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A Systematic Review on Pharmacognostical and Pharmacological Activity of *Quisqualis indica* : An Updated Review

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ABSTRACT

Medicinal plants are important for pharmacological research and drug development. *Quisqualis indica* Linn contains phytoconstituents such as trigonelline (alkaloid), L-proline (α-amino acid), L-asparagine (α-amino acid), quisqualic acid (agonist for both AMPA receptors), rutin (flavonoid), and two forms of the cysteine synthase, isoenzyme A and isoenzyme B (enzyme) and due to presence of these phytoconstituents, it is showing various activities such as anti-inflammatory activity, antipyretic activity, immunomodulatory activity, antistaphylococcal activity, anthelmintic activity, antiseptic activity, etc. This review summarizes and focused on the most interesting studies done in the last five years for the various pharmacognosy and pharmacological works done on the *Quisqualis indica*.

INTRODUCTION

India is richly endowed with a wide variety of plants having medicinal value. The term "herbal drugs" denotes plants or plant parts that have been converted into phytopharmaceuticals using simple processes involving harvesting, drying, and storage [1-2]. The plant processing encompasses drying, mechanical disruption, and solvent extraction such as aqueous or organic solvent, e.g., ethanol, and will influence the final quality of the herbal product. Analytical procedures can be used to determine the active constituents that are present in herbal substances [3]. Herbal medicine uses are based on historical medicinal practices. Historical practices determine the way herbal medicines are formulated and used. In some cases, e.g. China, there are well-defined procedures that are well documented in pharmacopeia dating back nearly 2000 years and other monographs.

The *Quisqualis indica* Linn plants are widely used either directly as folk remedies or indirectly as pharmaceutical preparation of modern medicine. *Quisqualis indica* Linn or Rangoon Creeper is an easy-to-grow vining plant, it's now more popular and widely cultivated as an ornamental vine in the gardens, it has a variety of traditional medicinal uses, which sometimes require that it be blended with other plant or natural ingredients 8. By considering the ethnomedicinal background and several research articles on *Quisqualis indica* Linn, it has been concluded that this plant carries some important phytochemicals constituents showing various pharmacological activities such as anti-inflammatory activity, antipyretic activity, immunomodulatory activity, anti-staphylococcal activity, anthelmintic activity, antiseptic activity, etc.

Plant Profile

Botanical Name: *Quisqualis indica Linn*.

Local Names: English (Rangoon Creeper), Hindi (Madhumalti), Bengali (Modhumalati), Telgu (Radha Manoharam), Filipino (Niyog-niyogan), Spanish (Quiscual), China (Shih-Chun-Tzu), Manipuri (Parijat), Marathi (Vilayati chambeli).

Taxonomical Classification

Kingdom- Plantae

Division- Magnoliophyta

Class- Magnoliopsida

Order- Myrtales

Family- Combretaceae

Genus- Quisqualis

Species- *Q.indica* [4, 5]

Quisqualis indica Linn

Habitat and Distribution

It is a vining and evergreen plant which is having vigorous growth needing sturdy support and can get quite out-of-hand on its favorable growing site, it doesn't require deep and anchoring roots. It is widely distributed all over the world especially in China, the Philippines, Bangladesh, Myanmar, and Malaysia, and now also broadly grown in India as an ornamental plant in most of the gardens. Distributed over: Thickets and secondary forests area throughout the Philippines. Ornamentally planted for its flowers. Also occurs in India to Malaya. Introduced in most tropical countries. [6]

Botanical Description

Quisqualis indica Linn. of the genus Quisqualis, is an exceptionally impressive tropical vine, with a few varieties, distinguishable by its flower color and leaf size. It can reach 21 m in the wild, but generally, its length in cultivation ranges between 2-9 m. A large, woody, and shrubby climber over pergolas, trellises, etc., and yet can be trained as a specimen shrub. Under good growing conditions, it's typically seen with lush and fresh green foliage on cascading branches with numerous axillary and terminal drooping racemose inflorescences that are simply spectacular. Leaves with distinct venation, are oblong to elliptic, 7-15cm in length with an acuminate tip and rounded base. They are simple and opposite. It non-stop blooms profusely all year round in the tropics. The original Rangoon Creeper with thorny stems produces single flowers in red while the Thai hybrid has double flowers, and both exude an intoxicating fragrance at night as a bonus. The beautifully colored flower clusters with pendulous trumpet-shaped blooms open first white, then turn pink and end deep pink, bright red, or reddish-purple over 3 days, displaying the various coloring stages altogether on the same flower stalk. Its fruit is narrowly ellipsoidal, 2.5-3 cm long with 5 sharp,

longitudinal angles or wings. The 12-15mm long seeds are pentagonal (shaped like the fruit-shell) and black. The 30 to 35 mm long fruit is ellipsoidal and has five prominent wings. The fruit tastes like almonds when mature. [4,5,7]

Traditional Use

Quisqualis indica is generally known as Rangoon Creeper. It belongs to the family Combretaceae and it is an excellent vine for outdoor gardens. Seeds decoction in oil is applied topically in skin diseases. Seeds are the source of fatty oil that is purgative in action.[8] Roasted ripe seeds are and given in diarrhea, fever, and case of rickets in China. Seeds are also useful in skin diseases. Roots are used to treat rheumatism, also can be used to expel parasitic worms or for alleviating diarrhea.[9] the leaves are given in compound decoction for flatulent distension of the abdomen.[10] Its seeds and leaves are utilized for restorative purposes, including as an antigelmintoznoe tool, particularly against tapeworm, likewise as a narcotic. It has additionally been accounted for to use effectively against stomach pain, looseness of the bowels, colds, skin parasites, and rickettsia [11] (Sanguri *et al.* 2012). Traditionally the plant is used as a cough cure. In the Philippines, the fruit and seeds are used as a vermifuge [12] (Nitu *et al.* 2011), whereas in China, Thailand, and the Indo-China region seeds are used as vermifuge and for rickets in children. In Bangladesh, seeds are used for diarrhea, fever, boils, ulcers, and helminthiasis. The seed oil contains linoleic, oleic, palmitic, and stearic acids [13] (Ta *et al.* 1997). Four phenylpropanoids were isolated from stem bark [14] (Jahan *et al.* 2008). Antibacterial, antifungal, anticoccidial, and antihelmintic activities of *Q. indica* stem have been reported [14-16] (Jahan *et al.* 2008; Jahan *et al.* 2009; Kumar *et al.* 2006). Traditionally, Quisqualis indica Linn (QI) has been used to treat inflammation, stomach pain, and digestion problems. [17]

Reported Activity

Anthelmintic Activity

The anthelmintic activity for different extracts was carried out and produced paralysis extending from loss of motility to loss of response to external stimuli, which slowly proceeded to death. All extract shows the potential anthelmintic activity as compared to standard. [18]

Antioxidant Activity

The highest total antioxidant capacity at a concentration of 400 mg/ml of methanolic extract. Scavenging activity of *Quisqualis indica* extracts against 1,1-diphenyl-2-picrylhydrazyl radical showed the highest activity of (91.32)% with 400 mg/ml. Scavenging of Superoxide radical by Alkaline DMSO Method was studied and ethanolic extract shows maximum results. [18]

The antioxidant potential of leaf, stem, root, and flower extracts of Quisqualis indica Linn. was assessed to verify its ethnopharmacological importance. Both polar and non-polar solvents like n-hexane, chloroform, ethanol, and distilled water were used to obtain crude extracts. The chloroform extract of leaves showed the maximum %age yield, i.e. 27.3% while the n-hexane extract of stem showed the minimum yield, i.e. 0.2%. Five activities including DPPH free radical scavenging activity, ABTS+ assay, Total flavonoid components (TFC), Total phenolic components (TPC), and Metal chelating Assay (MC) were employed to evaluate the antioxidant activity of the plant. The ethanol extract of the inflorescence of the plant displayed the most elevated DPPH potential, i.e. 452.11%. Aqueous extract of the root had the highest value of TEAC i.e., 7.4515 mmol. The aqueous extract of the flower displayed the highest level of phenolic contents with the value of 35 in terms of GAE mg/mL. On the other hand, the chloroform extract had the highest % bound iron value of 128 and the aqueous extract of the flower showed a high concentration of Flavonoids having the value 347.65mg/l of Quercetin. It has been inferred that all parts of Quisqualis indica L. possess good antioxidant potential. Differents parts showed different antioxidant potentials hence they can be used as curative agents against human and animal ailments. [19]

Rangoon creeper, *Quisqualis indica* Linn. is an important shrub belonging to the family Combretaceae. This plant is traditionally used for cell aging or other oxidative stress-related diseases. This study was done to quantify the polyphenols, flavonoids and to investigate the anti-oxidant and anti-microbial activity of aqueous and ethyl acetate crude and dry sample extracts of leaf, stem, and flowers. The phytochemical quantitative assay was done by the Aluminium chloride, Folin-Ciocaltue Method, and the antioxidant activity was measured by ABTS and H2O2 radical scavenging assay. To investigate the anti-microbial activity, the disk diffusion method was used. The highest amount of total polyphenolic content was found in the flower of crude (102.24±0.48 mg GAE/g of tissue) and dry (83.75±0.47 mg GAE/g of tissue) samples in ethyl acetate extracts. The highest amount of total flavonoids content was

found in crude leaf (60.67±0.31 mg QE/g of tissue) and dry flower (54.27±0.20 mg QE/g of tissue) of ethyl acetate extract. The aqueous extracts of leaf and flower showed higher antioxidant activity than the ethyl acetate extracts. The crude and dry samples of leaf and flower extracts showed maximum zone of inhibition for both the solvents rather than stem against *Staphylococcus aureus* as well as *Escherichia coli*. The results revealed that the leaves and flowers of *Quisqualis indica* contained more bioactive substances than the stem, which may be responsible for high anti-oxidant properties. So, the Rangoon creeper can be used to prevent various oxidative stress-related diseases. [20]

Benign prostate hyperplasia

Benign prostate hyperplasia (BPH) is a common disease in old-age males, accounting for approximately 77% of morbidity within the age range of 40 to 70 years. It has been shown that morbidity increases with social graying. *Quisqualis indica* Linn (QI) has been used to treat inflammation, stomach pain, and digestion problems. In this study, we evaluated the symptom-regulating effects of QI extract on a testosterone-induced BPH rat model. After inducing BPH in rats using testosterone propionate (TP) injection, we assessed basal intraurethral pressure (IUP) and increments of IUP elicited by electrical field stimulation (5 V, 5, 10, or 20 Hz) or phenylephrine (Phe) (0.01, 0.03, 0.1 mg/kg IV). To induce BPH, 8-week-old rats were subjected to a daily subcutaneous TP (3 mg/kg) injection for 4 weeks. Finasteride (Fina) (10 mg/kg PO) was administered to the rats in the first treatment, while QI (150 mg/kg PO) was administered to those in the second group. Blood pressure was measured together with IUP, after which low urinary tract (LUT), ventral prostate (VP), testicle, and corpus spongiosum were isolated and weighed. Basal IUPs for the Fina- and QI-treated groups were 87.6 and 86.8%, respectively. LUT and VP organ weights in the QI group were lower than those in the Fina group. However, the QI group showed significantly reduced electrical stimulated or Phe-induced IUP increment compared to the Fina and BPH groups. These results proved that QI can be beneficial for BPH symptoms by inhibiting 5α-reductase and consequently decreasing prostate and releasing urinary pressure. [21]

Benign prostatic hyperplasia (BPH) is an age-related disease characterized by prostatic enlargement is the most common urologic symptom in elderly men 60 years of age and older. Previously, we documented that 70% ethanol (EtOH) seed extract of *Quisqualis indica* (QI) attenuates pathological condition of testosterone propionate (TP)-induced BPH rat model *via* modulation of proliferation and apoptosis of prostate cells. Based on this potential of QI, we

produced a standardized seed extract of QI(HU-033) to prove further mechanisms. In this study, we aimed to suggest further mechanisms underlying the relationship between BPH and HU-033. Through not only cellular and nuclear receptor functional assays, but TP-mediated BPH rat model treated with HU-033, we demonstrated that HU-033 exerted antagonist effect on α1- and α1-adrenergic receptors *in Vitro* and inhibitory effect on protein expression of androgen receptor and estrogen receptor alpha *in vivo*. Taken together, these results suggest that HU-033 is a novel candidate for the management of BPH. [22]

Antitumor Activity

Green synthesis of metallic nanoparticles is a cost-effective environment-friendly technique and *Quisqualis indica* has ethnomedicinal values. With this background in this study, the floral extract of *Q. indica* was used to fabricate copper nanoparticles (QCuNPs) from copper acetate. Biophysical analysis revealed the formation of spherical, monodisperse, crystalline QCuNPs. Significant cytotoxic potentials of the nanoformulation were determined by MTT and lactate dehydrogenase (LDH) assay on B16F10 melanoma cells. Estimation of GSH and ROS demonstrated that QCuNPs induced melanoma cell death by induction of oxidative stress. Gene transcript analysis showed up-regulation of caspase-dependent as well as caspase-independent (AIF) apoptotic genes in treated cells. Comparative proteomics study mostly showed the abundance of apoptotic and cell cycle arrest proteins in treated samples. The in vivo therapeutic efficacy was studied in mice bearing B16F10 melanoma tumor where a significant decrease in tumor growth was observed in nanoparticles treated animal model. In conclusion, QCuNPs caused cytotoxicity and apoptosis in melanoma cells and its mechanism was established from gene expression and proteomic studies. QCuNPs exhibited potential suppression of B16F10 melanoma cell proliferation and substantial inhibition of tumor growth in animals. As per our information, this is the first study exploring the potential of Q. indica for the formulation of eco-friendly copper nanoparticles which will have great future application in the medicinal field. [23]

Anti-esophagitis potential

The extract of *Q. indica* flower has any role against esophagitis through scavenging of free radical oxygen species. In this study, we elucidated the effect of ethanolic flower extract of *Q. indica* on experimental esophagitis in albino Wister rats. The fasted animals were divided into six groups and received carboxymethyl cellulose (CMC) (0.25%, 3 mL/kg, Sham control) or toxic control or pantoprazole (30 mg/kg) or flower extract of different doses (100, 200, and

300 mg/kg) were subjected to the pylorus and forestomach ligation. All the animals were sacrificed after 8 h and evaluated for various parameters such as total acidity, free acidity, gastric pH, the volume of gastric juices, and esophagitis index. Esophageal tissues were subjected to estimation of various oxidative stress parameters like malonaldehyde (MDA), glutathione (GSH), catalase (CAT), superoxide dismutase (SOD), and protein carbonyl (PC). In a separate experiment, *in vitro,* antioxidant assays such as DPPH and H_2O_2 assays, total phenolic and flavonoid contents were also conducted. The results revealed that treatments with pantoprazole and flower extracts significantly inhibited gastric secretion, total acidity, and esophagitis index. Various oxidative stress parameters were also restored to a normal level in the treated groups. This action could be due to the presence of higher phenolic and flavonoid contents. All these findings collectively suggest that the flower extract of *Q. indica* possibly possesses anti- esophagitis potential. [24]

Antimicrobial activity

The antimicrobial activities of methanol extract, petroleum ether extract, and aqueous extract of *Q. indica* leaves were observed against two gram-positive bacteria, the *Staphylococcus aureus, Bacillus cereus,* and two-gram negative bacteria, the *Escherichia coli, Pseudomonas aeruginosa.* Imipenem was used as a positive control. All three extracts showed a zone of inhibition against both gram-positive and gram-negative bacteria except *P. aeruginosa*. *P. aeruginosa* was resistant to all three extracts of *Q. indica* leaves. The ranges of the zone were from 12.00±0.33 to 22.00±0.00 mm. [25]

The organic and inorganic crude extracts of different plant parts of *Quisqualis indica* Linn; were obtained by maceration technique in n-hexane, chloroform, ethanol, and water. The phytochemical screening of the crude extracts disclosed the presence of a variety of secondary metabolites, such as alkaloids, tannins, saponins, terpenoids, flavonoids, cardiac glucosides, and reducing sugars. The crude extracts were also tested for their antibacterial and antifungal activities by using the agar well diffusion method against gram-positive bacteria, i.e. *Escherichia coli* & *Pseudomonas aeruginosa*, gram-negative bacteria, i.e. *Bacillus subtilis* & *Staphylococcus aureus,* and fungal strains *Aspergillus niger* & *Aspergillus oryzae*. The broad spectrum of potential in the form of the zone of inhibition was exhibited against bacterial and fungal strains ranging from 9±0.3mm to 53±0.1mm and ±0.3mm to 51±0.4mm respectively. The maximum zone of inhibition, i.e. 53±0.1mm was developed by the ethanol root extract against *B. subtilis,* while the second and third largest zones of

inhibition, i.e. 51±0.4 and 46±0.5 were shown by chloroform and ethanol root extracts respectively against fungal strains. [26]

Cytotoxic Activity

The cytotoxic activity was evaluated via brine shrimp lethality test (BSLT) and MTT assay against liver carcinoma cell line (HepG-2). The cytotoxic results against (HepG-2) revealed that CH2Cl2 & n-BuOH are the most strong cytotoxic fractions (IC50= 11.9, 17.9µg/ml respectively) against Doxorubicin (IC50 = 4 µg/ml). [27]

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