Available on line www.eijppr.com

International Journal of Pharmaceutical and Phytopharmacological Research

ISSN (Online) 2249 – 6084

ISSN (Print) 2250 – 1029

Int.J.Pharm.Phytopharmacol.Res. 2012, 1(5): 313-321

(Review Article)

Quisqualis indica Linn : A Review of its Medicinal Properties

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Received on: 13/02/2012 ***Accepted on:*** 23/04/2012

ABSTRACT

An herbal medicine is crude drugs obtained from vegetables or plant which are the origin of herbal drugs utilized for the treatment of disease states, often of a chronic nature, or to attain or maintain a condition of improved health. Phytogenic agents have traditionally been used by herbalists for several diseases from the past two decades. This article contain brief reviews of medicinal properties of plant Quisqualis Indica Linn which had been proved but are rarely used as a herbal medicines, the point which have to be considered that this plant can be available easily as it is an evergreen plant and most of the people were used to decorate their house, as this is an ornamental plant too which doesn't depend on seasons to grow. 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, anti-staphylococcal activity, anthelmintic activity, antiseptic activity etc.

Key Words: *Quisqualis indica Linn*, Rangoon Creeper, Phytoconstituent, Pharmacological activity, Toxicity.

INTRODUCTION

The products which are obtained from the natural source such as plants, microorganisms, animals or minerals is the basic needs of making drugs used for the treatment of disease which are synthesized now a days for the making of a novel drugs. In the ancient time the herbal medicines is the only source which are used for the treatment of most of the disease and today also in many places it have been using for healthcare purpose so we can say that the herbal medicines remedy is an traditional system of medicine which are used in medical practices since from antiquity. During the past two decades, there has been an increasing interest in the industrialized nations to use medicinal plants. Sources of details are pharmacopoeias, indigenous knowledge, scientific literature, and other documented sources [1]. The practices continue today because of its biomedical benefits as well as place in cultural beliefs in many parts of world and have made a great contribution towards maintaining human health. The demand of herbal medicines is currently increasing day by day because of the side effects of the allopathy drug . India is a vast repository of medicinal plants that are used in traditional medical treatments. About 80% of people in developing countries still relays on traditional medicines which are based largely on plants and animals for their primary health care.

Herbal products are defined as the materials that are administered to patients and are mixtures of herbal substances and other constituents which are made by using herbals. Herbal medicine has become more popular in recent era in the purpose of healthcare. Herbal medicines are generally regarded as safe based on their long-standing use in various cultures [1] .Total global herbal market is of size 62.0 billion dollars. European Union is the biggest market with the share 45% of total herbal market and the India's contribution is only one billion dollars. But there are positive signals also for us in the global market. India has 16 Agro-

climatic zones, 10 Vegetative zones, 15 Biotic provinces, 426 Biomes, 45000 different plant species and 15000 medicinal plants that include 7000 Ayurveda, 700 in Unani medicine, 600 in Siddha medicine and 30 in modern medicine. This makes India one among 12 mega biodiverse countries of the world, which despite having only 2.5 % total land area, accounting for over 8 % of the recorded species of the world [2]. It is estimated that at least 25% of all modern medicines are derived, either directly or indirectly, from medicinal plants, primarily through the application of modern technology to traditional knowledge. In the case of certain classes of pharmaceuticals, such as antitumor and antimicrobial medicines, this percentage may be as high as 60% [3, 4] .The scientific evaluation of safety and efficacy of herbal products and medicinal preparation is thus of vital importance from both medicinal and economic perspectives [5]. Now a day's our world is facing a crisis in economic conditions so the use of herbal products is much more reliable than allopathic products because of its expensiveness.

Quisqualis indica Linn comprises of family Combretaceae. The word Quisqualis meaning "Which? What?" in Latin term which was given to this plant by a Dutch botanist called Rumphius to express his astonishment at the odd behaviour of the species. A new plant grows for the first six months as an erect shrub, and then it ends out a runner from the roots which soon becomes stouter and stronger than the original stem. It is a charming plant, a native of Burma and Malaysian Archipelago, and thrives well in most parts of India, being frequently cultivated in gardens. A fresh green leaf set off the clusters of pendent pink and white blossoms and the attractive appearance is enhanced by the delicious perfume [6]. Apart from its attractiveness it contains many phytoconstituent such as trigonelline (Alkaloid), L-proline (α-amino acid), L-asparagine (α-amino acid), quisqualic acid, rutin (Flavonoid) and two forms of the cysteine synthase, isoenzyme A and isoenzyme B (Enzyme) which is responsible for several pharmacological activities mentioned in different literatures. This plant is commonly called Rangoon Creeper which has been traditionally used over a long period of time due to its activity against common diseases such as boils, fever, diarrheoa etc. One of the reason of using this plant in making many herbal products is its availability almost in every season and also it grows faster.The main motto of mine behind this article is to aware more number of researchers about number of benefits of this plant because of its easy availability so that it will be helpful for human beneficiary in healthcare and economical purpose as much as possible.

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).
Kingdom- Plantae
Division- Magnoliophyta
Class- Magnoliopsida
Order- Myrtales
Family- Combretaceae
Genus- Quisqualis
Species- *Q.indica* [7, 8]

Habitat and Distribution

It is vining and evergreen plant which is having vigorous growth needing sturdy support and can get quite out-of-hand on its favourable growing site, it doesn't require deep and anchoring roots.
It is widely distributed all over the world especially on China, Philippines, Bangladesh, Myanmar and Malaysia and now also broadly grown in India as ornamental plant in most of the garden. Distributed over 1) Thickets and secondary forests area throughout the Philippines. 2) Ornamentally planted for its flowers. 3) Also occurs in India to Malaya. 4) Introduced in most tropical countries [9].

Cultivation and Collection

It generally requires an area with full sunlight, regular watering to keep the soil moist and need a support stand for the vine to grow on.For the proper growth of any plant it should be provided with basic requirements having well maintained conditioning i.e. sunlight, water, fertilizer etc. Generally these plants require:
Light - Prefers full to part sun and blooms best with good sunlight.
Moisture- Water moderately and regularly, keeping it evenly moist. Need more water during hot seasons and less in cooler climate. During establishment it cans tolerant drought condition also.
Soil-Fertile humus soil with a mix of sand that can retain water, yet well-drained soil.
Others: Require regular pruning to keep it within control, as well as to encourage more blooms with new branches as flowers appear on new growth. When newer shoots observe emerging from the base of the vine we can remove them also if we'd rather have one main strong stem continuing its growth at the top, otherwise leave them be to promote bushiness near its base. Require fortnightly or monthly feed with a flowering fertilizer to boost flowering. Relatively free from pests and diseases.

For subtropical regions - A tender evergreen that goes semi dormant or die back in lower temperature, but come back when weather warms up in spring. Flowers fall during all over summer season [10].

Botanical Description and Identification Features

Quisqualis indica Linn. of the genus Quisqualis, is an exceptionally impressive tropical vine, with a few varieties, distinguishable by its flower colour 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 is simply spectacular.

Leaves with distinct venation, are oblong to elliptic, 7-15cm in length with acuminate tip and rounded base. They are simple and opposite. It non-stop blooms profusely all year around 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 an added bonus.

The beautifully coloured flower clusters with pendulous trumpet-shaped blooms open first white, then turn pink and end deep pink, bright red or reddish purple over a 3-day period, displaying the various colouring stages altogether on one and 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 [7,8,10].

Useful Parts of Plant

Rangoon creeper is generally an ornamental plant but due to presence of phytoconstituent it was used as traditional medicines over a long period of time either used individually or it was given with other synergistic ingredients simultaneously. Generally the parts which are traditionally used of these plants are leaves, flower, seeds, fruits and roots. These parts contains some active ingredients which is responsible for giving particular pharmacological activity, but it will taken under some expert supervision as it giving some side effects also such as stomachaches or headaches, especially when the seeds will taken freshly or eaten frequently [9, 11].

PHYTOCONSTITUENTS

Every plant contains several phytoconstituent in its different parts showing various pharmacological activities and / toxicities, likewise *Quisqualis indica Linn.* also showing many pharmacological activities activities due to the presence of medicinally active compounds.

Quisqualis indica Linn contains phytoconstituent 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). Rutin and pelargonidin-3-glucoside have also been isolated from flowers. Fruits contain a sugary substance similar to levulose and an organic acid similar to cathartic acid. Seeds contain a fixed oil, which consists of linoleic, oleic, palmitic, stearic and arachidic acids, a sterol, an alkaloid with anthelimintic properties and a neuroexcitatory amino acid, quisqualic acid. [12]

UTILIZATION

Traditional Uses

Decoctions of the root, seed or fruit can be used as antihelmintic to expel parasitic worms or for alleviating diarrhea. Fruit decoction can also be used for gargling. The fruits are also used to combat nephritis. Leaves can be used to relieve pain caused by fever. The roots are used to treat rheumatism. Flowers are used to relieve headache.

The seeds of this plant and related species, *Q. fructus* and *Q. chinensis*, contain the chemical quisqualic acid, which is an agonist for the AMPA receptor, a kind of glutamate receptor in the brain. The chemical is linked to excitotoxicity (cell death).

Leaves and roots extracts are anthelimintic. Juice of leaves relieve flatulence. Infusion of leaves is used externally to treat boils and ulcers. Seeds are anthelimintic given to children to expel the worms [7, 8].

Industrial Uses

Medicinal plants are the richest bioresource of drugs for traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs. The first step in the value addition of medicinal bioresources is the production of herbal drug preparations, using a variety of methods from simple traditional technologies to advanced extraction techniques. The extract is further processed to be incorporated in any dosage form such as tablets and capsules. With the increasing demand for herbal medicinal products, nutraceuticals, and natural products for

health care all over the world, medicinal plant extract manufacturers and essential oil producers have started using the most appropriate extraction technologies in order to produce extracts and essential oils of defined quality with the least variations from batch to batch. Such approach has to be adopted by MAP-rich developing countries in order to meet the increasing requirement of good quality extracts and essential oils for better revenue generation within the country, as well as for capturing this market in developed countries [13].

PHARMACOLOGICAL ACTIVITY

Quisqualis indica Linn. showing various pharmacological activities such as anti-inflammatory activity, antipyretic activity, immunomodulatory activity, anti-staphylococcal activity, anthelmintic activity, antiseptic activity etc due to its presence of various active constituents all over the parts of plants. This plant contains some medicinally active phytochemical constituents which are responsible for various pharmacological activities.

Anti-inflammatory Activity

Inflammation is a normal, protective response to tissue injury caused by physical trauma, noxious chemicals or microbiologic agents [14]. Inflammation is defined as a local response to cellular injury that is marked by capillary dilatation, leukocyte infiltration, redness, heat, pain, swelling and often loss of function and that serves as a mechanism initiating the elimination of noxious agents and damaged tissue [15]. Inflammation is of two types, acute inflammation a short term process which appears within few minutes and chronic inflammation a long term process.

Anti-inflammatory action is considered to be inhibition of PG synthesis particularly it inhibit the COX at the site of injury, as the decrease the prostaglandin E_2 and prostacyclin reduces vasodilation and indirectly, oedema. Accumulation of inflammatory cells is not reduced that it does not depress the production of other mediators like leukotrines, PAF, cytokines, etc so there are many targets for anti-inflammatory actions [16,17].

The hydroalcoholic extract of *Quisqualis indica* has anti-inflammatory activity in acetic acid-induced vascular permeability and cotton pellet granuloma model. The phytochemicals analysis revealed the presence of polyphenols and flavonoids. The polyphenols have potent anti-inflammatory activity by inhibiting prostaglandin synthesis. So anti inflammatory activity of hydroalcoholic extract of *Quisqualis indica Linn* can be attributed to bradykinin and PG synthesis inhibition property of polyphenols [18, 19].

Antipyretic Activity

Fever or pyrexia is produced during infection through the generation of pyrogens which occurs when IL-1 releases PGs in the CNS, where they elevate the hypothalamic set point for temperature control, thus causing fever [16,17]. This can be caused by PGE_2 synthesis, which is stimulated when an endogenous fever producing agent a pyrogens, such as cytokine, is released from white cells that are activated by infection, hypersensitivity, malignancy or inflammation [20].

Fever is a common medical sign characterized by an elevation of temperature above the normal range of 36.5–37.5 °C (98–100 °F) due to an increase in the body temperature regulatory set-point [21]. This increase in set-point triggers increased muscle tone and shivering. As a person's temperature increases, there is, in general, a feeling of cold despite an increasing body temperature. Once the new temperature is reached, there is a feeling of warmth [22, 23].

Antipyretic are the drugs that reduces the elevated temperature of the body which resets the thermostat toward normal and it rapidly lowers the body temperature of febrile patients by increasing heat dissipation as a result of peripheral vasodilation and sweating [20].

The methanolic leaf extract of *Quisqualis indica Linn* plant was extensively investigated for its antipyretic activity against Brewer's yeast induced pyrexia model in rats. The methanolic extract of the plant at a dose level of 100mg/kg and 200mg /kg exhibited competent, potent and comparable results promoting *Quisqualis indica Linn* plant as a promising antipyretic plant species [24].

Immunomodulatory Activity

Immodulation is a process in which a substance alters the immune response by augmenting or reducing the ability of the immune system to produce antibodies or sensitized cells that recognize and react with the antigen that initiated their production. Immunomodulators include corticosteroids, cytotoxic agents, thymosin, and immunoglobulins. Some immunomodulators are naturally present in the body and certain of these are available in pharmacologic preparations [26].The term immunomodulation denotes a change, a strengthening of suppression, of the indicators of cellular and humoral immunity and nonspecific defense factors [27].

Hydroalcoholic extract of *Quisqualis indica Linn.* flower extract is a potent immunostimulants, stimulating specific and non-specific immune mechanisms. The role of phagocytosis is the removal of microorganisms and foreign bodies, dead or injured cells. The primary target of most of the immunomodulators is believed to be

macrophages which play a major role by engulfing pathogens or foreign substances and initiating innate immune response. The phagocytic index of (100 mg/kg) and QI flower extract (150 mg/kg) showed significant($p<0.05$) increased in phagocytic index when compared to control group [28].

Anti-staphylococcal Activity

Staphylococci (staph) are gram positive spherical bacteria that occur in microscopic clusters resembling grapes. Bacteriological culture of the nose and skin of normal humans invariably yields staphylococci. *S. aureus* is a successful pathogen is a combination of bacterial immuno-evasive strategies [29].

S. aureus can cause a range of illnesses, from minor skin infections, such as pimples, impetigo, boils (furuncles), cellulitis folliculitis, carbuncles, scalded skin syndrome, and abscesses, to life-threatening diseases such as pneumonia, meningitis, osteomyelitis, endocarditis, toxic shock syndrome (TSS), bacteremia, and sepsis. Its incidence ranges from skin, soft tissue, respiratory, bone, joint, endovascular to wound infections. It is still one of the five most common causes of infections and is often the cause of postsurgical wound infections. Each year, some 500,000 patients in American hospitals contract a staphylococcal infection [30- 32].

The extract of stem bark of *Quisqualis indica Linn* which was macerated with methanol followed by sequential solvent-solvent partitioning with n-hexane, carbon tetrachloride and chloroform act as a antibiotic against staphylococcal infection [33]. The effectiveness of the respective antibiotics is expressed as 'Therapeutic Index' (TI) according to the formula,

$$TI = LD50 / MIC$$

Which calculates the toxicity of antibiotics towards microorganisms in vitro (MIC = Minimal Inhibitory Concentration in ppm) and the toxicity towards animals invivo (LD50 = a dose causing death of 50% of test animals in mg/kg/body weight) [34].

Acetylcholinesterase Inhibitors

Acetylcholine (Ach) is a major neurohumoral transmitter at autonomic, somatic as well as central sites [35]. The preganglionic fibers terminating in the adrenal medulla, the autonomic ganglia and the postganglionic fibers of the parasympathetic division use acetylcholine as a neurotransmitter. Cholinergic neurons innervate the muscles of the somatic system and play an important role in the CNS [36].

Acetylcholinesterase inhibitors are also called as anticholinesterases, the agents which inhibit Cholinesterase, protect Ach from hydrolysis produce cholinergic effects in vivo and potentiate Ach both invivo and invitro. It gives action by reacting with enzyme in the same way as Ach. The carbamates and phosphates respectively carbamylate and phosphorylate the esteric site of the enzyme, whereas the acelyted enzyme reacts with water extremely rapidly and the esteric site is freed in a fraction of a milliseconds, the carbamylated enzyme reacts slowly and the phosphorylated enzyme reacts extremely slowly.

The methanol extract of flowers gave high total polyphenol content and exhibited strong antioxidant activity. There was research works suggested that the phytochemical antioxidants might act as Acetylcholinesterase inhibitors. Currently, the effective chemicals for Alzheimer's disease therapy are Acetylcholinesterase inhibitors, which elevate the attenuated acetylcholine concentrations in the Alzheimer's disease affected brain by enhancing cholinergic function. Although the use of Acetylcholinesterase inhibitors e.g. Donezepil, Rivastigmine and Galantamine, a symptomatic treatment of Alzheimer's disease, causes the adverse effects due to cholinergic stimulation in the brain and peripheral tissues. Therefore the searching for new Acetylcholinesterase inhibitors particularly edible flowers which may cause lower side effects is very interesting for extensively investigated [38].

Antioxidants Activity

An antioxidant is a molecule capable of inhibiting the oxidation of other molecules. Oxidation is a chemical reaction that transfers electrons or hydrogen from a substance to an oxidizing agent. Oxidation reactions can produce free radicals. In turn, these radicals can start chain reactions. When the chain reaction occurs in a cell, it can cause damage or death to the cell such as nucleic acids, proteins, lipids or DNA and can initiate degenerative disease. Antioxidants terminate these chain reactions by removing free radical intermediates, and inhibit other oxidation reactions. They do this by being oxidized themselves, so antioxidants are often reducing agents such as thiols, ascorbic acid, or polyphenols [39].

The methanolic plant extract *Quisqualis indica Linn* show 95% antioxidant activity was due to the redox properties, which allowed them to act as reducing agents by scavenging free radicals such as peroxide, hydroperoxide or lipid peroxyl and thus inhibit the oxidative mechanisms that lead to degenerative diseases. The present study showed that the partitionates of the methanolic extract of *Q. indica* (stem bark) especially the chloroform soluble fraction possesses significant antioxidant potentials [40].

TOXICITY

India is richly endowed with a wide variety of plants having medicinal value [41].A number of herbs are thought to be likely to cause adverse effects [42].Furthermore, adulteration, inappropriate formulation, or lack of understanding of plant and drug interactions have led to adverse reactions that are sometimes life threatening or lethal [43]. Proper double-blind clinical trials are needed to determine the safety and efficacy of each plant before they can be recommended for medical use [44].

In general, quality control is based on three important pharmacopeial definitions which directly or indirectly depend on the toxicity:

- Identity: The herb should be that only the one we are using.
- Purity: They are not contaminants, e.g., in the form of other herbs which should not be there.
- Content or assay: The active constituents should be within the defined limits [45, 46].

The OECD guidelines defined the acute, sub-acute and chronic toxicity of the herbs and modern medicines [41].

Acute (short-term) toxicity tests, a single dose of a test substance is given to an animal. One measure of acute toxicity is the lethal dose 50 (LD_{50}), or the dose of a substance that kills 50 percent of the animals tested.

Subchronic toxicity studies are 13 to 26 weeks in duration. The animals are dosed daily by the same route that the substance would normally be administered to humans. They are then observed for any toxicity, as well as changes in body weight or food consumption. At the end of the dosing regimen, the animals are euthanized and their tissues evaluated for evidence of toxicity.

Chronic toxicity studies assess the longer-term toxic as well as carcinogenic potential of various substances. The test animals are observed for the same parameters as those on subchronic testing, only the observation period are longer up to two years and checked for tumors. Postmortem analysis includes evaluation for toxicity as well as carcinogenicity [47].

Quisqualis indica linn plant yields fatty oil, 15% gum resin. The nut yields 12.96 percent moisture: yellow oil, 28.37 percent of the original nut. Studies yield quisqualic acid, quisqualin A. An analysis of the seed reported the presence of oleic and palmitic acids in the oil, in addition to sitosterol, and an acetyl derivative from the saponifable matter [9].The dose limits were selected on the basis of previously performed oral acute toxicity studies in rat according to the OECD guidelines Acute toxicity studies were performed which is different as per pharmacological activity [46] generally Quisqualis indica Linn did not showing any signs of toxicity up to the dose of 150 mg/kg p.o. From acute toxicity test we concluded that two doses (maximum dose- $1/10^{th}$ of maximum tolerable dose i.e. LD_{50}) i.e. (100 mg/kg and 150 mg/ kg) were found safe for the experimental animals.

CONCLUSION

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 by means of simple processes involving harvesting, drying, and storage [46, 47].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 [48].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 pharmacopoeias 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 popularly 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.

ACKNOWLEDGEMENT

I would like to express my gratitude to all those who gave me the possibility to complete this work, specially my family who always give me support and encouraging me at every moment. I am deeply indebted my guide Balakrishna Dubey. I have furthermore to thank to my dear friends Pooja Sonakpuriya and Brijesh Baghel.

Table-1: Parts of *Quisqualis indica Linn* used for Medicinal Purpose

Sr. No.	Part of Plant	Medicinal Properties
1	Flower	Relieve headache
2	Leaf	Gastric pain, Dysentery, anthelmintic, boils, ulcer
3	Fruit	Tonic, nephritis and astringent
4	Seed	Diarrhea, antiseptic, febrifuge for high fevers, vermifuge
5	Root	Rheumatism, anthelmintic

Table-2: Active constituent presents in parts of *Quisqualis indica* Linn.

Sr. No.	Part	Phytoconstituent
1	Leaf	Trigonelline, L-proline, L-asparagine, quisqualic acid, rutin and two forms of the cysteine synthase, isoenzyme A and isoenzyme B.
2	Flower	Polyphenol contents, Rutin and pelargonidin-3-glucoside
3	Seed	Fixed oil(contain linoleic, oleic, stearic and arachidic acids, a sterol, an alkaloid and quisqualic acid)
4	Fruits	Sugary substance similar to levulose and an organic acid similar to cathartic acid
5	Roots	Fixed oil

Figure -1 : Flowers and Leaves Parts of *Quisqualis indica* Linn.

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