

Phytochemical and Pharmacological Properties of Cactus and Hibiscus: A Systematic Review

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❖ Abstract:

Cactus and Hibiscus plants are utilised in traditional medicine for a variety of purposes. The purpose of this systematic review is to summarise the existing research on the phytochemical and pharmacological properties. We looked through numerous databases for studies on Cactus and Hibiscus, concentrating on their chemical makeup, biological activities, and potential health benefits. This review focuses on these plants' antioxidant, anti-inflammatory, and antibacterial capabilities, as well as their potential for treating a variety of disorders.

Cactus is a valuable medicinal shrub that thrives in desert and dry environments. Through practically all of its parts are employed in traditional medical systems, the stem, blossom, and roots are the most essential medicinal components. Previous pharmacological studies revealed that Hibiscus rosa-sinensis had reproductive, antidiabetic, fibrinolytic, hypolipidemic, antioxidant, antiinflammatory, antipyretic, analgesic, immunostimulating, anticonvulsant, antidepressant, memory enhancement, cytotoxic, antimicrobial, antiparasitic, dermatological, anti-haemolytic, urinary, hepatoprotective, neuroprotective, antitussive, and a variety of other effects. Hibiscus sabdariffa and Cactaceae are two plant species with significant relevance that extends beyond their aesthetic appeal. Hibiscus is medically, nutritionally, and culturally important, whereas cactus is environmentally, medicinally, and economically useful. Both plants have evolved to withstand harsh circumstances, making them durable and valuable resources. This study focuses on bioactive compounds, their traditional uses, and potential applications in medicine, food, and sustainable development. Exploring the multifaceted significance of Hibiscus and Cactus enables us to appreciate their contributions to human well-being, biodiversity conservation, and ecological resilience.

Key word: fibrinolytic, hypolipidemic, anti-inflammatory, immunostimulant, antiparasitic, hepatoprotective.

• Introduction:

Hibiscus sabdariffa is a hibiscus species native to the Old World tropics that is used to manufacture bast fibre and a herbal tea infusion. The plant is an annual or perennial herb, or a woody subshrub, with a height of 2-2.5 m (7-8 ft). The leaves are deeply 35 lobed, 8-15 cm long, and arranged alternately on the stalk.^[1] People in ancient times used to enquire about the medical plants in their surroundings in order to cure illness, and they learned about plant use by trial and error. They sought medications in nature ^[2]. Because of their effectiveness, medicinal herbs are in considerable demand in affluent countries for primary health care. tolerability, and few side effects. According to previous research, more than 3.3 billion individuals in less developed nations eat medicinal plants on a regular basis.^[3] Roselle has been well known and frequently utilised in traditional medicine for thousands of years^[4,5], growing to its high quantity of pharmacologically active chemicals and consequently good therapeutic

capabilities. In many cultures, the cactus *Opuntia* spp. has been utilised in traditional medicine as well as a source of vegetative nutrients. It has been observed that extracts of cactus fruits and stems demonstrate hypoglycemic,^[6] anti-oxidant,^[7] anti-tumor,^[8] anti-ulcer,^[9] anti-allergenic,^[10] and analgesic and anti-inflammatory properties.^[11] Cactus is a genus of plants in the Cactaceae family with a significant number of studied species. In several regions of the world, they are used for their nutritional and medicinal (herbal) characteristics. *Opuntia* is a cactus subspecies native to Mexico, but it can also find arid and semi-arid situations in tropical and subtropical regions of Latin America, Africa, and the Mediterranean. ^[12] *Hibiscus sabdariffa* is grown for its leaves, seeds, fleshy calyx, and fibre.^[13]



❖ Plant profile: Hibiscus

• Synonyms:

Hibiscus arnottii Griff. ex Mast.; *Hibiscus boryanus* DC.; *Hibiscus cooperi* auct.; *Hibiscus festalis* Salisb., *Hibiscus liliiflorus* Griff. ex Mast., *Hibiscus rosiflorus* Stokes and *Hibiscus storckii* Seem^[14].

• Common names:

Arabic: Bent EL-Kunsil, Ward El-Jemal, Khatmah Siniyah, Hab misk Seni, and Pooq Seni; Chinese: Zhu jin, Da hong hua, Fo sung, Fu sang. English: China-rose, Chinese hibiscus, Hawaiian hibiscus, hibiscus, rose-of-China; French: Hibiscus de Chine, Hibiscus rose de Chine, Rose de Chine; German: Chinese Roseneibisch; Italian: Rosa della Cina; Japanese: Aka-bana, Fusou, Haibisukasu Portuguese: Rosa da China; Spanish: Clavel Japonés; Swedish: Hibiscus ^[15].

Traditional uses: In medicine, the red-flowered type was chosen. Roots and leaves were analgesic and emmenagogue. They were used to control menstrual cycles and promote blood circulation. The leaves were also used to induce abortion and accelerate the ejection of the placenta after childbirth. Flower was used to regulate the menstrual cycle, treat liver illnesses, high blood pressure, as an antitussive, relieve stomach pain, treat eye problems, act as an abortifacient, and as an aphrodisiac. Young leaves and blossoms were utilised for headaches. Decoctions of leaves, roots, and fruits were effective cures for arthritis, boils, and coughs. Fruits were used externally to treat sprains, wounds, and sores^[16-20].

Chemical constituents: *Hibiscus rosa-sinensis* is rich in tannins, anthraquinones, quinines, phenols, flavanoides, alkaloids, terpenoids, saponins, cardiac glycosides, protein, free amino acids, carbohydrates, reducing sugars, mucilage, essential oils, and steroids [21-25]. *Hibiscus rosa-sinensis*

(Red) floral extract contains $0.678 \pm 0.14\%$ phenols, $0.51 \pm 0.16\%$ alkaloids, and $7.5 \pm 0.20\%$ tannins. Hibiscus rosa-sinensis (White) flower extract contains $0.680 \pm 0.11\%$ phenols, $0.50 \pm 0.18\%$ alkaloids, and $8.9 \pm 0.21\%$ tannins, whereas Hibiscus rosa-sinensis (Yellow) flower extract has $0.678 \pm 0.16\%$ phenols, $0.48 \pm 0.16\%$ alkaloids, and $8.5 \pm 0.20\%$ tannins.^[26]

- **Physicochemical characteristics of hibiscus sabdariffa :**

Physicochemical characteristics of root extract: Swelling Index: 2.5%; extractive values (chloroform soluble extractive 2.80%, water soluble extractive 5.30%, carbinol soluble extractive 15.60%, ethanol soluble extractive 2.60%, and petroleum ether soluble extractive 1.45%); and ash levels. [27]. With slight changes, the gravimetric approach described in [28] was used to quantify the plant's phytochemical contents. The analysis included alkaloids, flavonoids, phenols, saponins, tannins, and glycosides. This is how the percentage of constituents was calculated:

Pharmacological activities of different extracts of Hibiscus sabdariffa Linn.

Hibiscus Part and extracts used species		Bioactivity	Bioassay methods	Rferance
Hibiscus sabdariffa linn	Ethanol extracted from leaves.	Antioxidant activity.	DPPH activity	Bako al.(2009)
	Ethanol seed extracts.	Antioxidative properties.	Toxicity produced by chronic sodium nitrate therapy in wistar rats.	Anokwuru et al.(2001)
	Calyx extracts in methanol, ethanol, acetone, and water possess antioxidant properties.	Antioxidative properties.	(DPPPH)inhibition and lipids.Inhibiting peroxidation	Fulletron et al.(2012)
	80% aqueous methanol from freeze-dried calyces.	Antibacterial activity of the disc diffusion approach. (Esherichi	—	Edema and Alaga,(2012)
	Mathanoic extract of dried calyces	Antibacterial Agar well diffusion technique and antifungal properties	—	AI-Hashim(2012)
	Dried red calyces and ferricthiocyanate were diffused in an Agar cup with water and ethanolic extract, resulting in reduced antibacterial powder. Chelation of ferrous activity ions	—	—	Yang et al.(2012)

- **Pharmacological Activities Of Hibiscus sabdariffa Linn.**

In traditional medicine, hibiscus sabdariffa Linn. is used to treat fever, liver disease, and hypertension. It is also widely used to make beverages and pickles. The plant has been reported to have hepatoprotective, anti-stress, antispasmodic, antidiuretic, anticancer, antihypertensive, antioxidant, anti-clastrogenic, hypolipidemic, and antidiarrheal effects. [29–31]

- 1. Antihypertensive:** In hypertensive people, Hibiscus sabdariffa extracts have been demonstrated to reduce blood pressure. [32].
- 2. Antioxidant:** Hibiscus sabdariffa contains antioxidants that scavenge free radicals, providing protection against oxidative stress. [33].
- 3. Anti-inflammatory:** The anti-inflammatory properties of hibiscus sabdariffa extracts aid to reduce inflammation in a variety of conditions. [34].
- 4. Antimicrobial:** Hibiscus sabdariffa inhibits fungus, bacteria, and viruses. [35].
- 5. Anticancer:** Hibiscus sabdariffa extracts contain anticancer effects, which impede cancer cell growth and cause apoptosis. [36].
- 6. Hepatoprotective:** Hibiscus sabdariffa extracts protect the liver against toxins and injury. [37].
- 7. Neuroprotective:** Hibiscus sabdariffa extracts have neuroprotective properties, preventing neurodegenerative diseases. [38].
- 8. Diabetes Mellitus:** Diabetes mellitus (DM) is a chronic metabolic disorder marked by high blood glucose levels. Over time, it can cause significant harm to the heart, blood vessels, eyes, kidneys, and nerves [38]. There are various forms of diabetes, but two are dominant: type 1 diabetes (T1DM) and type 2 diabetes (T2DM). [38].

- **Mechanism Of Action Of Hibiscus Sabdariffa:**

- 1. Hibiscus Sabdariffa extracts:** inhibit the angiotensin-converting enzyme (ACE) and reduce blood pressure.
- 2. Antioxidant Activity:** Hibiscus sabdariffa includes antioxidants that scavenge free radicals, therefore protecting against oxidative stress.
- 3. COX Inhibition:** Hibiscus sabdariffa extracts inhibit COX, resulting in reduced inflammation.
- 4. Insulin Sensitisation:** Hibiscus sabdariffa extracts increase insulin sensitivity and reduce blood glucose levels.
- 5. Anti-inflammatory Cytokine Modulation:** Extracts of Hibiscus sabdariffa decrease inflammation by modifying pro-inflammatory cytokines. [39]



❖ **Marketed formulation of hibiscus sabdariffa:**
Tablets/Capsules:

1. Nature's Bounty Hibiscus Tea Capsules
2. Now Foods Hibiscus Extract Tablets

Tea/Infusions:

1. Traditional Medicinals Hibiscus Tea
2. Celestial Seasonings Roselle Tea

Juice/Soft Drinks:

1. Hibiscus Direct Hibiscus Juice
2. R.W. Knudsen Family Roselle Juice^[40]

❖ **Plant profile:Cactacea:**

Cactaceae, an Americas-derived family, are well-known as decorative plants throughout the world's temperate zones. Many species exhibit traits of practical significance. For thousands of years, they have been used in a variety of ways, notably by the people who live in the places they serve. ^[41]

Opuntia dillenii (Cactus) is a popular name for prickly pear that belongs to the Cactaceae family. Chapathi balli is the popular name for a plant found in Tamil Nadu. Cactaceae is said to include over 130 genera and almost 1500 species that were originally endemic to the New World. Cacti have a specific carbon dioxide fixation system known as Crassulacean acid metabolism (CAM) and are particularly suited to water-scarce arid areas of the world as an additional source of food and fodder. ^[42-46]



• **Traditional Uses:**

The fruit is said to be a refrigerant and can help with gonorrhoea. In the Deccan, cooked fruit is used to treat whooping cough. Giving a teaspoonful of the fruit syrup three or four times a day will boost bile secretion and alleviate spasmodic coughs and expectorations. In Dacca, the milky juice is used as a purgative in quantities of ten drops combined with a little sugar. The leaves, mashed up and placed as a poultice, are supposed to relieve heat and inflammation. The heated leaf used to boils accelerates suppuration, while the leaf prepared into a pulp is administered to the eyes in cases of ophthalmia. ^[47]

- **Poisonous parts :**

The toxicity is concentrated in the sap and is mostly due to the chemical component 'diterpene'. When cutting the spurges, vapours can cause irritation to mucosal membranes even from metres away, and the fumes are known to be very poisonous. [48].

- **Phytochemistry of opuntia dillenni:**

Sciuto, S., *et al.* [49] Betanin (5-O- β -D-glucoside of betanidin) from the fruit of *Opuntia dillenii* was found to contain ¹⁴C-labelled betanidin. This study indicates that glucosylation happens late in the pigment's production, probably as the last step. Srivastava, B K., and Pande, C S. [50] isolated Chemical and spectral research discovered six substances in the stems of *Opuntia dillenii* (Ker-Gawl.): 3-O-methyl quercetin, kaempferol, kaempferide, quercetin, isorhamnetin, and β -sitosterol. For the first time, *Opuntia dillenii* produced kaempferol, kaempferide, and 3-O-methyl quercetin. [51]

- **Side effects :**

Some species are more toxic than others, and as a result, even little quantities of latex can cause significant harm to the skin. The major adverse effect of *Euphorbia cactus* is local skin irritation, which includes dermatitis and caustic burn. [52,53]

- **Pharmacological activity:**

Marina Perfumi and Rosalia Tacconi (1996) investigated if there is a scientific basis for this common use. The effects of the fruit's red appetising juice on blood glucose levels were measured in normoglycemic and alloxan-induced diabetic rabbits. These findings show that *O. dillenii* causes hypoglycemia primarily via limiting intestinal glucose absorption, although additional modes of action cannot be ruled out, such as the existence of an orally active insulin-like molecule. During the oral toxicity testing of the crude medication, rats given dosages of up to 50 ml/kg showed no signs of harm. [54,55,56].

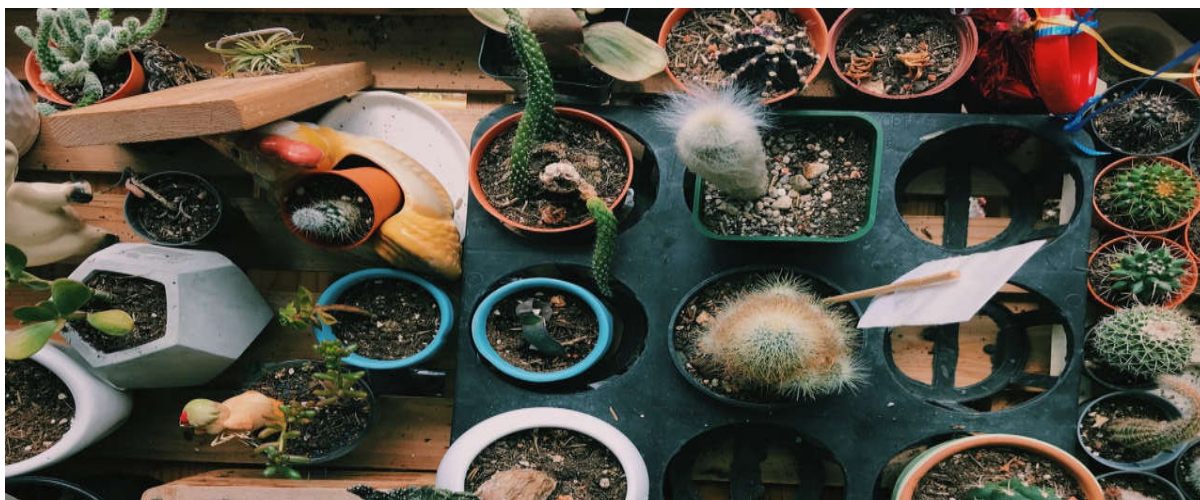
1. Anti diabetic activity: The study used *Opuntia dillenii* to conduct a four-week clinical observation on thirty type 2 diabetes mellitus (DM) patients, and it found that this drug might enhance the glycometabolism of DM patients and prevent the early deterioration of renal function caused by diabetic neuropathy. Abdallah, Inas, and Z A. [57] Chronic hyperglycemia during diabetes induces lasting tissue damage, but not to the retinas, kidneys, or nerve endings [58]. antiviral, anti-inflammatory, antidiabetic, antioxidant, and antiulcerogenic properties [59].

2. Antioxidant: Cactus antioxidants scavenge free radicals to protect against oxidative stress.

3. Anti-inflammatory: Cactus chemicals decrease inflammation, which relieves pain and irritation.

4. Cardiovascular Protection: Cactus extracts have antihypertensive, antiatherosclerotic, and anti-thrombotic properties.

5. Neuroprotective: Cactus chemicals exhibit neuroprotective properties, possibly treating neurodegenerative illnesses. [60]



❖ **Marketed formulation of cactus:**

• **Dietary Supplements:**

1. Opuntia Ficus-Indica Extract Capsules (Now Foods)
2. Cactus Fruit Extract Tablets (Nature's Bounty)
3. Prickly Pear Cactus Powder (BulkSupplements)

• **Teas and Infusions:**

1. Prickly Pear Cactus Tea (Traditional Medicines)
2. Cactus Flower Tea (Celestial Seasonings)
3. Opuntia Ficus-Indica Tea (Yoga Tea)

• **Topical Preparations:**

1. Cactus Extract Cream (Jason Natural)
2. Prickly Pear Cactus Oil (Desert Essence)
3. Cactus Flower Face Mask (The Body Shop)

• **Food Products:**

1. Prickly Pear Cactus Jelly (from Arizona Cactus Ranch)
2. Cactus Fruit Jam (Mitla Products)

3. Opuntia Ficus-Indica Juice (Hibiscus Direct)^[61]

- **Herbal Tablet: Evaluation And Method Of Preparation Of Hibiscus &Cactacea**

Formulation:

- Cactus extract (Opuntia ficus-indica): 200mg
- Hibiscus extract (Hibiscus sabdariffa): 150mg
- Excipients (Microcrystalline cellulose, Magnesium stearate, Silicon dioxide): q.s.

- **Method of Preparation:**

Step 1: Extraction

1. Cactus extraction: Soak 500g of dried Opuntia ficus-indica cladodes in 2L of 50 percent ethanol for 7 days. Filter and evaporate to get a dry extract.
2. Hibiscus extraction: Soak 300g of dried Hibiscus sabdariffa flowers in 1.5L of 50 percent ethanol for 7 days. Filter and evaporate to get a dry extract.

Step 2: Standardisation

1. Standardise the cactus extract to contain 20% flavonoids and 10% polysaccharides.
2. Standardise the Hibiscus extract to include 30% anthocyanins and 15% flavonoids.

Step 3: Mixing and Granulation.

1. Combine the standardised Cactus and Hibiscus extracts 4:3.
2. Blend in the excipients (microcrystalline cellulose, magnesium stearate, and silicon dioxide).
3. Using a granulator or mixer, finely grind the mixture.

Step 4: Tablet Compression.

1. Press the grains into tablets with a tablet press machine.
2. Use an appropriate die and punch to create tablets of the specified shape and size.

Step 5: Coating (optional).

1. Add a coating to the tablets to improve their look, stability, and bioavailability.

Quality Control:

1. Test pills for identity and purity.
 - Assay (Cactus and Hibiscus Extract Content)
 - Heavy metals.
 - Microbial contamination.
 - Dissolution

- **Packaging and Storage:**

1. Package the tablets in HDPE containers or blister packs.
2. Store in a cool, dry place, protected from light.

- **Labeling:**

1. Label the product with
 - Product name and description
 - Ingredients and composition
 - Dosage instructions

- Warnings and precautions
- Manufacturer's information^[62,63]

❖ **Conclusion:**

The review of hibiscus (*Hibiscus sabdariffa*) and cactus (*Opuntia* species) found that both plants contain a high concentration of bioactive components such as flavonoids, phenolics, and other antioxidants, which contribute to their significant pharmacological properties. Several research have shown that these plants have antioxidant, anti-inflammatory, antibacterial, anti-diabetic, cardioprotective, and anti-obesity characteristics. Hibiscus promotes tropical biodiversity and provides several health advantages, whereas cactus are critical to arid ecosystems and human survival in dry climes. Both plants demonstrate nature's diversity and flexibility, making them valuable in horticulture, ecology, and human use.

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