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Review Article

PHARMACOLOGICAL POTENTIALITY AND MEDICINAL USES OF *IPOMOEA AQUATICA* FORSK: A REVIEW

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ABSTRACT

It has been noteworthy from the ancient times; the human race is dependent on the use of traditional plant-based medicines as well as polyherbal preparations. And from the last few decades several research works are carried out which confirms the potentiality of these natural sources as a good source of medications. *Ipomoea aquatica* was among such plant having good nutraceutical applications and is commonly consumed as a vegetable and is commonly found in tropical Asia, India, Africa and Australia, etc. The plant is considered to be a good source of vitamins, minerals, plant proteins, fibers, etc. as well as the plant is supposed to have tremendous pharmacological importance. The present review aims to present a brief overview of the medicinal use as well pharmacological value of the plant.

Keywords: Pharmacological activity, Phytochemistry, Potential uses, Compounds.

INTRODUCTION

The plant *Ipomoea aquatica* is a common trailing vine with milky sap belongs to the family Convolvulaceae. The plant is commonly known as aquatica morning glory, Chinese water spinach, Kangkong, morning glory, swamp cabbage, swamp morning glory, water convolvulus, water spinach, etc. [1-6]. The plant is considered to have a wide distribution and grows in moist soils as well as the side-lines of fresh water, ditches, lakes, ponds, marshes and wet rice field. The plant is grown in the wild and is usually grows all-round the year as well as cultivated throughout South East Asia and is generally consumed as a vegetable in different regions of the world. In most part of the tropical Asia, *I. aquatica* is a common food consumed by all social groups, and have different ways people consume it [7]. In the rural area of India, it is generally used as green leafy vegetable [8].

ETHNOBOTANICAL RELEVANCE

Since from the earlier time, it is believed that people from all over the world is used to cure their disease with the help of traditional medicines, which is mainly plant-based herbal preparation. About 80% of total world's population believed to use the traditional medicine [9]. The present review is based on a trailing vine namely *I. aquatica* and is reflected in the new era as a potent medicinal plant. From the traditional knowledge, it had been reported that the plant recommended to use as a laxative in piles patients and other problems related to sleeplessness and headache [10]. In Ayurveda (the traditional medicine) it is reported that oral administration of *I. aquatica* leaves leads to cure ailments such as jaundice, nervous debility. The plant is used in the treatment of liver diseases [11] constipations [12] diabetes [13,14] abscesses, mental illness in Tanzania and intestinal problems in Somalia [12] nose bleeds and high blood pressure [15,16] anthelmintic [17,18] central nervous system depression (CNS) depressant, antiepileptic, hypolipidemic effects [19], antimicrobial and anti-inflammatory [20] as well as nootropic effect on rat hippocampus. The dried juice also possess a potent purgative property [18,21,22]. The plant is also effective in the inhibition of prostaglandin synthesis [23]. The plant extract also possess antimicrobial activity against the microbes such as *Escherichia coli*, *Pseudomonas aeruginosa* and *Bacillus subtilis* [24]. From the above mentioned investigation of the plant, it is revealed that *I. aquatica* could be really an effective natural herb having good nutraceutical applications as well as to cure many fatal diseases. However, many beneficial use of this herb remain unexposed therefore required a proper attention in the medicinal field.

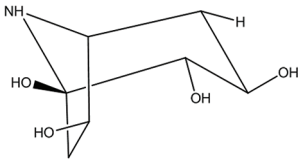
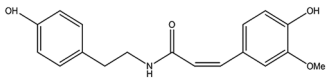
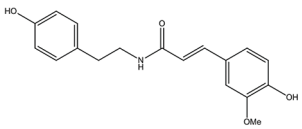
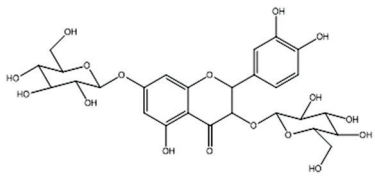
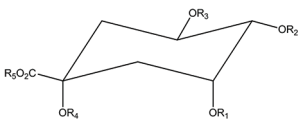
Phytochemistry

The basic preliminary phytochemical screening of the plant *I. aquatica* reveals the fact the plant contains various phytochemicals such as vitamins, flavonoids, amino acids, alkaloids, lipids, steroids, saponin, phenols, reducing sugar, tannins, β-carotene, glycosides, and minerals, etc. The plant is found to contain vitamins such as A, B1, B2, B6, B12, C, E, K [25] and "U" (S-methyl-methionine), and is reported to treat the ailments like gastric and intestinal disorders [26]. The plant also supposed to contains aliphatic pyrrolidine amides, carotenoids, hentriacontane, β-sitosterol and its glycosides, prostaglandin, leukotriene, N-trans - and N-cis-feruloyltyramines [5,27-31]. Moreover certain amino acids like aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, leucine, tyrosine, lysine, histidine, and arginine [8] and sugars like glucose, fructose, sucrose [6], and starch [1]; and organic acids such as malic acid, citric acid, and oxalic acid [6] and minerals like sodium, potassium, calcium, iron, magnesium, and zinc were detected in *I. aquatica* [32]. Polyphenols such as myricetin, quercetin, luteolin, apigenin, and kaempferol were detected in *I. aquatica* [33-35]. However, several studies reveals the presence of 12 pigments [28] and various types of chlorophylls, carotenoids *viz.* lutein, anthraxanthin, flavoxanthin, auroxanthin, luteoxanthin, neoxanthin, B-carotene, violoxanthin, cryptoxanthin, neoxanthin A and neoxanthin B and polyphenolsviz quercetin 3'-methyl ether, quercetin 4'-methyl ether and anthocyanins [31,34] (Table 1).

PHARMACOLOGICAL POTENTIALITY OF THE PLANT

From the traditional point of view such as Ayurveda and homeopathy, leaves extracts of *I. aquatica* are directed orally to cure antioxidant related ailments [21]. It was reported that the plant possess excellent antioxidant activity because of the presence of vitamin C and phenolic compounds [47,48] and contain a high level of polyphenolic compounds [44,49-51]. It was reported that 1-diphenyl-2-picrylhydrazyl (DPPH) study of ethanolic extract of *I. aquatica* leaves shows IC_{50} value of 0.387 mg/mL whereas ABTS method displays IC_{50} value of 0.394 mg/ml [47] whereas ethanol extract of stem shows highest radical-scavenging activity as compared to water extract of leaf and stem, but methanol extract IA showed outstanding DPPH free radical scavenging activity (85%), which is very close to the synthetic antioxidant butylhydroxyanisole (95%) [52]. In another study

Table 1: Some major compounds from the plant *I. aquatica*

Compound	IUPAC Name	Activity
Nortropane alkaloids Calystegines B1 	(1R,2S,3R,5S,6R)-8-azabicyclo[3.2.1] octane-1,2,3,6-tetraol	The compound shows a potent inhibitory activity against rat lysosomal β-glucosidase [36,37]
N-cis-Feruloyltyramine (phenolic compound) 	(Z)-3-(4-hydroxy-3-methoxyphenyl)-N-(4-hydroxyphenethyl) acrylamide	Both the compounds are isolated from the toots of the plant and is considered to be potent inhibitors of prostaglandin synthesis. [23,38]
N-trans-feruloyltyramine (phenolic compound) 	(E)-3-(4-hydroxy-3-methoxyphenyl)-N-(4-hydroxyphenethyl) acrylamide	
3α,7β-*O*-D-di glycopyranosyl-dihydroquercetin 	2-(3,4-dihydroxyphenyl)-5-hydroxy-3-(((2R,3S,4R,5R,6S)-3,4,5-trihydroxy-6-(hydroxymethyl) tetrahydro-2H-pyran-2-yl) oxy)-7-(((2S,3R,5S,6R)-3,4,5-trihydroxy-6-(hydroxymethyl) tetrahydro-2H-pyran-2-yl) oxy) chroman-4-one	The compound found to be cytotoxic against normal, as well as cancer cell lines *viz*. Hep-2 and A-549 [39,40]
Isochlorogenic acid a, b and c (phenolic compounds)  Isochlorogenic acid a=R_1 and R_3=Caffeoyl; R2=R4=R5=H Isochlorogenic acid b=R_1 and R_2=Caffeoyl; R3=R4=R5=H Isochlorogenic acid c=R_2 and R_3=Caffeoyl; R1=R4=R5=H	Isochlorogenic acid a, b and c is found not only in *I. aquatica* but also observed in other species of the genus *Ipomoea viz. I. batatas, I. pres-caprae* having collagenase inhibitory activity [41], antioxidant activity [42], anti HIV activity [43,44]. Isochlorogenic acid an alone shows potent antifungal activity[45] and anti-spasmodic activity [46]	

flavonoid glycoside *viz*. 7-*O*-*β*-D-glucopyranosyl-dihydroquercetin-3-*O*-*α*-D glucopyranoside (DHQG) isolated from the leaf extract of *I. aquatica* shows compelling antioxidant activity [40]. Moreover, methanolic and aqueous extracts shows a profound anti-inflammatory activity against carrageenan-induced rat paw edema model and shows its effect in a dose dependent manner [20]. In Sri Lanka, the plant is used as a vegetable and thought to have insulin like activity [53]. The plant is also reported to possess hypoglycemic effects [13,14] and suggests that plant extracts inhibit the absorption of glucose from the intestine [54-57]. However, the exact mechanism by which the plant extract is considered to anti-diabetic is still not clear but it is assumed that the hypoglycemic effect is due to increase the insulin secretion or peripheral glucose uptake or decrease in gluconeogenesis or inhibit the release of hormones such as cortisol, glucagon, and growth hormone, etc. Simultaneously the plant also possesses cytotoxic and anti-proliferative activity. In a study it is found that the water extract of the stem have the highest anti-proliferative activity as compared to leaf extract [52]. In another study it was stated that crude methanolic extract , its column fraction and purified bioactive compound i.e. 7-O-ß-D-glucopyranosyl-DHQG isolated from the plant *I. aquatica* shows a profound cytotoxic activity against Hep-2 and A-549 cell lines, respectively [39], whereas MWE extract of plant acts as a potent anti-mutagen against Trp-P2-induced mutagenicity and shows a detectable anti-tumor activity in the mouse myeloma P388 cell line [58]. Furthermore it is reported that the MIAF and AIAF shows a maximum zone of inhibition against the microbes, and hence it is confirmed that the leaf extract of *I. aquatica* possess a characteristic antimicrobial property [20], whereas ethanolic extract of *I. aquatica* possess a significant anti-ulcer activity when administered to an aspirin-induced ulcer model in a dose dependent manner [51]. In addition to this the plant also shows nootropic activity in neonatal and young adult age groups of rat for 30 days, which causes a profound increase in the acetylcholine level in the rat hippocampus as compared to the control groups [47], Next to this the plant displays potent CNS depressant and antiepileptic activity and reported that continuation administration of methanol extract (200 and 400 mg/kg) causes a notable increases in onset to clonic and tonic convulsions and at 400 mg/kg, reflects an ample protection against seizures-induced by strychnine and picrotoxin but not with pentylenetetrazole in a dose dependent manner [19]. It was reported the oral administration of methanol:acetone extract of leaves of *I. aquatica* at a dose of 200 and 400 mg/kg exhibited anxiolytic activity in elevated plus maze, light: Dark apparatus, and hole board apparatus models there by increasing the time spent [48]. Beside this it was reported that oral administration of methanol leaf extract at a dose of 200 and 400 mg/kg for 30 days

in Swiss Albino rats significantly reduced the concentration of plasma total cholesterol, total lipid, free fatty acid, phospholipid, and triglycerides as well as the liver, kidney and heart total cholesterol [59] as well it was mentioned in that oral administration of methanol extract of whole plant at illustrates a good diuretic activity in a dose dependent manner [60]. It was reported that the plant extract acts as an antidote against scorpion venom with a great efficacy [61].

CONCLUSION

The plant *I. aquatica* can be considered as an effective natural herb for the treatment of various ailments and having numerous health benefits because of the presence of rich source of vitamins, minerals, flavonoids, alkaloids and many other secondary metabolites. Over the last few decades, a few works had been carried out on this plant and is found to be a promising natural herb in the treatment of various ailments *in vitro*. Since the plant is considered to be an effective herb therefore it may be possible that many un-explored pharmacological application of this herb need to be exposed and can be studied both *in vitro* and *in vivo* as well as study the mechanism of its action in the system of an organism.

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