American Journal of Psychiatric Rehabilitation Expert Opinion Article

Screening of Bioactive Molecules and Phytopharmacological Potential Of *Ipomoea Cairica*: A Comprehensive Review

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ABSTRACT
Ipomoea cairica (L.), commonly known as Morning Glory, is an ornamental plant widely recognized in folk medicine for its therapeutic properties. It has been traditionally used to treat a variety of ailments, including diabetes, hypertension, liver diseases, cancer, and heart disease. The seeds of *I. cairica* possess numerous bioactive qualities such as anthelmintic, anticholinergic, antifungal, antispasmodic, antitumor, diuretic, and laxative effects. Additionally, they are used to alleviate conditions such as oedema, oliguria, ascariasis, and constipation. Interestingly, the seeds contain trace amounts of ergoline alkaloids, including the hallucinogens LSD, ergonovine, and ergine, which contribute to their psychotropic effects. The plant is also employed in the treatment of various mental disorders, underscoring its multifaceted medicinal value. Phytochemically, *I. cairica* is rich in phenolic compounds, flavonoids, tannins, anthocyanins, and carotenoids, which are known for their antioxidant and therapeutic properties. These compounds have drawn increasing attention from researchers exploring folk medicine, with the aim of discovering novel bioactive molecules for drug development. The ongoing investigation into the plant's pharmacological potentials holds promise for advancing the development of new, more effective treatments for a wide range of diseases, particularly those that are currently challenging to treat.

Keywords: Hypertension, anticholinergic, antitumor, psychotropic effects and ergonovine etc.

1. INTRODUCTION

1. 1. Overview

There are over 53 million tribal people in India belonging to 550 communities of 227 ethnic groups (Maikhuri and Gangwar 1993) [1]. These tribal communities draw their sustenance largely from forest for food, medicine and other requirements (Nautiyal et al. 2000) [2]. There are many plant species are been used as medicine from ancient time. The genus Ipomoea L. at the time of immemorial use as, nutritional, medicinal, fodder, as ethno-medical, ritual and agricultural evaluated by chemical studies. There are thirteen species used in the Ayurvedic preparations. Flowers, leaves and pedicels are eaten as a vegetable in Chinese and Malaysian vegetable soup.

The family Convolvulaceae includes about 57 genera and 1625 species (Stevens, 2012) [3]. *Ipomoea* is one of the dominant genera within this family with approximately 650 species mainly distributed in tropical and warm temperate regions of the world and known as "morning glories" (Miller et al., 1999) [4]. Most of the species within this genus are twining climbing plants and include annual and perennial herbs, lianas, shrubs and small trees (Miller et al., 1999) [4]. The genus name *Ipomoea* comes from the Greek words *"ips"* which means "worm", and the word *"homois"* which means "similar to" referring to the genus wormlike twining habit.

Ipomoea cairica is a fast-growing, herbaceous climbing vine in the family **Convolvulaceae**. Commonly known as the **mile-a-minute vine**, **coast morning glory**, or **railway creeper**, it is native to tropical and subtropical regions but has become widespread as an ornamental plant and an invasive species in many parts of the world [5]. *Ipomoea* is one of the dominant genera within this family with approximately 650 species mainly distributed in tropical and warm temperate regions of the world and known as "morning glories" [6]. Most of the species within this genus are twining climbing plants and include annual and perennial herbs, lianas, shrubs and small trees [6].

1. 2. Taxonomy

The taxonomy of *Ipomoea cairica* is as follows:

Kingdom	Plantae
Division	Tracheophyta
Class	Dicotyledonae
Order	Solanales
Family	Convolvulaceae
Genus	Ipomoea
Species	cairica
Scientific name	*Ipomoea cairica* L.

Genus: The genus Ipomoea is a large genus in the family Convolvulaceae, which consists of over 650 species, many of which are important food storage. It includes species commonly known as morning glory, such as Ipomoea purga, Ipomoea violacea, and Ipomoea batatas.

Species: Ipomoea cairica is commonly referred to as the five fingered morning glory. Most of the species within this genus are twining climbing plants and include annual and perennial herbs, lianas, shrubs and small trees [6].

1.3. Botany and Morphology

Growth Form	Vine with a climbing or creeping growth habit, it can grow up to 5m height with support.
Roots	Roots occur along the stem at the leaf nodes.
Foliage	Dark green, hairless leaves are deeply divided into 5 lance- shaped segments. The lobes are entire or minutely undulate. The basal pair of lobes is parted while the middle lobe is larger and ovate to ovate-elliptic or lanceolate in shape.
Flowers	Large, funnel-shaped flowers are dark pink to light purple (3.5 - 6 cm long, 6 - 8 cm wide).
Fruit	The fruit is a globose capsule which splits apart to reveal black, tomentose seeds.

Fig-1: Flowering plant

1. 4. Cultivation and Harvesting

Ipomoea cairica prefers a warm climate with little frost and moderate to high rainfall. Prefers a rich but well drained soil with some to much water and some sun. It is easily cultivated from seeds and cuttings. When sowing seed, chip the seed and soak it in water overnight. Transfer seeds to potting pots and germination will take place in 1 to 3 weeks after sowing. When seedlings have emerged, thin them and replant at least 45 cm apart, so it can start climbing on the trellis, frequently training it while young to climb evenly on your trellis. Ipomoea

cairica is easily rooted from tip cuttings and stem cuttings, and trailing stems that have rooted can be transplanted.

1. 5. Medicinal Benefits
Wound Healing: Applied as poultices for cuts and injuries. Respiratory Disorders: Decoctions used to treat asthma and bronchitis. Laxative Properties: Due to its potential purgative effects. Antimicrobial Usage: Leaves and roots are utilized to treat infections and skin diseases.

1. 6. Habitat and Distribution
Native to tropical and subtropical regions of Asia, especially in India, Sri Lanka, and Southeast Asia. It has been introduced to other parts of the world, including Africa, Australia, and the Pacific Islands, and is now considered an invasive species in some areas. Often found in coastal environments, roadways, disturbed areas, and gardens.

2. PHYTOCONSTITUENTS ISOLATED FROM *IPOMOEA CARICA*

Ipomoea carica, a member of the Convolvulaceae family, is known for its diverse range of bioactive compounds. Several key phytoconstituents have been isolated from this plant, contributing to its medicinal properties.

2. 1. Alkaloids: Ipomoeamine is a notable alkaloid found in Ipomoea carica with antimicrobial activity (Jothi et al., 2010) [7].

2. 2. Flavonoids: Quercetin and Kaempferol are major flavonoids that possess antioxidant and anti-inflammatory properties (Bello et al., 2017; Raut et al., 2015) [8].

2. 3. Triterpenoids: Betulinic acid, a bioactive triterpenoid, is isolated from this plant, contributing to its anticancer and anti-inflammatory effects (Sangwan et al., 2013) [9].

2. 4. Phenolic Compounds: Chlorogenic acid, an antioxidant, is another significant compound found in Ipomoea carica (Sankaranarayanan et al., 2014) [10].

2. 5. Steroids: β-Sitosterol is a sterol with potential anti-inflammatory and cholesterol-lowering properties (Saxena et al., 2017) [11].

2. 6. Anthocyanins: Cyanidin-3-glucoside, an anthocyanin, is present and contributes to the plant's antioxidant activity (Liu et al., 2008) [12].

2. 7. Glycosides: Ipomoea glycoside A is another bioactive compound, with notable biological activity (Zhao et al., 2014) [13].

2. 8. Saponins: Caricagenin, a saponin, is known for its biological activities (Zhou et al., 2011) [14].
2 .9. Essential Oils: β-Caryophyllene, a major compound in essential oils, exhibits antimicrobial properties (Santos et al., 2012) [15].

2. 10. Fatty Acids: Linoleic acid, a polyunsaturated fatty acid, is found in the seeds and has health benefits (Ali et al., 2015) [16].

3. PHYTO-PHARMACOLOGY OF *IPOMOEA CAIRICA*

Ipomoea cairica commonly known as morning glory is a widely consumed tuber crop in tropical and subtropical regions and has been recognized for its nutritional and medicinal value. Beyond its role as a food source, Ipomoea cairica contains numerous bioactive compounds that have attracted significant attention for their potential pharmacological properties. This review explores the literature on the isolation of bioactive compounds from Ipomoea cairica and evaluates their pharmacological activities. The pharmacological activities of Ipomoea cairica have been extensively studied, with several compounds showing promising therapeutic potential

3. 1. Antioxidant Activities
The in-vitro antioxidant activities of the methanolic extracts of leaves and flowers of Ipomoea cairica were determined by spectrophotometric method. Antioxidant activities of extract were expressed as percentage of DPPH radicals inhibition. The methanolic extract of Ipomoea cairica leaves showed maximum antioxidant activity of 83.52% and methanolic extract of Ipomoea cairica flowers showed maximum antioxidant activity 81.85 % at 500 µg/ml concentrations. This study reveals that leaves and flowers of I. cairica can be used as natural sources of antioxidants [17].

3. 2. Anti-Candidal Activity
The present work aims to investigate the anti-candidal herbal cream of aqueous and ethanolic extract of Ipomea cairica Linn. (Roots) ICR. The extracts were used to formulate herbal cream and both were compared with standard anti-fungal drug. Results indicate that prepared herbal cream showed optimum and significant anti-candidal activity. Further studies need to be establish to deepen knowledge on this area, namely, focused on clinical trials to provide safer and more effective anti-fungal than the current ones extensively used for the treatment of vaginal candidiasis [18].

3. 3. Pharmacognostic evaluation and in-vitro antioxidant activity
In ayurveda Ipomoea cairica has its own importance to treat various health problems. It is tropical plant and a wild relative of sweet potato (Ipomoea

batatas), which is considered as one of China's most invasive alien species. Ipomoea cairica is a climber plant in the Convolvulaceae family that is frequently used as a medicinal herb in India and Western Asia. In this study two different solvents like water and ethanol were used for the extraction of Ipomoea cairica. The highest extraction yield was obtained by using Ethanol. The antioxidant activity, total phenolic content, and total flavonoid content of aqueous and Ethanolic extracts were investigated using various in vitro assays. Study revealed that Ethanolic extract showed the highest antioxidant potential activity by DPPH (2, 2- diphenyl- 1-picrylhydrazyl) radical scavenging activity. The same extract also exhibited the highest phenolic content and the highest flavonoid. These results indicate that ethanolic extract of Ipomoea cairica can be used to reduce oxidative stress [19].

3. 4. Neuroprotective activity

Exposure to cadmium is implicated in the etiology of some neurodegenerative diseases. Compounds isolated from Ipomoea cairica extract are neuroprotective. However, there is no reported neuroprotective activity of the crude extract of I. cairica (ICE). They investigated the neuroprotective activity of I. cairica extract against cadmium-induced biochemical changes in the brain of male Wistar rats [20].

3. 5. Phytochemical and Proximate Analysis

The analyses for nutrients of Ipomoea cairica tuber were carried out and the phytochemical and proximate parameters were determined. The phytochemical analyses looked into the alkaloid, flavonoid, cyanogenic glycoside, tannin, phytate and saponin contents of Ipomoea cairica tuber while the proximate composition determination was aimed at the protein, carbohydrate, moisture, lipid, ash and fibre contents. The methods applied for these analytical determinations were mainly those of the Association of Official Analytical Chemist (AOAC, 2005). Each type of analysis was carried out in triplicate and the mean values determined. The phytochemical analyses showed that Ipomoea cairica tuber had; flavonoid, Alkaloid, Tannin, Saponin, Cyanogenic glycoside and phytate. The proximate analysis showed that Ipomoea cairica tuber had; Carbohydrate, protein, ash, lipid, moisture, and fibre. These results show that Ipomoea cairica tuber can be used as a substitute for other mostly consumed carbohydrate foods like yam and cocoyam [21].

3. 6. Antioxidant and antiproliferative activities

Extracts of Ipomoea cairica possess alkaloids, saponins, phenols, flavonoids, phytosterols, tannins, triterpenoids, and anthraquinones. The results from the DPPH and ABTS assays revealed that the methanol and ethyl acetate fractions had significantly the highest antioxidant potentials while the methanol stem extract exhibited the most significant antioxidant activity in the FRAP assay. The DCM stem extract showed the highest antiproliferative activity against a wide array of breast cancer types including the most challenging triple-negative breast cancer. The plant would make for a strong herbal candidate for adjuvant therapy with breast cancer medication [22].

3. 7. Antidiabetic activity

Antidiabetic activity of methanolic extract, petroleum ether, ethyl acetate and n-butanol fractions of Ipomoea cairica (L.) Sweet leaves was performed in-vitro using α-glucosidase and α-amylase inhibition methods. Phytochemical study of the ethyl acetate fraction which possessed the highest antidiabetic activity led to isolation of five flavonoids for the first time from this plant, including two rare flavonoid sulphates, ombuin-3-sulphate and rhamnetin-3- sulphate and three flavonoid glycosides, kaempferol 7-O-α-L-rhamnopyranoside kaempferol 3,7-di-O-α-L-rhamnopyranoside and quercetin 3-O-α-L-arabinopyranoside . The 1H and 13C NMR of 1 and 13C NMR of 2, were reported here for the first time. Compounds showed a concentration-dependent in-vitro inhibitory activity against α-glucosidase and α-amylase. Furthermore, in-silico study predicted that compounds showed good interactions with α- glucosidase, α-amylase, and protein tyrosine phosphatase 1b [23].

3. 8. Hepatoprotective Effect

Increased exposure to cadmium is becoming a major concern in Nigeria and the world in general. Exposure can be through ingestion of contaminated food and water. This observation as led to a continuous search for drugs and compounds that can prevent the toxic effect of cadmium. This study investigated the hepatoprotective effect of Ipomoea cairica against cadmium induced liver injury [24].

4. CONCLUSIONS

Ipomoea carica, a plant belonging to the Convolvulaceae family, has demonstrated significant bioactive potential in various pharmacological studies. Its bioactive compounds, including alkaloids, flavonoids, terpenoids, and phenolic acids, exhibit a wide range of medicinal properties such as antioxidant, anti-inflammatory, antimicrobial, and anticancer effects. These properties suggest that I. carica could be a valuable natural resource for developing therapeutic agents against various diseases. The plant's compounds have shown promising results in preclinical models, offering hope for new treatments for conditions such as diabetes, cardiovascular diseases, and cancer.

5. FUTURE ADVANCEMENTS

Future research should focus on identifying and isolating the specific bioactive compounds responsible for these pharmacological effects through advanced analytical techniques like chromatography and mass spectrometry. Additionally, more in-depth clinical studies are needed to validate the safety and efficacy of I. carica's compounds in humans. The plant's potential as a source of novel drugs for chronic diseases like cancer and diabetes warrants further exploration. Moreover, the development of sustainable cultivation and harvesting techniques is essential for ensuring a steady supply of high-quality I. carica material for pharmaceutical use. With continued research, I. carica could contribute significantly to the future of natural medicine and drug discovery.

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