



JOURNAL OF PHARMACEUTICAL SCIENCE AND BIOSCIENTIFIC RESEARCH (JPSBR)

(An International Peer Reviewed Pharmaceutical Journal that Encourages Innovation and Creativities)

Potential Review of Hydrilla

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ABSTRACT:

Hydrilla verticillata (L.f.) Royle (Hydrocharitaceae) is a submerged aquatic angiosperm that is thought to be native in various tropical and subtropical areas such as the warmer regions of Asia, Australia, and United States which become established in a variety of fresh water habitats around the world. Where the plant occurs, it causes substantial economic hardships, interferes with various water uses, displaces native aquatic plant communities, and adversely impacts freshwater habitats. Besides this it has shown promising heavy metals sorbing property because once they contaminate the environment have permanent adverse ecological effects like Cd and it also can take up and store several trace metals for metabolic and biological process like Hg, Ni, and Zn etc. which are toxic to biota above threshold levels. In this present study we have undertaken to evaluate the different pharmacological activities with a correlation of chemical constituents available with this plant so that it may serve as a reference for further studies besides all those above ecological beneficial activities.

Key words: Hydrilla, Vitamin B12, chemical constituents, Nutritional Values.

Article history:

Received 10 March 2016

Revised 19 March 2016

Accepted 28 March 2016

Available online 01 May 2016

Citation:

Bhavsar V. P., Panchal A. H., Maheshwari O. Potential Review of Hydrilla. *J Pharm Sci Bioscientific Res.* 2016, 6(3):436-441

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INTRODUCTION:

Use of herbs and plants for medicinal purposes has a long tradition. Being universal, no one can exactly describe the actual role of plants to our mankind because of the outstanding phenomenon of symbiosis between us. Without the plants it is impossible for the existence of life in the earth. The plants being in tremendous amount are associated with certain unique and a few common active principles known as secondary plant metabolites which are not directly involved in the normal growth, development or reproduction of organism. Unlike primary metabolites, absence of secondary metabolites doesn't cause immediate death, but is involved with the long-term impairment of the organism's survivability or aesthetics and sometimes represents no significant change at all. Numerous data on the uses of plants including medicinal use have been systematically gathered by Gadil and Vartak 1981. (¹⁻⁴) In this present study, we will see the versatile role of Hydrilla verticillata (L.f.) Royle (⁵⁻⁸) (Figure. 1), commonly known as water thyme, Florida elodea, Wasserquirl and Indian star- vine which is a native plant of Asia but first introduced to the United States in Florida in 1960. Hydrilla's scientific name is made up of the Greek word "hydro" meaning "water" and the Latin word "verticillus" that means "the whorl of a spindle". Appropriately named, it is an aquatic plant with leaves that are whorled around the stem and belongs to the Frog's Bit family or Hydrocharitaceae. Some sources give a broad native range of parts of Asia, Africa and Australia.

Some sources are more specific and say that the dioeciously form of Hydrilla originated from the Indian subcontinent and the monoecism form originated from Korea. Hydrilla could easily be called the perfect aquatic plant because of the extensive adaptive attributes it possesses to survive in the aquatic habitat but it can grow in both static and flowing water including lakes, ponds, rivers, streams and reservoirs, and can survive few centimeters to 45 feet in depth in some parts of the country. It grows 2.5 cm in one day in fresh water. The monoecism species of Hydrilla plant capable of producing seeds which have been recently reported in the US⁽⁹⁻¹¹⁾ but generally it can reproduce itself through shoot fragmentation or the production of axillary and subterranean turions.⁽¹²⁻¹³⁾ The previous studies about the therapeutic potential of the plant *H. verticillata* found to be used as antioxidant, in detoxification, in digestion and gastrointestinal function, for improvement of blood circulation, for blood sugar control and for neurological health.⁽¹⁴⁻¹⁷⁾ they are noted as aquatic "nutrient power house" (Pal and Nimse 2006), and only limited chemical investigations of *H. verticillata* were reported.⁽¹⁸⁾

How to Recognize Hydrilla

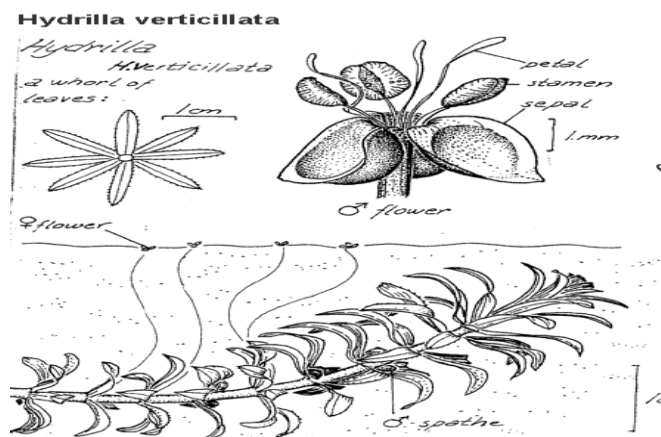
Hydrilla is very similar in appearance to its close relatives, American and Brazilian elodea, and often is misidentified as one of these species. A number of characteristics can be used to distinguish hydrilla from these related species. The most certain way of distinguishing hydrilla from American and Brazilian elodea is its floral characteristics. The male flowers of American and Brazilian elodea are readily distinguishable from those of monoecism hydrilla because they are larger and remain attached to the parent plants on stalks rather than floating free on the surface. Also, the male flower of Brazilian elodea is opaque white and much more showy than that of hydrilla. No female flowers are present on populations of Brazilian elodea in the United States. Another characteristic of hydrilla that clearly distinguishes it from similar species is the development of tubers and turions. New tubers may be found during the growing season still attached to the ends of the rhizomes. Early in the season when no plants are visible or before

Tubers begin to form on the new growth, tubers can be found by digging up some of the mud where the plants were growing the previous year and sieving it through a piece of coarse screen. Neither American nor Brazilian elodea produces tubers or turions. The general

robustness of the plants sometimes has been used to distinguish hydrilla from similar species. American elodea is usually much smaller than hydrilla or Brazilian elodea. Its leaves occur in whorls of three in comparison to whorls of three to six (usually five) in Hydrilla and four or eight (usually four) in Brazilian elodea. Brazilian elodea is usually the largest of the three species and usually appears bushier because the leaves are longer and closer together. These characteristics vary widely with environmental conditions, however, and are not always very reliable means of identification. The leaves of hydrilla usually have fairly prominent teeth along the margins and may have recorded spines along the underside of the midrib (common in the dioeciously, or Florida, variety but rare in the monoecism variety), giving the plant a rough texture when it is drawn through the hand. Both American and Brazilian elodea lack the spines on the midrib, usually have much smaller and more numerous marginal teeth, and generally do not feel as rough as hydrilla. The presence and extent of development of the marginal teeth and spines on the midrib of hydrilla leaves vary somewhat with location, age of the plant, and position of the leaf on the stem. These features may also be influenced somewhat by water and sediment quality. Older plants often feel rougher than younger plants because the teeth and spines are more developed. Hydrilla growing in some lakes or portions of an individual lake may have poor tooth and spine development and feel relatively smooth. Plants growing in hard, alkaline water often have well developed teeth and spines as well as external mineral deposits (marl) and may feel rougher than plants taken from very soft waters. (Most inland surface waters in North Carolina are very soft and many are acidic.) Consequently, rough texture and the development of teeth and spines, although often cited as a way of distinguishing hydrilla from its look-alike relatives, are not very reliable means of identification.

DESCRIPTION

Hydrilla is highly polymorphic and a submerged, rooted (usually) perennial with long, sinewy branching stems that often reach the surface and form dense mats. Its appearance may vary considerably depending upon the conditions under which it is growing.⁽¹⁹⁻²⁰⁾ it grows submerged in water and generally is rooted to the bottom, although sometimes fragments will break loose and survive in a free-floating state. Erect stems can be quite long when the plant grows in deep water.⁽²¹⁾



IDENTIFYING CHARACTERISTICS

LEAVES Usually bright green in color but could be bleached by the sun and may appear yellowish (width: 2-4 mm length: 6-20 mm). Having pointy teeth like edges. About 4-8 leaves whorled around each nodes and the midrib of the leaf is often red in color with one or more sharp spines. The main specification which makes it distinguish from other species that it has an axillary leaf scale called squamula intravaginalis which found next to the stem at the base of the leaf (Figure. 2).⁽²²⁾

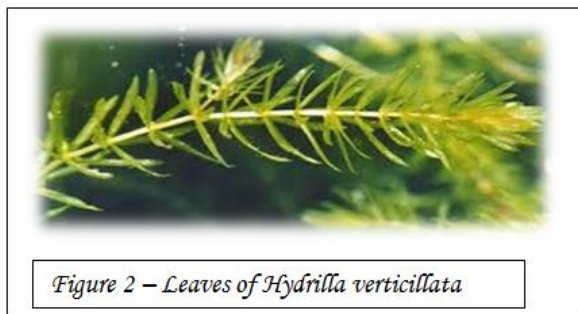


Figure 2 – Leaves of Hydrilla verticillata

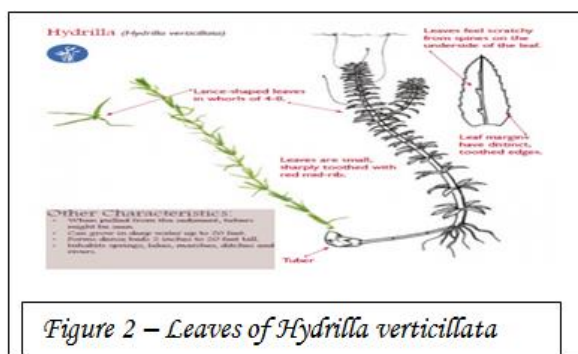


Figure 2 – Leaves of Hydrilla verticillata

ROOT/ STEM It produces hibernacula, turions in leaf axils and tubers terminally on rhizomes (Figure. 3). The tubers or subterranean turions are very compact dormant buds and fall from the plant when mature. The turions are 5-8

mm in length, dark green in color and having spiny appearance. The tubers on the terminal of the rhizomes may be found 30 cm deep in the sediment. New root sprout are generally white in nature but may be brown when grown in highly organic soil. Stems are only 1/32 of an inch wide; grow up to 30 feet length. The stem form branches when near the water's surface, specially the monoecism form start to branch out at the sediment level.⁽²³⁾

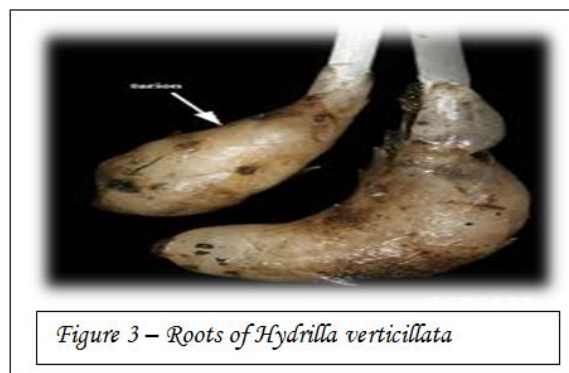


Figure 3 – Roots of Hydrilla verticillata

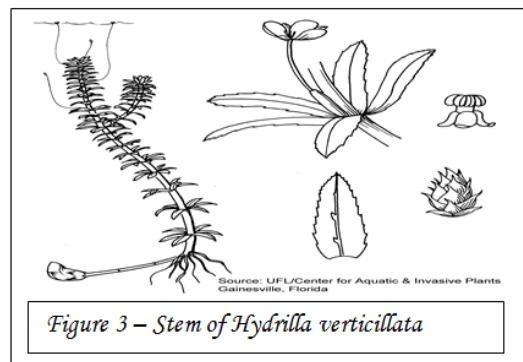


Figure 3 – Stem of Hydrilla verticillata

FLOWERS

The flowers are imperfect depending on the two forms of Hydrilla presents. The monoecism type contains male and female on the same plants. The dioeciously type contains only female per plants, generally found in US. Female flower (Figure. 4) consists of three whitish sepals and three petals each are 10-50 mm long and 4-8 mm wide attached at leaf axils and are clustered towards the tips of the stems from which female flowers arise are often very compact and have very short leaves. Where male flower Contains three whitish red or brown sepals each are 3 mm length and 2 mm wide having three stamens formed in leaf axils as they approach maturity these are released and float on the surface.^(24, 25)



Figure 4 – Flowers of Hydrilla



Figure 4 – Flower of Hydrilla

CHEMICAL CONSTITUENTS

The lipophilic extract of *H. verticillata* after extracted with petroleum ether and acetone (1:1 ratio) showed the presence of 3, 5, 11, 15-tetramethyl-1-hexadecen-3-ol (C₂₀H₄₀O) and an acrylic diterpenoid alcohol known as phytol (C₂₀H₄₀O) as major components. Other than the above two components some other unsaponifiable lipophilic compounds are also detected by GC-MS.26 John et al.1992 analyzed the phenolic content of *Hydrilla verticillata* (L. f.) Royle by high-pressure liquid chromatography and thin-layer chromatography which showed the presence of phenols in trace amounts included ferulic, chlorogenic, and caffeic acids.27 Flavonoids anthocyanins are accumulated in internodes as the tissues matured. The major compound in both leaves and internodes was a caffeic acid ester which inhibited germination and germ tube elongation of conidia of the fungal pathogen *Fusarium culmorum*. Mainly five compounds were isolated by different methods. For examples 1-(5'-Hydroxy-4'-hydroxymethyl-1'-methyl-1H- pyrrol-2'-yl)-hencosa-2,12,15-trien-1-one and thymidine was identified by EIMS, 1H NMR, 13C NMR and IR spectra. Crystal loliolide and sulphur-gamma were identified by X-ray diffraction. Octadecanedioic acid was also elucidated.(27)

NUTRITIONAL VALUES

Hydrilla verticillata has high concentration of many vitamins and minerals that are typically hard to obtain from plant foods, for example- it contains 15% elemental calcium a dry weight basis, which is bound to carbohydrates, proteins and polyphenols. Besides, this are also a rich source of B- vitamins and a host of other minerals (chromium, selenium, boron, silica etc.), amino acids, essential fatty acids, enzymes, antioxidants and health promoting compounds. It contains about 50-60% complete protein and furthermore contains high amount of lysine. So, this little known nutritional power house is a true green super food in every sense of the word. *Hydrilla* also found to contains chlorophyll, which has a chemical structure nearly identical to hemoglobin which increases the oxygen carrying capacity of the blood. (28-29)

Nutritional Info Based on 4.75g Serving Size

Dietary Fiber	2 g (8%)
Sugars	<1 g (0%)
Protein	0.65 g
Vitamin A	5454 i.u. (109%)
Vitamin C	6.53 mg (11%)
Vitamin E	2.77 i.u. (9%)
Thiamin	7.2 mg (480%)
Riboflavin	0.26 mg (15%)
Niacin	13 mg (65%)
Vitamin B6	4.5 mg (225%)
Vitamin B12	475 mcg (7,750%)
Pantothenic Acid	8.4 mg (84%)
Calcium	624 mg (62.4%)
Chromium	7.4 mcg (6%)
Copper	174 mcg (8.7%)
Iron.	4.6 mg (25%)
Phosphorus	12 mg (1.2%)
Magnesium	38.3 mg (9.6%)
Molybdenum	8.7 mcg (11.7%)

Selenium	1.25 mcg (2%)
Zinc	0.3 mg (2%)
Boron	65 mcg*
Cobalt	174 mcg*
Silica	32.7 mg*
GLA	3 mg*
Chlorophyll	16 mg*
Polysaccharides	2 g*

PHARMACOLOGICAL ACTIVITIES

1. ANTIOXIDANT ACTIVITY

Pal et al. 2006 performed the antioxidant activity of *Hydrilla verticillata*. In this experiment the plant materials were exhaustively extracted successively with petroleum ether (40-60°C), benzene, chloroform, ethyl acetate, ethanol and distilled water using a Soxhlet extractor. Those extracts were evaluated for possessing antioxidant properties by non-enzymatic haemoglycosylation method and DPPH free radical scavenging activity methods. This showed that the chloroform extract has the highest and petroleum ether extract has the lowest antioxidant activity.⁽³⁰⁾

2. CNS ACTIVITY

In another study Pal et al. 2006 showed that the plant extract of *H. verticillata* potentiated the sleeping time in mice. Here the sleeping time in mice (induced by standard hypnotics, for example- pentobarbitone sodium, diazepam and meprobamate) was potentiated by aqueous extract of *H. verticillata* (AEHV) in different concentrations which proved that the AEHV has significant CNS activity in a dose dependent manner.⁽³⁰⁾

3. ANALGESIC ACTIVITY

AEHV produced analgesia in mice, to prove these two different methods were used namely-acetic acid induced writhing & eddy's hot plate method. In the first method the aqueous extract inhibit the percentage of writhing episode compared with those of acetyl salicylic acid, paracetamol & morphine and in the another method after administration of AEHV the reaction time of the mice licking its feet or jumping out of the cylinder when reached to the hot plate was reduced. The plant extract not only produced analgesia but also potentiated the analgesic action of morphine and pethidine.⁽³⁰⁾

4. ANTICONVULSANT ACTIVITY

Introduction of strychnine and leptazol cause tonic type of convulsions with clonus in mice. By the administration of AEHV the average survival time was increased and the percentage mortality decreased at different doses. This proves that the aqueous plant extract has anticonvulsant property in a dose dependent manner. But it was observed that different combinations of strychnine or leptazol with plant extract did not show any significant protective action against convulsions.⁽³⁰⁾

CONCLUSION

It is concluded that, scientific parameters based on taxonomical, pharmacognostical and phytochemical studies are essential to identify the plant and many bioactive constituents. Besides this many pure compounds have so far been neglected by phytochemists and pharmacologists and a large amounts of works have been done only on extracts and not on the isolated fraction(s). This present review article pointing *Hydrilla* as a huge source of different nutrients, aims at focusing the attention of research scientists on the unexplored and untouched areas related to *Hydrilla verticillata*.

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