-stearyl-β-D-glucose pyranoside]) from P. stratiotes exhibited significant decrease in the weight of reproductive organs in mice-including testis, epididymis, seminal vesicle-sperm count, sperm viability and serum testosterone level and significant increase in the number of abnormal spermatozoa thus it has the potential to act as a male contraceptive.[49]

Water hyacinths have a high potency as an antibacterial, antifungal, antioxidants and anticancer remedy.[50]

Ayurvedic Properties

The plant shows antithyroid[12,28], diuretic[12,26], antipyretic[12,24,30], anti-hemorrhoid[12], broncho-dilator properties[26]. It can be very well used in bleeding disorders and in individuals suffering from emaciation, *Sagrahani*, *Karnapaka*, prickly heats etc. It is *Tridoshamak*, thus alleviates all three vitiated humour *Vata, Pitta, Kapha*. It is also used to get rid of bedbugs; these bedbugs cannot tolerate the smell of *Jalakumbhi* and when in contact, they become unconscious and ultimately it leads to their quietus.[22]

There is no reference of *Eichhornia crassipes* in classical texts, though in Bhav Prakasha Nighantu there is a separate mention of *Badi jalakumbhi* for *Eichhornea crassipes* separating it from *Jalakumbhi* which is *Pistia stratiotes*.

Traditional Medicinal Uses

The leaves of Pistia stratiotes are diuretic, emollient, expectorant, laxative and stomachic; they are used in the treatment of dysuria and stomach problems. They are mixed with rice and coconut milk in the treatment of dysentery, and mixed with rose water and sugar for treating coughs and asthma. The leaves are used in the treatment of gonorrhoea, probably because they act as a diuretic. The leaves are used externally to treat skin diseases, such as boils, piles and syphilitic sores; They are also applied to haemorrhoids. A decoction is added to bathwater to treat oedema.[51] The roots are used externally to treat burns. They are pounded and applied as a poultice.[52] Plants are cultivated for animal feed and are used to treat swelling and urinary tract infections.[5] Its leaves are traditionally used against ringworm infection of scalp, boils and syphilitic eruptions; traditionally, oil extracts are used for treatment of tuberculosis, asthma and dysentery.[53] In various parts of the world it is also used as anodyne for eyewash; leaf infusions have been mentioned in the folklore to be used for dropsy, bladder complaints, kidney afflictions, hematuria, dysentery and anemia.[21]

The leaf stalks of *Eichhornia crassipes* are efficacious as medicines for swelling.[37] Water hyacinth is considered as the only water plant that can remove pesticides dissolved in water.[37]

Classical Therapeutic Usage of *Jalakumbhi*

Jalakumbhi is a versatile drug beneficial in many diseases. The most promising results can be seen in the management of goiter which is explained as *Galaganda*; it is also comparable to modern day concept of thyroidism- Hypo/Hyper. The ash of *Jalakumbhi* cooked in cow's urine and strained through a cloth piece should be taken keeping on diet of *Kodo* and buttermilk[22,23], the ash of *Jalakumbhi* mixed with mustard oil should be applied externally even in chronic stages.[23] Its *Bhasma* is given with cow's urine[12], *Jalakumbhi* in combination with *Lavanabhaskar churna* and *Pippali churna* in morning regularly eleviates *Galaganda*[22,23].

Its leaves are made into paste and this *Kalka* is applied warm on haemorroids (*Arsha*).[12,22] Fine powder of *Jalakumbhi* and curry leaves *(Kaidarya)* should be taken with honey to destroy haemorrhoids.[23]

Juice of *Jalakumbhi* mixed with coconut water and rice water *(Tandulodaka)* is used to cure IBS (*Sangrahani)*.[22]

Leaves of *Jalakumbhi* mixed with rose water and sugar candy *(Mishri)* alleviates *Kapha* and *Shwas roga* i.e., respiratory disorders whereas its roots act as mild laxative.[22]

Oil prepared from juice of *Jalakumbhi* is used in Otitis media (*Karnapaka)*.[22]

Jalakumbhi can be used in various skin diseases. The decoction prepared from leaves or leaves alone made into paste and tied on the region below navel help treat diuresis *(Mutrakricchra)*.[12.22]

Its oil prepared from juice is applied on affected area in *Charma roga*[12]. Ash of *Jalakumbhi* alone or mixed in oil is applied on any fungal infection especially on head region. [12,22]

The whole plant of *Jalakumbhi* should be powdered and taken with honey in morning; it destroys all types of leprosy within six month.[23]

It can be used to treat diseases like bleeding disorders, fever, swellings.[25]

Formulation

Jalakumbhi is usually available in the market in the form of *Jalakumbhi* extract, *Jalakumbhi* oil, *Jalakumbhi* powder, *Jalakumbhi Bhasma*.

DISCUSSION

The main objective of this paper is contentedly demonstrated as it is elucidated that the *Jalakumbhi* with the medicinal property indicated in the compendium is the aquatic plant known as *Pistiastratiotes* and not *Eichhornia crassipes*. Water hyacinth was introduced into different countries including India (1890)[54] for ornamental purpose in the water bodies. *E.Crassipes* is also known as *Badi Jalakumbhi*, which can be the root for the misinterpretation of the actual *Jalakumbhi* along with various similar names to both the plants in several regional languages along with aquatic habitat, but surely there are various differences in appearances of the plant. Traditionally, around the world *P. stratiotes* is very well known for its various medicinal properties which *E. crassipes* fails to show. The latter is a major problem for the world in regards to clogging of its water bodies. Some amount of recognition to the former could save individuals from various diseases. It is pellucid through their medicinal properties both classically and through several research trials.

CONCLUSION

Jalakumbhi as a medicine will prove a boon to mankind and save from the various aftermath of using non-herbal drugs. Thus *Pistia stratiotes* should be used as medicine in curing various diseases as discussed above.

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