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Full Length Review Paper

Ipomoea cairica: a medicinal weed with promising health benefits

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Abstract

Ipomoea cairica (Convolvulaceae) is a weed of waste areas, disturbed sites, rainforest margins, open woodlands, bush-land, gardens, fences, coastal sand dunes and vegetation growing near waterways (i.e. riparian areas). It inhabits tropical, sub-tropical and warmer temperate environments (especially near the coast).It may be used as carminative agent and lessens inflammation, and is useful in fever, jaundice, biliousness, bronchitis, liver complaints, etc Recent reports supports that it can also be used for treatment of Japanese encephalitis because of its antioxidant and anti-inflammatory properties. The objective of this review is to highlight the morphological, phytochemical, and pharmacological information of this plant

Keywords: Jaundice, Biliousness, Bronchitis, Liver Complaints, Phytochemical.

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INTRODUCTION

Knowledge of herbs has been handed down from generation to generation for thousands of years. The revival of interest in natural drugs started in last decade mainly because of the wide spread belief that green medicine is healthier than synthetic products. In the recent past, there has been a tremendous increase in the use of plant-based health products in developing as well as developed countries resulting in an exponential growth of herbal products globally. According to the WHO, about 80% of the population in the world relay on the traditional medicine for the treatment of various diseases (Padmaa, *et al.,* 2010). However, due to over population, urbanization, and continuous exploitation of these herbal reserves, the natural resources along with their related traditional knowledge are depleting day by day (Pande *et al.,* 2007). In the present era of drug development and discovery of newer drug molecules, many plant products are evaluated on the basis of their traditional uses. In this regard, one of the many plants which are being evaluated for their therapeutic efficacies is *Ipomoea cairica* (Convolvulaceae) which is a perennial herb of unknown origin, possibly tropical Africa and Asia (Austin and Huaman, 1996); widely cultivated, now distributed nearly pantropically. Grows in disturbed sites, such as roadsides and waste-ground in urban areas, and is invasive of natural habitats, especially along river banks and coastal dunes. It Flowers throughout the year aqueous extract from *I. cairica* showed anti-RSV (respiratory syncytial virus) activity *in vitro* (Ma *et al.,* 2002). The ethanolic extract of this plant presents an antinociceptive effect (Ferreira *et al.,* 2006). Arctigenin was the most cytotoxic and presents also antioxidant and anti-inflammatory activities (Cho *et al.,* 2004), as well as, inhibited the replication of human immunodeficiency virus (Eich *et al*., 1996). The essential oil of *I. cairica* possesses remarkable larvicidal properties. It could induce 100% mortality in the larvae of *Culex tritaeniorhynchus* (100 ppm), *Aedes aegypti* (120 ppm), *Anopheles stephensi* (120 ppm) and *Culex quinquefasciatus* (170ppm) (Thomas *et al.,* 2004; Lallianrawna *et al.,* 2014). In Brazilian system of medicine, *Ipomoea cairica* has been used for treatment of inflammation and rheumatism (Saied *et al.,* 2011). The aim of this review is to highlight the Morphological, phytochemical, and pharmacological investigation carried out on the plant so that more pharmacological studies could be conducted to investigate the unexploited potential.

Scientific Name

Ipomoea cairica (L.) Sweet

Synonyms

Convolvulus cairicus L.
Convolvulus pendulus (R. Br.) Spreng.
Ipomoea palmata Forssk.
Ipomoea pendula R. Br.
Ipomoea tuberculata (Desr.) Roem. andSchult.

Common Names

Cairo morning glory, coast morning glory, coastal morning glory, five-fingered morning glory, five-leaf morning glory, ivy-leaved morning glory, Messina creeper, mile a minute, mile a minute vine, mile-a-minute vine, morning glory, railroad creeper

Family

Convolvulaceae

Origin

The exact native range of this species is obscure, but it is thought to have originated in tropical Africa and Asia (Austin and Huaman, 1996). It is now found throughout the tropical regions of the world (i.e. it is pan-tropical).

Naturalised Distribution

Widely naturalised in the warmer coastal regions of eastern Australia occasionally naturalised in the coastal districts of south-western Western Australia and southern South Australia, and on Lord Howe Island, Norfolk Island and Christmas Island. Also regarded as being naturalised in New Zealand, southern USA, Central America, South America and on numerous Pacific islands (e.g. Fiji, New Caledonia, Niue, the Solomon Islands, Tonga and Hawaii) (Wagner *et al.,* 1999).

Habitat

A weed of waste areas, disturbed sites, rainforest margins, open woodlands, bushland, gardens, fences, coastal sand dunes and vegetation growing near waterways (i.e. riparian areas). It inhabits tropical, sub-tropical and warmer temperate environments (especially near the coast) (Weber, 2003; Sykes, 1970).

Distinguishing Features

- A rampant climber or creeper with hairless slender stems.
- It's very distinctive leaves have 5-7 finger-like lobes.
- Its large purple, purplish-pink or whitish tubular flowers (4-6 cm long and 5-8 cm across) have a darker centre.
- Its small capsules (10-12 mm across) turn brown as they mature and contain four seeds.
- These seed are partly covered in long silky hairs.

Habit

A rampant long-lived (i.e. perennial) climber reaching up to 5 m or more in height, or creeping along the ground Figure 1.

Stems and Leaves

The slender stems are hairless (i.e. glabrous), grow in a twining habit, and sometimes produce roots at the joints (i.e. nodes). The alternately arranged leaves (3-10 cm long and 3-10 cm wide) are divided into five or seven narrow lobes, like the fingers of a hand (i.e. they are palmately lobed) Figure 2. These leaves are hairless (i.e. glabrous) and borne on stalks (i.e. petioles) 2-6 cm long.

Figure 1. Ipomoea cairica in its natural habitat

Figure 2. Palmately Compound leaves of *Ipomoea cairica*

Flowers and Fruit

The funnel-shaped (i.e. tubular) flowers are purple to pinkish-purple (occasionally white) with a darker purple centre Figure 3. They are borne singly or in small clusters on short stalks originating in the leaf forks (i.e. axils). These flowers (4-6 cm long and 5-8 cm across) have five petals that are fused into a tube (i.e. corolla tube) and five small sepals (4-7 mm long).

Figure 3. Flowers of *Ipomoea Cairica*

Flowering occurs throughout most of the year (Wagner *et al.,* 1999). The fruit capsules are more or less globular (i.e. sub-globose) in shape and turn from green to brown in colour as they mature Figure4. These capsules (10-12 mm across) contain four large brown seeds (about 6 mm across) that are slightly three-angled in shape Figure 5. The seeds have smooth surfaces interspersed with dense tufts of long silky hairs (Sykes, 1970).

Figure 4. Fruits of *Ipomoea cairica*

Figure 5. Seeds of *Ipomoea cairica*

Reproduction and Dispersal

This plant reproduces vegetatively by rooting along its stems and also produces seeds. Stem fragments and seeds are often dispersed in dumped garden waste and can also be spread by water (Weber, 2003).

Impacts

Coastal morning glory (*Ipomoea cairica*) is a significant environmental weed in Queensland, New South Wales and on Norfolk Island (Sykes, 1970; Whistler, 1988 and Starr *et al.,* 2006). It is also an environmental weed of some importance in Western Australia and on Lord Howe Island, and regarded as a potential environmental weed in Victoria (Whistler, 1988).This species is capable of very rapid growth and can completely smother trees and under-storey plants, but it will creep along the ground in the absence of supporting vegetation. Significant infestations may lead to a reduction in biodiversity through the replacement of native vegetation and the displacement of certain native animals.

It is particularly common in the coastal districts of eastern Australia (Swarbrick, 1997, Swarbrick andJohn, 1997), where it often invades river banks and riparian vegetation. It also commonly invades rainforest margins, where it grows over larger trees and smothers tree saplings and under-storey shrubs, and is a major problem in littoral rainforest remnants. However, it is also a weed of sandy beachfronts and other coastal environments, drier forests, wetlands, and limestone cliffs. Coastal morning glory (*Ipomoea cairica*) is ranked among the top 30 environmental weeds in south-eastern Queensland (Sykes, 1977; Bostock andHolland, 2007), and among the 10 worst weeds in Gold Coast City (Holm *et al.,* 1979; Josekutty *et al.,* 2002).

Similar Species

Coastal morning glory (*Ipomoea cairica*) is very similar to common morning glory (*Ipomoea purpurea*), blue morning glory (*Ipomoea indica*), ivy-leaved morning glory (*Ipomoea hederacea*) and white convolvulus creeper (*Merremia dissecta*). These species can be distinguished by the following differences:

- coastal morning glory (*Ipomoea cairica*) has hairless (i.e. glabrous) stems and five to seven lobed leaves that resemble the fingers of a hand (i.e. they are palmately lobed). Its flowers are relatively large (5-8 cm across), its sepals are relatively short (4-7 mm long), and it often produces capsules containing four hairy seeds.
- blue morning glory (*Ipomoea indica*) has hairy (i.e. pubescent) younger stems and heart-shaped (i.e. cordate) or three-lobed leaves. Its flowers are relatively large (7-10 cm across), its sepals are long and thin (14-22 mm long), and it does not produce viable seeds (capsules are generally not seen).
- common morning glory (*Ipomoea purpurea*) has hairy (i.e. pubescent) younger stems and heart-shaped (i.e. cordate) or three-lobed leaves. Its flowers are relatively large (3-7 cm across), its sepals are moderately long (10-15 mm long), and it often produces capsules containing six hairless seeds.
- ivy-leaved morning glory (*Ipomoea hederacea*) has hairy (i.e. pubescent) younger stems and heart-shaped (i.e. cordate) or three-lobed leaves. Its flowers are relatively small (3-5 cm across), its strongly curved sepals are long and thin (about 20 mm long), and it often produces capsules containing four to six hairless seeds.
- white convolvulus creeper (*Merremia dissecta*) has sparsely hairy (i.e. puberulent) stems and five to seven lobed leaves, but each segment is also further lobed or divided. Its flowers are relatively large (4-6 cm across), its large sepals are relatively long (20-25 mm long), and it often produces capsules containing four hairless seeds.

Chemical constituents

The literature survey reveals that the plant possesses various bioactive compounds Table 1. The major constituents of the extract were the coumarins, scopoletin and umbelliferone and the lignans, arctigenin, matairesinol and trachelogenin (Olga *et al.,* 1997; Sharda and Kokate, 1979). Indole alkaloids were isolated from the leaves of this species (Mohamed and Karawya, 2010).

Table 1. Chemical constituents of *Ipomoea cairica*

Sl. No	Plant Constituents	Test/ Reagent	*Ipomoea cairica* leaves			*Ipomoea cairica* flower		
			Pet ether	$CHCl_3$	CH_3OH	Pet ether	$CHCl_3$	CH_3OH
1	Alkaloids	Mayer Dragendorff Wagner Hager	-	-	+	-	-	-
			-	-	+	-	-	-
			-	-	+	-	-	-
			-	-	+	+	-	-
2.	Sterols	Liebermann- Burchard H2SO4	+	-	+	+	+	+
			+	-	+	+	+	+
3.	Flavonoids	Shinoda H2SO4 NaOH	+	+	+	-	-	+
			-	-	+	-	-	+
			-	-	+	-	-	+
4.	Gums	Molisch	-	-	-	-	-	-
5.	Reducing sugars	Fehling Benedict	-	+	-	-	+	+
			-	+	-	-	+	+
6.	Tannins	Pot. Dichromate Leadacetate FeCl3						
			-	-	+	-	-	+
			-	-	+	-	-	+
			-	-	+	-	-	+
7.	Saponins	Foam	-	-	+	-	-	+
8.	Terpenoids	CHCl3 Liebermann- Burchard	+	+	-	+	+	-
			+	+	-	+	+	-
9.	Anthraquin- ones	Borntrager Upper layer CHCl3 layer						
			-	+	+	-	-	-
			-	+	+	-	-	-
10	Glycosides	Legal Borntrager	+	+	-	+	+	-
			+	+	-	+	+	-
11	Phenols	FeCl3 Liebermann	-	-	+	-	-	+
			-	-	+	-	-	+
12.	Amino-acids	Ninhydrin	-	-	-	-	-	-

From the aerial parts of *Ipomoea cairica* the coumarins umbelliferone and scopoletin, and the dibenzyl-g-butyrolactone lignans arctigenin, matairesinol and trachelogenin, were isolated along with b-sitoterol and fatty acids (Singh *et al.,* 2013). (+)-(8*R*,8′*S*)-thujaplicatin methyl ether, arctigenin, matairesinol, *trans*-2,3-dibenzylbutyrolactone, vanillic acid, *p*-hydroxybenzoic acid, methoxybenzoic acid, methylparaben, stearic acid, palmitic acid, olenic acid, friedelinol and a mixture of β-sitosterol and stigmasterol were obtained from the methanolic extract of the *Ipomoea cairica* (Ralte, 2014) Figure 6-a, b, c, d, e, f, g.

Pharmacological Profile

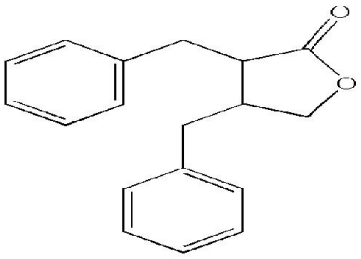
Antioxidant activity: Methonal extract of leaves of *Ipomoea cairica* possesses good antioxidant potential presumably because of its phytochemical constituents. The DPPH scavenging activities of *Ipomoea cairica* leaves extract showed a good correlation with its reductive potentials. The methanol extract of (MEIP) flowering tops showed antioxidant activity by inhibiting DPPH and hydroxyl radical, nitric oxide and super oxide anion scavenging, hydrogen peroxide scavenging, and reducing power activities. (Dudharejia and Shah, 2009; Ralte and Lallianrawna, 2014; Arora *et al.,* 2013).

Antibacterial Activity: Antibacterial studies of methanol extract of leaves of *Ipomoea cairica* showed inhibition zone against bacterial strains *i.e., Escherichia coli* (22 mm), *Klebsiella pneumonaie* (11 mm), *Bacillus subtilus* (10 mm), *Salmonella typhi* (13 mm), *Sacchromyces cerevisiae* (08 mm) in comparison with standard drug Chloramphenicol which showed inhibition zone against *Escherichia coli* (25 mm), *Klebsiella pneumonaie* (16 mm), *Bacillus subtilus* (26 mm), *Salmonella typhi* (25 mm)*, Staphylococcus aureus* (34 mm) (Arora *et al.,* 2013)

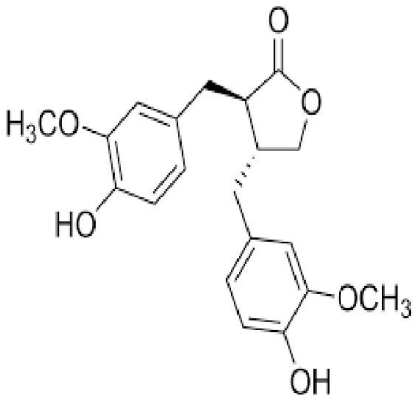
Antifungal Activity: Antifungal studies of methanol extract of leaves of *Ipomoea cairica* showed inhibition zone against fungus strains i.e., *Aspergilus nigar* (16 mm), *Candida albicans* (24 mm), *Sacchromyces cerevesie* (25mm), *Penicillium chrysogenum* (20 mm) in comparison with standard drug Ketoconazole which showed inhibition zone against fungus strains i.e., *Aspergilus nigar* (19 mm), *Candida albicans* (12 mm), *Sacchromyces cerevisiae* (30 mm), *Penicillium chrysogenum* (21mm) (Arora *et al.,* 2013)

Anti-Inflammatory Activity: *Ipomoea cairica* ethanolic extract (100, 300, 1000 and 3000 mg/kg; per os) induced dose-dependent reduction of response in the formalin test inflammatory phase in mice (Ferreira *et al.,* 2006). Aqueous methanol extract of *Ipomoea cairica* leaves posses a strong anti-inflammatory activity (Mohamed andKarawya, 2010).

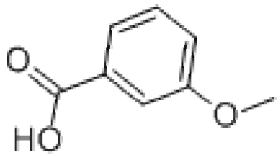
Mosquitos' Larvicidal activity: The essential oil of *I. cairica* possesses remarkable larvicidal properties.



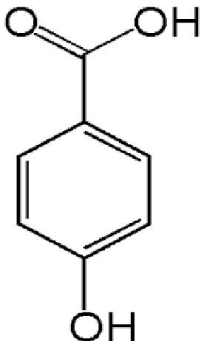
(a) 2, 3. dibenzylbutyrolacetone



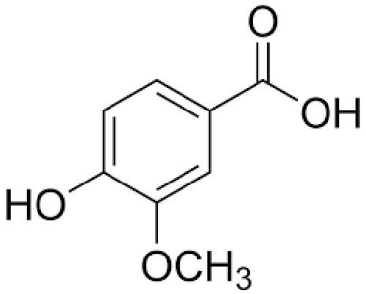
(b) Matairesinol



(c) Methoxybenzoic acid

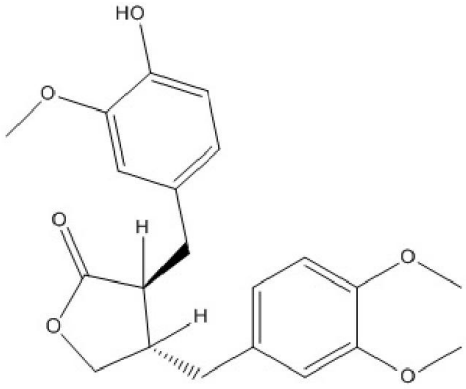


(d) *p*-hydroxybenzoic acid



(e) vanillic acid

(f) (+)-(8*R*,8′*S*)-thujaplicatin methyl ether



(g) Arctigenin

It could induce 100% mortality in the larvae of *Culex tritaeniorhynchus* (100 ppm), *Aedes aegypti* (120 ppm), *Anopheles stephensi* (120 ppm) and *Culex quinquefasciatus* (170 ppm).It is worthwhile to study extensively the larvicidal properties of the plants essential oil by isolating and identifying the active components that cause larval mortality and then use in field trails in order to assess their potential as an alternative to chemical larvicides (Thomas, 2004; Lallianrawna, *et. al.,* 2014).

Anti-Japanese Encephalitis- Arctigenin, a lignan found in *Ipomoea cairica* may be used as a treatment to Japanese encephalitis. Inhibition of chronic neuro-inflammation, particularly of microglial activation, has been suggested to be a practical strategy in the treatment of neurodegenerative diseases. It has been shown that treatment with arctigenin following JE reduces the number of activated microglia as well as the level of pro-inflammatory cytokines TNF-α, IFN-γ, IL-6 and chemokine MCP-1. In vivo microglial activation could be a response to neuronal damage with the subsequent inflammation resulting in negative consequences. Henceforth, early inhibition of neuronal apoptosis compounded by a decrease in the subsequent release of pro-inflammatory mediators by activated microglia would attenuate the severity of disease observed in JE. Because *Ipomoea cairica* extracts anti-inflammatory and anti-apoptotic effects will be beneficial in reducing the severity of diseases induced by JEV (Swarup *et al.,* 2014).

Anticonceptive effect- The ethanolic extract of this plant presents an antinociceptive effect. From the bio-active fraction 3, 5-di-O-caffeoylquinic acid and 4, 5-di-O-caffeoylquinic acids were obtained. These compounds have been previously reported to have analgesic and antioxidative effects. A possible explanation for the antinociception is that somehow the compounds present in the extract reduced the release of pro-nociceptive mediators unrelated to carrageenan-induced edema,

such as histamine. Interestingly, caffeoylquinic acid derivatives have been reported to inhibit histamine release on in vitro models. The isolated caffeoylquinic acids could explain, at least in part, the antinociceptive effect of *Ipomoea cairica* polar extract. (Ferreira *et al.,* 2006)

Anti HIV activity: It has been reported recently that Phytoconstituents of *Ipomoea cairica* also posses anti- HIV activity. Lignans like dibenzylbutyrolactone-type lignanolide, (–)-arctigenin obtained from *Ipomoea cairica* and *Arctium lappa* showed anti-HIV activity primarily due to inhibition of HIV proviral DNA (Eich *et al.,* 1996; Barkat *et al.,* 2014). Two naturally occurring lignanolides, isolated from Ipomoea *cairica*, (-)-arctigenin and (-)-trachelogenin, were found to inhibit strongly replication of human immunodeficiency virus type 1 (HIV-1; strain HTLV-III B) in vitro. At a concentration of 0.5 microM, (-)-arctigenin and (-)-trachelogenin inhibited the expression of HIV-1 proteins p17 and p24 by 80-90% and 60-70%, respectively. The reverse transcriptase activity in the culture fluids was reduced by 80-90% when the cells (HTLV-III B/H9) were cultivated in the presence of 0.5 microM (-)-arctigenin or 1 microM (-)-trachelogenin. At the same concentrations, the formation of syncytia in the HTLV-III B/H9-Jurkat cell system was inhibited by the compounds by more than 80%.Studying the molecular mechanism of action of (-)-arctigenin and (-)-trachelogenin we found that both compounds are efficient inhibitors of the nuclear matrix-associated DNA topoisomerase II activity, particularly of the enzyme from HIV-1-infected cells (Schroder *et al.,* 2011).

Allelopathic activity: Identification of species with allelopathic potential has been a target of researches aiming to use them to control crop weeds. *Ipomoea cairica* is considered a weed with allelopathic potential. The chemical nature of its secondary compounds was recently examined and two compounds, 3-3′-5-Trihidroxi-4′-7-dimethoxyflanove and 3-3′-5-Trihidroxi-4′-7-dimethoxyflavone-3-O-sulphate, were identified as being responsible for its allelopathic properties on radish (*Raphanus sativus* L.), cucumber (*Cucumis sativus* L.), Chinese cabbage (*Brassica pekinensis*) and a weed *Ligularia virgaurea*, making it a possible candidate for the development of new herbicides based on natural products (Ma, *et. al.,* 2009).

Steroidal activity: Steroids isolated from extract of *Ipomoea cairica* shows antibacterial activity (Singh *et al.,* 2012). Steroidal compounds present in the extracts are of importance and interest due to their relationship with various anabolic hormones including sex hormones (Okwu, 2001). Quinlan *et al.* (2000) worked on steroidal extracts from some medicinal plants which exhibited antibacterial activities on some bacterial isolates. Neumann *et al*. (2004) also confirmed the antiviral property of steroids.

Cytotoxic Activity: The compounds obtained from methanolic extract of the *Ipomoea cairica* were (+)-(8*R*,8′*S*)-thujaplicatin methyl ether, arctigenin, matairesinol, *trans*-2,3-dibenzylbutyrolactone, vanillic acid, *p*-hydroxybenzoic acid, methoxybenzoic acid, methylparaben, stearic acid, palmitic acid, olenic acid, friedelinol and a mixture of β-sitosterol and stigmasterol. Among them, arctigenin and *trans*-2, 3-dibenzylbutyrolactone were demonstrated to have significant cytotoxicity against LNCaP cell line. Compound *trans*-2, 3-dibenzylbutyrolactone was also found to be significantly active against A549 cell line (Rong-Jyh *et al.,* 2008; Brasileiro *et al.,* 2006)

Conclusion

The present study reveals that locally available non-economical weed plant *Ipomea cairica* commonly found in waste lands has a great pharmaceutical potential. The plant shows the presence of many phytochemicals which are responsible for various pharmacological medicinal properties. The pharmacological studies showed that different parts of plants posesses anti-inflammatory, antioxidant, antimicrobial, anti-HIV, cytotoxic and anti-Japanses encephalitis activities. *Ipomoea cairica* can also be used as herbicide and larvicide as it has shown mosquito's larvicidal activity and allelopathic activities in the present investigation. Based on the result of this study it can be said that *Ipomoea cairica* has a leading capacity for the development of new good efficacy drugs in future and can be effective source to treat and control many diseases

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