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Hibiscus rosa-sinensis L. (Malvaceae): Distribution, chemistry and uses

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Abstract

Medicinal plants gained much attention in recent decades because of their widespread uses. *Hibiscus rosa sinensis* (Shoe flower) is an ornamental plant having wide distribution throughout world. It has been traditionally used in food, cosmetic, and medicines. Major bioactive constituents include glycosides, terpenoids, saponins, and flavonoids. Plant has wide variety of pharmacological applications such as anti-fertility, anti-microbial, anti-inflammatory, anti-diabetic, anti-microbial, and anti-pyretic activities. Toxicological studies indicated that plant extracts are safe to use at higher doses. Current review highlights distribution, chemical composition, and major uses of this plant with the aim of assessing the future research demand and investigating its pharmacological applications through clinical experiments.

Key words: Karanda, pharmacology, bioactive constituents, anti-convulsant

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1. Botany

1.1. Introduction

Hibiscus rosa-sinensis (shoe flower) is a perennial shrub belonging to the family Malvaceae and genus *Hibiscus*. The genus *Hibiscus* contains about 275 species, which are native to tropical and south Asia and are widely distributed in different regions of world. Many *Hibiscus* species are mostly cultivated as ornamental plants [1]. They produce vibrantly colored showy flowers, throughout the year. Various cultivars having flowers (single or double) in shades of red, peach, white, pink, and orange are available [2]. Flowers morphology suggests the pollination through sunbirds and hummingbirds which are attracted towards nectar producing flowers. *Hibiscus rosa sinensis* is known by different names depending where you are in the world. It is known as Bent EL-Kunsil (Arabic), Rosa della Cina (Italian), Aka-bana (Japanese), Shoe flower (English), Japa (Sanskrit), Jasum (Hindi, Punjabi), Hibiscus de Chine (China), Joba (Bengali), Java (Telugu), Chinesischer Roseneibisch (German), Clavel japonés (Spanish), Hibiscus (Swedish) and Gudhal (Urdu) [3].

1.2. History

Hibiscus rosa-sinensis is probably originated from India. Old Moorish (Arabs) believe that it is originated from Spain. Many others claim that *Hibiscus rosa sinensis* is a collection of man-made hybrids and is not a natural herb. Hibiscus word is derived from Greed word "hibiskos" meaning white or marshmallow.

1.3. Demography/Location

Hibiscus rosa-sinensis is highly sensitive to frost and freeze in mild cold conditions. It shows best growth in full sun and well drained soil rich in organic matter. It is widely distributed in following countries: India (south western regions), Sri-Lanka (tropical regions), Thailand, South Africa, Phillipines, Myanmar, China and Pakistan.

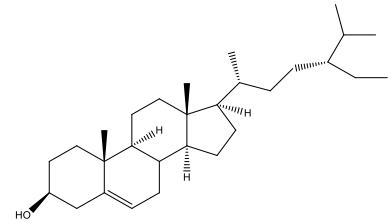
1.4. Botany, Morphology

Hibiscus rosa-sinensis is a perennial shrub having tap root system. Its leaves are 3 to 12cm long and 2 to 5cm wide. Leaves are simply ovate or lanceolate which are entire at the base and coarsely toothed at the tip/margins. Flowers are actinomorphic, pedicillate, complete, and pentamerous. Corolla contains five petals and is 3 inches in diameter [4]. A number of varieties differing in color and size of corolla are available. Fruit is a capsule having length of 3cm and forms very rarely [5]. *Hibiscus rosa sinensis* show best growth in well-drained and slightly acidic soils. In sandy soils, it uses fully decomposed organic matter to maintain water holding capacity, aeration and drainage of the soil. Plants require full sunlight because inadequate light limits flowering. However, they can tolerate partial shade.

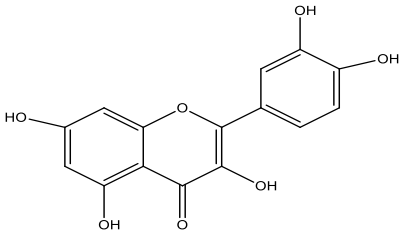
2. Chemistry

The chemical composition of *Hibiscus rosa-sinensis* varies in different studies, because of different varieties, environment, and harvesting conditions of plant. *Hibiscus rosa sinensis*is reported to contain proteins, carbohydrates, fats, and fiber contents. They also contain

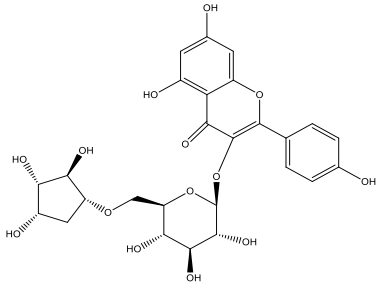
appreciable amounts of vitamins, iron, β-carotene and calcium. Leaves contain fats (3.5/100g), phosphorous (0.52/100g), calcium (1.67g/100g), carbohydrate (69.7g/100g), fiber (15.5g/100g), ash (11.4g/100g). Flowers contain protein (3,9g/100g), fat (3.9g/100g), carbohydrates (86.3g/100g), fiber (15.7g/100g), calcium (39mg/100g), phosphorous (265mg/100g), iron (1.7mg/100g), ash (5.9mg/100g), vitamin B1 (0.29mg/100g), vitamin B2(0.49mg/100g), vitamin B3 (5.9mg/100g), and vitamin C (3.9mg/100g) [6]. Bioactive constituents including glycosides, terpenoids, saponins, and flavonoids are present in different parts of plant, which impart medicinal properties to it. Stem and leaves contain stigma sterol, taraxeryl acetate, β-sitosterol, and three cyclo propane compounds. Flowers are rich in Quercetin-3-diglucoside, cyanidin-3-sophoroside-5-glucoside, kaempferol-3- xylosylglucoside, cyanidin-3, 5-diglucoside, and 3,7- diglucoside. Plant extract is a source of a number of potential antioxidants and anticancer compounds including quercetin, glycosides, riboflavin, niacin, carotene, malvalic acid gentisic acid, margaric acid and lauric acid. Roots are the richest source of tannins, mucilage, flavonoids, and saponins [6]. Saponins are useful for the patients of hypercholesterolemia as they bind with cholesterol, form insoluble complexes and excrete through bile, to lower blood pressure. Figure 1 shows structures of important bioactive constituent of *Hibiscus rosa-sinensis*.



β-sitosterol



Quercetin



kaempferol-3-xylosylglucoside

Figure 1. Structures of important bioactive constituents present in *Hibiscus rosa-sinensis*

3. Value addition

Typical value added products include juices, gulkand, chocolates, cakes, sauces, soups, jams and shrikhand

4. General uses

Hibiscus rosa-sinensis has wide variety of applications in food, cosmetics, and medicine. *Hibiscus* extracts are used as flavoring agents in various food products including jams, sauces, spices, and soup [7]. They are also used to enhance the aroma and flavor of tea mixtures. Essential oil of this plant is used in cosmetic industry due to the presence of various active chemical constituents. GCMS is generally used to find out the chemical composition of essential oils [8-13]. Its fragrance is pleasant, calming, and relaxing, thus, it is used in many beauty products such as lotions, soaps, shampoos, conditioners, and perfumes. The oil is also useful in preserving the elasticity and flexibility of skin and reduces the aging effects, when used on regular basis. Flowers of *Hibiscus rosa-sinensis* are considered as refrigerant, emmenagogue, and demulcent. Flowers are crushed to make a dark purple dye which is used to blacken the shoes. Dye is also used to color eyebrows, hairs, liquors, and food in many regions of the world. Flower extracts are used to cure ulcers, sore eyes and hypertension. Leaves of this plant are laxative, aperients, and emollient. Stem bark is useful for abortion. Various parts of plant are used to cure urinary infections. Roots are taken as a remedy for stomach disorders, gonorrhea, and blood vomiting. Roots are also used to cure certain cattle's diseases. Alcoholic and aqueous extracts of leaves have anti-infective, anti-dandruff, and prophylactic action against various skin diseases and allergies. They are also used to stimulate hair growth and darken the color of hair as they have anti-graying properties.

5. Pharmacological uses

5.1. Anti-fertility activity

In an investigation, the effect of *Hibiscus rosa-sinensis* flowers extracts (benzene, alcohol, and chloroform) on male albino rats was studied. Extracts were administrated at two different dose levels (125mg and 250mg/kg of body weight) for twenty days. Significant decline in spermatogenic elements of testies and sperm number of epididymis was observed after treatment. Testicular cholesterol level was increased due to decrease in the synthesis of androgen [14]. In another study, the effect of *Hibiscus rosa-sinensis* crude aqueous extract on reproductive organs of mice was studied. The extract at the dose level of 500mg/kg of body weight was orally administrated in model animals. Significant reduction in weight of epididymis and testis was observed. In addition to this, testosterone level was also reduced [15]. The effect of benzene extract of *Hibiscus rosa-sinensis* on reproductive organs of female albino mice was also studied. The treatment of thirty days resulted in disruption of estrous

cycle. Weights of uterus, pituitary glands, and ovaries were also decreased [16].

5.2. Anti-diabetic activity

The antidiabetic potential of ethyl acetate extract of petals of *Hibiscus rosa-sinensis* was investigated in diabetic rats. Extract was administrated at dose level of 25mg/kg as per body weight. Metformin was used as standard drug. The increased levels of glycated hemoglobin (12.89 ± 1.89) and serum glucose (398.56 ± 35.78) were decreased significantly (6.12 ± 0.49, and 156.89 ± 14.45 respectively) after treatment. Levels of Hepatotoxicity marker enzymes were restored in serum and glycogen level was normalized because of regulation of glycogen metabolizing enzymes activities [17]. In another investigation, the anti-diabetic activity of aqueous ethanolic extract of *Hibiscus rosa-sinensis* was studied in streptozotocin-induced diabetic rats. Extract was orally administrated at dose level of 500mg/kg for four weeks. Significant reduction in elevated levels of blood glucose, creatinine, uric acid, and urea was observed. Treatment also restored the level of marker enzymes and increased the activities of albumin, insulin, and C-peptide [18]. The antioxidant, hyperlipidimic, and anti-diabetic potentials of extracts of *Hibiscus rosa-sinensis* were studied in alloxan induced diabetic rats. Flower extract (hydrochloric) was administrated in animals at dose level of 50-200mg/kg. The anti-diabetic effect of *Hibiscus rosa-sinensis* extract was comparable to standard drugs (glibenclamide and sulphonylurea). After treatment of twenty eight days, size, number and diameter of iselts was increased significantly, and atrophy and necrosis were also improved [19].

5.3. Anti-microbial activity

The antimicrobial effect of methanolic extract of *Hibiscus rosa-sinensis* leaves was investigated against *Streptococcus pyogenes*, *Enterobacter aerogenes*, *Pseudomonas aeruginosa*, and *Escherichia coli*, using well diffusion method. Highest inhibition zone observed after 24 hours of incubation period at 37 ºC was against *Escherichia coli* and *Enterobacter aerogenes* (13 ± 00 and 12 ± 00) mm, respectively [20]. Another study was conducted to investigate the antibacterial effect of aqueous extract of leaves of *Hibiscus rosa-sinensis*, using disk diffusion method. Extract showed maximum inhibition zone at concentration level of 40mg/ml against *Staphylococcus aureus, Bacillus subtilis, and Escherichia coli* (11.00 ± 1.20, 14.00 ± 1.05, 12.30 ± 0.95) mm, respectively [21]. Interestingly, similar results were reported in another study, conducted using aqueous and hexane extracts of *Hibiscus rosa-sinensis* flowers. Aqueous extract gave maximum inhibition zone against *Escherichia coli* and *Bacillus subtilis* (15.00 ± 2.81 and 15.00 ± 2.81) mm, respectively. While, maximum inhibition zone of hexane extract was shown against *Escherichia coli* and *Bacillus subtilis* (18.00 ± 1.53 and 19.86 ± 0.15) mm, respectively [22].

5.4. Antioxidant activity

Antioxidant activity of various solvent extracts of *Hibiscus rosa-sinensis* was investigated by determining their DPPH free radical scavanging potential, total phenolic and flavonoid contents, and capacity of inhibition of linoleic acid oxidation. Ethanol and methanol extracts showed total phenolics (59.31 ± 4.31 and 61.45 ± 3.23) mg/100g as gallic acid equivalent, and total flavonoid contents (32.25±1.21 and 53.28 ± 1.93) mg/100g as catechine equivalent. Potential of linoleic acid oxidation inhibition of both extracts was 61.6 ± 2.01% and 75.8 ±3.22%, respectively. While, DPPH scavenging effect was 64.98 ± 2.11% and 75.46±4.67 [23]. Another study was conducted to investigate the antigenotoxic and antioxidant (in vitro) potentials of *Hibiscus rosa sinensis* flowers ethanolic extracts. Ethanolic extract enhanced the free radical scavanging potential in a dose dependent manner, and inhibited the process of lipid oxidation [24]. In another investigation, the ferric reducing antioxidant power (FRAP) and DPPH inhibition assays were used to determine the antioxidant potential of *Hibiscus rosa sinensis* flower extracts. Antioxidant activities of extracts were dependent on extraction solvents. Aqueous extracts contianed high amounts of tannins and anthocyanins, and exhibited strong antioxidant effect [25].

5.5. Anti-inflammtory and anti-pyretic activites

Anti-inflammatory potential of *Hibiscus rosa-sinesis* ethanol extract (0.125, 0.25, 0.5g/kg) was investigated against carrageenan based paw edema, xylene based ear edema, and cotton pallet based granuloma in mice. Analgesic effect was evaluated using writhing and formalin tests, while, antipyretic effect was tested using brewer's yeast induced pyrexia in rats. Significant anti-pyretic, anti-inflammatory, and analgesic activities were shown by the extract [26]. In another investigation, the anti-inflammatory effects of flower and leaf extracts (ethanolic) of white (*Hibiscus rosa-sinensis* var alba), and red (*Hibiscus rosa-sinensis* L.) hibiscus were studied against paw edema induced by carrageenan. Extracts were administrated at dose levels of 5, 50, and 100mg/kg. Anti-inflammatory action of white hibiscus was more potent than red hibiscus as red hibiscus extracts showed significant ($P<0.05$) anti-inflammatory action at dose levels of 50 and 100 mg/kg, while white hibiscus extract showed significant ($P<0.05$) anti-inflammatory action at all dose levels (5, 50, and 100mg/kg) [27]. Another study was conducted to evaluate the antipyretic effect of aqueous extracts of leaves of *Hibiscus rosa-sinensis* in yeast suspension induced fever. Yeast suspension was injected intraperitoneally in mice at dose level of 100mg/kg to induce fever. Aqueous extract was orally administrated in the animals having fever at the dose level of 0.5g/kg. Results indicated the significant action of extract against fever [28].

6. Side Effects and Toxicity

Administration of all the extracts of *Hibiscus rosa-sinensis* in mice produced no toxicity upto dose level of 500mg/kg, which indicated the safety of *Hibiscus rosa-sinensis* extracts [26].

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