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REVIEW ON SCIRPUS ARTICULATUS: A WEED WITH MANY PROSPECTIVE

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ABSTRACT

Scirpus articulatus (Bulrush/Chichora) is very well distributed sedge of genus *Scirpus* and family *Cyperaceae*. It is known by a lot of local names at different places. It mostly grows near wet or marshy areas. The plant is perennial, erect, glabrous and non-rhizomatous, height ranges between 30-90 cm. The main characteristic feature of Chichora is thick and tufted strong stems of light green in colour. Its germination is done by Seed propagation and flowers appear near the stem base. According to the analysis, this plant is rich in water content and contains good amount of protein, fat and many minerals. The GC/MS analysis of seed hexane, chloroform and Methanol extracts has shown the presence of saturated fatty acids and various phytosterols. Presence of Diosgenin, Vanillin, Anthranilic acid and Carbonic acid was confirmed in seed extracts using Thermal Desorption System. *S. articulatus* is also rich in phenolic and flavonoid constituents. It can also be used as bioindicator for contamination detection of Chlorine, Rubidium, Mangneese and Titanium because of high concentration of these elements in it. The plant is used traditionally as purgative and tuber part is indicated for the treatment of vomiting and diarrhoea. Other reported activities are antibacterial, febrifuge, contraceptive, anthelmintic, antifungal, digestive, antiemetic, sedative and carminative. Its seeds and nuts are used for preparation of sweet dish as laddu in lower Assam and Khubani in districts of Bihar. According to veterinary practice, this whole plant can be used as food of cattle for more lactation. Pharmacologically it is proved to be used as an antioxidant, antibacterial against both gram positive & gram negative bacteria and as Phytoremediator. As

compared to other species of *Scirpus*, this plant is lesser explored and the current review is an effort to collect and present all characteristics of *Scirpusarticulatus* plant.

KEYWORDS: *Isolepis articulata*, Khubani, *Physoderma thirumalacharii*, Phytoremediation, *Schoenoplectiella*.

INTRODUCTION

Scirpus articulatus Linn. is known as Chichora in Hindi. It is distributed in all over India, Philippines, Ceylon-Africa and Australia. It belongs to genus *Scirpus* and family Cyperaceae. This family contains 85 genera and 2,600 species of marshy plants which are mostly perennial grasses and rarely annual. These grasses show fibrous roots and simple stem which is either terete or 3-angled. Leaves are generally absent and if present, they are grass like and grouped at the base of stem. Different types of inflorescence may be present like solitary, fasciculate, paniculate or spicate spikelets. They show two different arrangements for imbricate scales or glumes as either distichous (as in *Cyperus*, *Kyllinga* and *Juncellus* genus) or spiral (as in *Scirpus* and *Fimbrystilis* genus). Flowers are small, either mono or bisexual and present in the axils of the glumes. Hypogynous flowers consist of perianth generally 0-2 or more in number. Ovary is found enclosed in a utricle in Carex. Ovary is single celled with solitary, basal, erect and anatropous ovule. Gynaecium shows either short or long style with 2-3 stigmas. Stamens are 1-3 with flat filament and basifixed anther. Fruit is either compressed or trigonous nut. Seed is erect and free. Cyperaceae plants are traditionally used as bitter aromatic, diuretic and diaphoretic, tonic and stimulant.[1,2]

The genus *Scirpus*, contains about 200 species which are glabrous and tall herbs. These are mostly leafless or leafy at the stem base only. Their stems are terete, trigonous or triquetrous and inflorescence is terminal or lateral, made of umbels or clusters of oblong or ovoid spikelets which may contain sessile or pedicellate flowers. Its Glumes are spirally imbricating around a stout or slender rhachilla. In androceum part, stamens are 1-3 with linear anthers. In gynoeceum, ovary is obovoid, trigonous or biconvex and style is not leaving any button on the nut.[1]

This genus *Scirpus* is broadly said to be a diversified gathering of poorly defined species because according to literature, this genus contains all the scirpoid species having spirally arranged glumes and a style continuous to the ovary as the characteristic features, but these are not exclusive for *Scirpus* but also shown by other genus of family Cyperaceae. So,

addition of some other important features is needed for a satisfactory characterisation of any *Scirpus*species.[3,4] Yet a broad classification of *Scirpus* genus is as following-

The genus *Scirpus* species are divided in two categories on the basis of presence of transverse wavy lines on Nut and hypogynous bristles. The first category showing presence of transverse wavy lines on nut and absence of hypogynous bristles (*S. articulatus*) and second category having no transverse lines on nut and presence of hypogynous bristles (*S. Maritimus, S. Grossus*and *S. kysoor*).[1]

Mainly the roots of *Scirpus* genus species are used medicinally as astringent and diuretic. This review is a collection of information available and prospective of plant *Scirpusarticulatus* till date.

Scirpus articulatus Linn. is a perennial sedge and commonly known as Bulrush in English and Chichora in Hindi. Its vernacular names are Chirchera (in Bengali), Chelli (in Malyalam), Sesu-bon/ Mitmiti-bon (In Assamese), Jhanji (In South India) and Apurau (in list of Philippines understudied medicinal plants). The synonyms of this plant are- *Isolepis articulata* (L.) Nees in Wight, *Schoenoplectiella articulate* (L.) Lye, *Schoenoplectus articulatus* (L.) Palla in Engl.[5,6]

It is distributed all over India, Philippines, Malaysia, Ceylon-Africa and Australia. Commonly found in open and wet places and also in old world tropics.

The taxonomic profile of the plant is-

Kingdom- *Plantae*
Subikingdom- *Viridiplantae* (Green plants)
Infra-kingdom- *Streptophyta* (Land plants)
Super-division- *Embryophyta*
Division- *Tracheophyta*
Sub-division- *Spermatophytina*
Class- *Magnoliopsida*
Super-order- *Lilianae* (Monocots)
Order- *Poales*
Family- *Cyperaceae*
Genus- *Scirpus*

Species- *Articulatus*[7]

General description

Bulrush or Chichora is a type of semi-aquatic and marshy area weed[8] and found widely distributed in country India. In India, it is mainly found in various districts of north and central Bihar, Orissa, West Bengal, Andhra Pradesh and also in other parts of the country. It is a perennial, erect, glabrous and non-rhizomatous herb, growing to a height of 30-90 cm. The plant is characterised by thickly tufted strong stems of light green in colour. It is germinated by Seed propagation and flowers appear near the base part of plant.[9] Its flowering season is in the month of June to August and fruit appears in September to November.[10]

Morphology

S. articulatus Linn. is a member of grass family and found near wet places or marshy areas. Its stems are long and densely growing in a tuft. Stem are of spongy nature and thickness is similar to our little finger. When cut transversely, they look like a septate, which can be observed externally too. Stems are striated and terete in shape. Flowering occurs near to the stem base rather than the top (Figure 1).

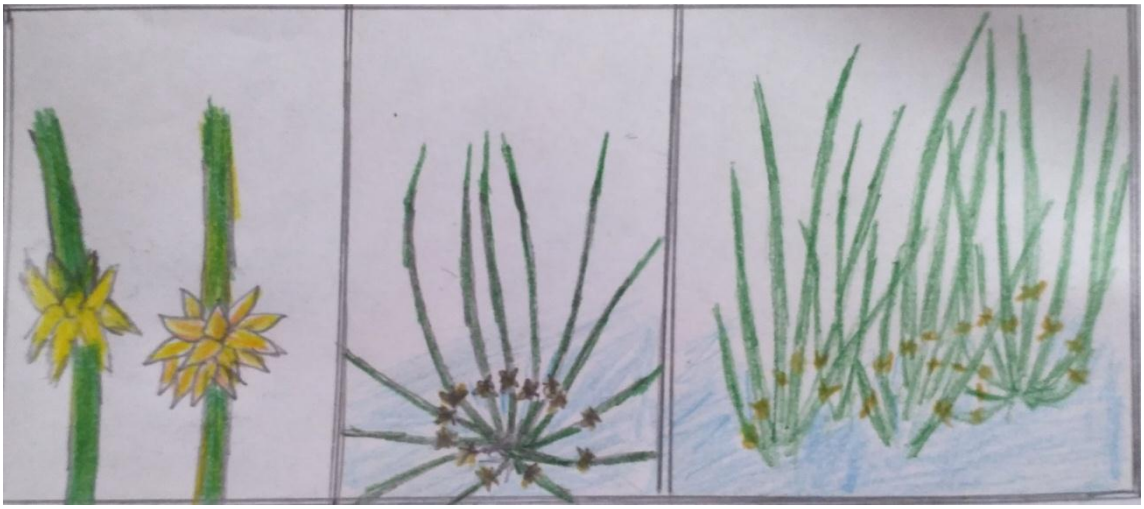

Figure 1: *Scirpusarticulatus* Spike, Individual Plant and In cluster.

This plant is generally leafless. Sheathing can be observed like a membrane with acute tip part and about 2.5 cm length. The type of inflorescence found is Spikelet which may vary in length from 6 to 20 cm. These are long, ovoid to oblong in shape, acute, angular or terete and colour rusty Brown. It consists of a cluster of 15-60 florets which are sessile and arranged laterally like spreading stellate. Bracts are absent and Glumes are of 5 mm. length, broadly

ovate in shape, acute to shortly mucronate from top, subcordate base, arranged in closely imbricate form and have hyaline margins. Stamens are three of 5 mm. length and have 0.8 mm long linear anther. The style is 2 mm. long and stigmas also have similar length to style. Nut is black opaque in colour, 2 mm. long, shape obovoid, having three sharp edges (triquetrous) and striated with wavy transverse striations.[1]

Chemical constituents

In general, plants of Cyperaceae family contains various chemical constituents like Stilbenes, phenolic acids, flavonoids, phenyl propanoids, coumarins, terpenoids and quinines. Among these, Stilbenoids are the most important compounds. Mainly, these are Resveratrol derivatives. Some Scirpus species like *S. fluviatilis, S. maritimus, S. californicus, S. holoschoenus* and *Schoenu nigricans* have been reported to contain Stilbenoides for example trans-resveratrol, Scirpusin, Piceatannol and Viniferin[11-13] (Figure 2). But till date, no stilbenoid is reported from *S. articulatus*.

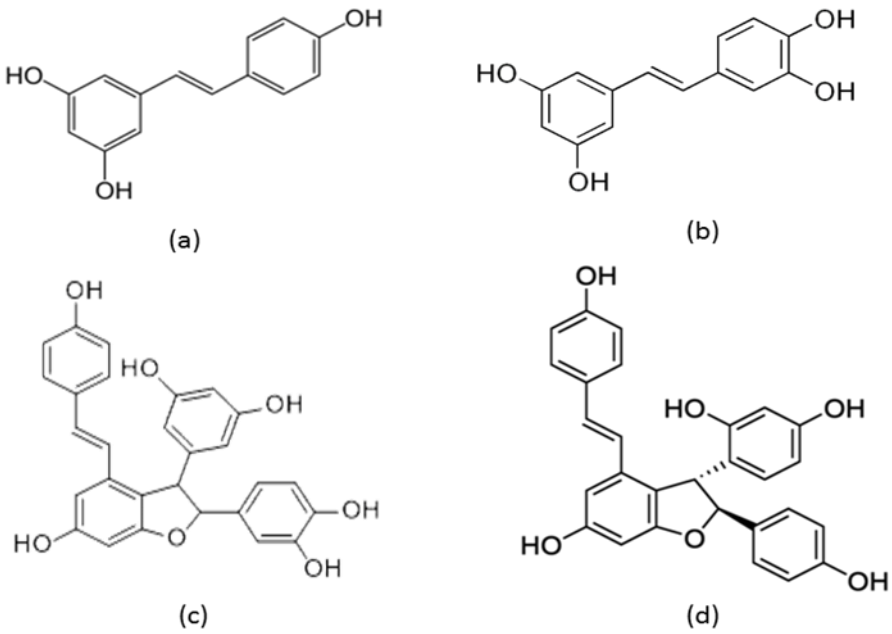

Figure 2: Stilbenoids found in *Scirpus* plant species (a) Resveratrol, (b) Piceatannol, (c) Scirpusin and (d) Viniferin.

According to a study done to find out chemical composition and nutritive value of *S. articulatus*, it contains 81.5% of water content, 9.31% Digestible Crude Protein, 43.93% Total Digestible Nutrient and per day average balances for Calcium, Nitrogen and Phosphorus 18.16±4.37, 2.06 ±1.63 and 0.76 ± 0.14 respectively on dry weight basis. It was also observed in the same study that when *S. articulatus* was fed to animals with paddy straw,

it increased the average consumption of dry matter by animals from 1.46 ± 0.13 to 2.33 ± 0.05 kg per 100 kg of body weight and also increase in metabolic body size from 56.31 ± 2.94 to 96.98 ± 3.06 g per kg.[9]

One more study was carried out to determine nutritional composition and Phytochemical profile of *S. articulatus* seeds. The results showed 8.19%w/w moisture, 4.95%w/w ash, 0.15 %w/w protein, 6.15 % w/w fat, 20.53%w/w crude fibre and 80.56 %w/w carbohydrates. The amount of various minerals in ppm was observed as Fe (0.85), Cu (0.10), Mn (1.21), Zn (0.13) and K (62.55). Some trace elements like Arsenic (0.24ppm), Lead (0.17 ppm) and Nickel (0.02) were also reported. Amount of total alkaloids was determined as 0.0265%w/w, saponin content 0.808 %w/w, Total phenolic content 26.6733µg per 100 mg, Total flavonoid content 9.568 µg per 100 mg and Total Flavonol content 5.851 µg per 100 mg of methanol extract when compared with standards. The GC/MS analysis of seed hexane, chloroform and Methanol extracts showed the presence of saturated fatty acids and various phytosterols. During profiling of volatile compounds for flavour and fragrance by Thermal Desorption System, presence of Diosgenin, Vanillin, Anthranilic acid and Carbonic acid was confirmed in seed extracts.[14]

In an another study for determination of total phenolic content and total flavonoid content of whole plant biomass, a good amount was observed as 47.877mg per g and 1.950mg per g respectively when compared with standards. This study also enlightened that *S. articulatus* is rich in mineral content and can be used as bioindicator for contamination detection of Chlorine, Rubidium, Mangneese and Titanium because of high concentration of these elements in it.[15]

Traditional medicinal uses

Chichora plant is used as purgative where as its tuber part is used for the treatment of vomiting and diarrhoea. Its fruits and leaves are effective in cure of bodyache, fever and pains. Other than these, it is reported as antibacterial, febrifuge, contraceptive, anthelmintic, antifungal, digestive, antiemetic, sedative and carminative.[15,16] In Bangladesh, its branches and roots are used for treatment of vomiting and loose motion in babies. Also the root powder juice is prescribed to babies for good digestion before breakfast.[17]

General uses

Articulatus nuts are used for preparing laddu in lower Assam area by their local communities. For this, the roasted endosperm is separated from the matured nuts and used for making of traditional and delicious food.[10]

Also in some districts of Bihar state, local people use *S. articulatus* black colour seeds for preparation of sweets by roasting them on sand and then the seed pops are passed in a hot solution of concentrated sugar to process in the form of granular sweets. This sweet is a affordable livelihood to poor population of Bihar. One more type of sweet dish named Khubahi is also prepared by mixing of these seeds with condensed milk or Khoya and is available at nominal price. This Khubahi sweet is the only food that can be given to smallpox patients because these are easy to digest without involving the jaw movement. But it is not prescribed in the patients suffering with tuberculosis or asthma[14]

According to veterinary practice, this whole plant can be used as food of cattle for more lactation.[9]

Biological activities

Antioxidant effect

To evaluate antioxidant effect of *S. articulatus* seeds, these were successively extracted with hexane, then chloroform and last with methanol in a round bottom flask. All three extracts were examined for the presence and quantity of polyphenols which are strongly responsible for antioxidant effect. Polyphenols were found in good amount in seed methanol extract. Antioxidant activity was evaluated with help of ABTS radical scavenging assay and FRAP assay. Due to more amounts of polyphenols in methanol extract, it was also better in antioxidant capacity as compared to chloroform and hexane extract. According to results, the antioxidant potential of methanol extract was observed as IC_{50}= 0.75mg/ml in ABTS assay and 970.90µg BHTE per 100mg in FRAP assay. So this study confirmed the antioxidant potential of *S. articulatus* seeds.[14]

Phytoremediation effect

As the contamination of soil and water is increasing day by day due to industrial and other waste material & heavy metals, it is mandatory to acquire some technologies that can help in lowering of this contamination. Phytoremediation is an example of such technique in which we uses plants and the associated micro-organisms, who can uptake and accumulate these wastes. To evaluate Phytoremediation effect of *S. articulatus* weed, a study was carried out

by Khatun A *et al*. in 2016 at Ramsar site of East Kolkata Wetlands, where both industrial and domestic waste material is accumulated from nearby surrounding areas. This study was focused on concentrations of Cd, Cu, Pb and Mn heavy metals in plant aerial part and roots. In this work, Phytoremediation efficiency of *S. articulatus* was evaluated and also compared with other macrophyte *Colocasia esculenta*. It was observed that *Scirpus* was more efficient in metal accumulation than *Colocasia* and also plant can accumulate more amounts of metals than the surrounding environment. It was also found out that inside a plant, roots can accumulate more in comparison to shoots. According to study, Mn can accumulate in highest amount in plant and Cd in lowest. The actual order for amount of metal accumulation is Mn>Cu>Pb>Cd in plants. It was also reported that *S. articulatus* has shown higher Transfer Factor (TF- Ability to translocate metals from root to aerial part) and more than one Bioaccumulation Factor (BCF- Ability of metal accumulation from surrounding). Therefore *articulatus* has been proved as a prominent Phytoremediator and is helpful in making the environment free from contamination.[18]

Antibacterial effect

To evaluate antibacterial effect for gram positive and gram negative bacteria, a study was carried out on *S. articulatus* seed extracts using nutrient Agar media in Disc Diffusion method. Activity was evaluated against a total of five bacterial strains in which three were Gram positive *Staphylococcus epidermidis, S. aureus* & *Bacillus subtilis* and two were Gram negative *Proteus mirabilis* & *Escherichia coli*. According to the measured diameter of zone of inhibition, only seed methanol extract has shown antibacterial effect but at high concentration (700mg/ml). The Hexane and Chloroform extracts of *articulatus* seeds have no any antibacterial activity.[14]

Allelopathic effect

It is the natural phenomenon for inhibition of neighbouring plants growth by releasing some biochemicals. The weed plant produces some chemicals which can retard the growth, reproduction, germination and survival of field plants or other plants. These chemicals are termed as Allelochemicals. As *S. articulatus* is a weed, so one study was carried out to know the allelopathic potential of it on growth of field grown rice plant. Three weed plants were selected *S. articulatus, Parthenium hysterophorus* L. and *Eleocharis congesta* L. Aqueous extracts of these three weeds in concentrations 0.5%, 1% and 2% were tested. It was observed that all three weeds significantly reduced the germination rate of rice as compared to control

rice plant. This inhibition effect was found increasing with increase in concentration of weed extract and roots were more affected than shoots. The highest allelopathic effect was observed for 2% concentration of *S. articulatus* aqueous extract and it not only affected the physiological growth process of rice plant but even amount of plant chemical constituents was also reduced. So, this study confirms the allelopathic potential of *S. articulatus* as a weed.[19]

Other studies

Parasite found on Bulrush

A new parasite species *Physoderma thirumalacharii* Pavgi & Singh was found in the spikelets and ovaries of *S. articulatus* that was growing near the banks of shallow ponds in Varanasi district of Uttar Pradesh. This was discovered because generally *Scirpus* species are used as feed for cattle's and as astringent in Ayurvedic medicine but some *Scirpus* species was supposed to be poisonous and cannot be used for cattle feed. So, these were examined and found with sickly yellow scattered patches with deformed spikelets of pale cream yellow colour. After preliminary examination of these species, they were found infected with *Physoderma* parasite which make *Scirpus* plant not suitable for general uses.[8]

Nutritive value

S. articulatus or Jhanji plant is found as a semi-aquatic weed plant in wet and marshy areas of coastal lands in various states of West India. Its tubers have medicinal importance and can be prescribed in vomiting and diarrhoea. A study was conducted to determine nutritional benefits of this plant for cattle. For the study, five Sindhi bullocks of age 3 to 3.5 years were used as experimental animals and Jhanji was fed in two manners as alone and in combination with paddy straw. When given alone, about 3-4 kg of freshly harvested plant was fed per animal daily in beginning and increasing gradually up to 20-21 kg per animal daily for a period of 21 days and animal's metabolism parameters were evaluated for seven days. In other experiment, fresh and chaffed Jhanji (20 kg) was mixed with paddy straw (3-4 kg) for one animal daily. In both studies, common salt was given at the rate of 60 g/animal/day. The study concluded that Jhanji is a rich source for Calcium & protein and have a good nutrition value. It caused an increase in cattle's dry matter consumption from 1.46 ± 0.13 to 2.33 ± 0.05 kg/100 kg of body weight and also increased the metabolic body size from 56.31 ± 2.94 to 96.98 ± 3.06 g per kg. So, Jhanji was proved as a new source of cattle's green feed especially when the lean period is going on during the year.[9]

Mineral content

A study was carried out to determine amount of minerals present in *S. articulatus* aerial parts (stem, leaves and fruits). For this the plant sample was properly cleaned, dried and powdered. The instrument used for analysis was Bruker Tracer 5i portable X-Ray Fluorescence (pXRF) inbuilt a Rhodium tube. According to observation noticeable amount of Cl, Rb, Ti and Mn was detected in *S. articulatus* biomass. These elements accumulation was proposed in form of Chlorine complexes. The concentration of Se was very low and other trace elements were in detectable amount. The toxic heavy metals As, Pb and Cr were found in concentration more than the prescribed limit. In conclusion of this study, although it has good amount of many trace elements and heavy toxic metals, yet *S. articulatus* can be used to control soil and water alkalinity, metal toxicity, hardness and bio-indicator for contamination detection of Cl, Rb, Mn and Ti.[15]

CONCLUSION

S. articulatus is a very well distributed semi aquatic weed of genus *Scirpus*. It has found to have good nutritional value in form of protein, calcium, fibers, carbohydrates and many important elements. Along with nutritional components, Chichora has a number of plant secondary metabolites which have medicinal importance. Traditionally it is used for treatment of diarrhoea, vomiting, body ache, fever, microbial infection and indigestion. It is a good source of nutrition for cattle's. It's discovered medicinal activities are antioxidant and antibacterial. It can be used as a bio-indicator for Cl, Ti, Mn and Rb contamination. It is effective in accumulation of toxic substances from environment, so it is a good phytoremediator. But it can affect the growth of neighbouring field plant due to its allelopathic effect. It acts as a host for *Physoderma* parasite. In conclusion, *Scirpus articulatus* is a useful plant from different point of views but it needs more research to explore its phytochemical and pharmacological finger print profile because till date no any particular compound has been isolated from it and very few medicinal activities have been verified.

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Conflict of interest

The authors have no any conflict of interest.

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