



Review Article

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***Ipomoea carnea* Jacq.: Ethnobotany, Phytochemistry and Pharmacological Potential**

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Abstract

Ipomoea carnea Jacq. (Family: Convolvulaceae) commonly known as Bush Morning Glory which is originally from the tropics of South America, grows in dense populations along river beds, river banks, canals and other wetland areas. This evergreen, flowering shrub has been reported to have medicinal properties hence find enormous potential for pharmacological properties such as anti-inflammatory, anti-fungal, hepatoprotective, anti-diabetic, antimicrobial, cardiovascular, anti-oxidant, anxiolytic, immunomodulatory, anti-bacterial, anti-cancer and wound healing activities. It is used indifferent traditional medical systems including Ayurveda, Siddha and Unani. It contains a component identical to marsilin, a sedative and anticonvulsant. Very little is known about the impact of this weed on native flora and fauna in India. It has been reported that the plant possess various bioactive compounds such as glycosides, alkaloids, reducing sugars, flavonoids, fatty acid, esters, alcohol and tannins. The present communication constitutes a review on the medicinal properties, major phytochemical constituents and pharmacological activities of *Ipomoea carnea*.

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Introduction

Ipomoea carnea (Family: Convolvulaceae; Fig. 1) which is generally known as Bush Morning Glory. This plant is spread all over the world including American tropics, Argentina, Brazil and Bolivia (Shinners, 1970), Pakistan, Srilanka, etc. (Bhattacharyya, 1976; Mahapata, 1978; Sharma, 1978; Austin and Ghazanfar, 1979; Dassanayake and Fosberg, 1980). It is well distributed in India and found particularly in Chhattisgarh and Madhya Pradesh (Ekka and Dixit, 2007; Dwivedi, 1999; Dwivedi, 2003). In India, it has become a naturalized species invading the wetlands, canals, drain banks, waste lands, field edges and road sides. The plant can propagate both vegetatively by stems which show rooting within a few days and sexually by seeds, and has rapid growth rate (Bhalerao, 1985).

This evergreen, flowering shrub grows to a height of 5m. The stem is thick and develops into a solid trunk over several years with many branches from base. The stem is erect, woody, hairy, and more or less cylindrical in shape and greenish in colour. It has alternate leaves. Normally it attains 1.25 - 2.75 m long and 0.5 - 0.8 cm diameter. The leaves are light green, heart shaped or somewhat lanceolate and 10-25cm long. The upper surface of leaf is dull green and the lower surface is paler. The leaves which receive lesser sunlight may grow larger than the leaves which receive full sunlight (Afifiet al., 1988; Chaudhuri et al., 1994; Sharma and Bachheti, 2013). The plants bloom in clusters of 4 inch pink flowers all spring and summer long. Flowers of *Ipomoea Carnea* are axial. The pedicel is green, erect and cylindrical. Its length ranges between 1.5–2.2 cm and diameter ranges between

0.15 – 0.20 cm. The mouth of the corolla has an entire margin, with slight conspicuous depressions at the points of the cohesion of the petals, measure 5.2-6.0 cm long and 1.6-1.8 cm width at its mouth (Cook, 1987).

The flowers are pale rose, pink or light violet in lax, terminal, pedunculate cymes; fruits have a glabrous capsule; seed is silky. As the name suggests, the blooms fade as the sun warms them, just like morning glories - but they are impressive while they last, blooming in large clusters at the ends of the tall branches which is very attractive to butterflies and hummingbirds.

The species is used as folk medicine in traditional medicinal systems including Ayurveda, Siddha, and Unani (Sharma and Bachheti, 2013). Leaves are used as purgative. Leaves paste is applied on 'Haja' (a kind of sore between toes and fingers due to fungal infection). In Brazil, *Ipomoea carnea* is known as *canudo-de-pita*, literally "pipe-cane", as its hollow stems were used to make tubes for tobacco pipes. It acts as toxic to cattle. It is reported to have stimulatory allelopathic effects. Roots are boiled to use as laxative and to provoke menstruation. Traditional healers for treatment of skin diseases have used it.

The milky juice of plant has been used for the treatment of leucoderma and other related skin diseases. Only external applications have been recommended due to poisonous nature of the plant. It has depressant effect on central nervous system. Also shows muscle relaxant property (Kumar et al., 2014). The aim of this review is to highlight the traditional uses, phyto-constituents and pharmacological profile of *Ipomoea carnea*.



Fig. 1: *Ipomoea carnea* Jacq. in natural environment.

Taxonomic classification (Shrivastava and Shukla, 2015)

Kingdom	:	Plantae
Sub Kingdom	:	Tracheobionta
Division	:	Spermatophyta
Subdivision	:	Magnoliophyta
Class	:	Magnoliopsida – Dicotyledons
Subclass	:	Asteridae
Order	:	Solanales
Family	:	Convolvulaceae
Genus	:	<i>Ipomoea</i>
Species	:	<i>Ipomoea carnea</i> Jacq.

Vernacular names (Shrivastava and Shukla, 2015)

Marathi	:	Beshram
English	:	Bush Morning glory
Hindi	:	Beshram, Behaya
Bengali	:	Beshram
Oriya	:	Behayo
Others	:	Pink Morning Glory, Borrachero, Bush Morning Glory, Badoh Negro, Matabra, Morning Glory Tree

Traditional uses (ethnobotany)

The species is used as folk medicine in traditional medicinal systems comprising Ayurveda, Siddha, and Unani (Sharma and Bachheti, 2013). The most efficient use of the species is in skin diseases; particularly the milky juice (latex) of plant is advantageous in treatment of leucoderma (Adsul et al., 2009). The latex is used as an antiseptic for treating lesions in traditional medicines because of its anti-inflammatory effects (Chowdhury et al., 1997). The whole plant extract prepared in hot water is extensively used as an anti-rheumatic medicine, and the plant is also believed to reduce the teratogenic effect of cyclo-phosphamide (Phillips et al., 1994). In many folk medicines, it is used as aphrodisiac, purgative as well as cathartic (Ved et al., 2004). Antimicrobial and antifungal activities of extracts of the plant have been reported by various workers (Guleria and Kumar, 2006; Adsul et al., 2012). Aqueous extract of the plant demonstrates neuromuscular blocking activity while plant has been proven to have antioxidant, anti-diabetic, wound healing, cardiovascular and hepato-protective activities (Ambiga et al., 2007; Kadiyawala et al., 2012; Sharma and Bachheti, 2013).

It has also been reported as having adverse effects on several animals. Toxic and poisoning effects of leaves on

the nervous system has been reported very recently (Sharma and Bachheti, 2013). Aqueous extract of leaves has shown embryo-toxic effects in rats resulting in skeletal and visceral abnormalities, malformations and reduced maternal reproductive performance (Hosomi et al., 2008). Furthermore, in African culture, the leaves of *Ipomoea carnea* are claimed to be effective in the treatment of pile, rheumatic pain, toothache and other inflammatory conditions (Ijeoma et al., 2011). Ijeoma

et al. (2011) studied above claims and positively proved that the leaf extract of the plant has anti-nociceptive and anti-inflammatory properties.

The plant extract releases precursor which plays a significant role in the nociceptive mechanism, causing inhibitory effect on pain development process, thus, ameliorating the symptoms associated with various inflammations (Kumar et al., 2014).

Phytochemistry

Various phytochemical constituents in different parts of *Ipomoea carnea* is given below.

Root	The roots are reported to contain 2-Ethyl-1,3-dimethylbenzene, 2-(12-Pentadecyloxy) tetrahydro-2H-pyran, 3-Furanyl[2-hydroxy-4-methyl-2-(2-methylpropyl) cyclopentyl]-methanone, 2,2-Dideuterooctadecanal, Hexadecanoic acid, Linoleic acid (Sahayaraj et al., 2014).
Stem	The stem of the plant contains 2-(12-Pentadecyloxy) tetrahydro-2H-pyran, 1-Octadecanol, Hexadecanoic acid, Epiglobulol, Squalene, 1-Octadecanol (Sahayaraj et al., 2014).
Leaves	The leaves of the plant showed the presence of thirteen compounds which include hexadecanoic acid, stearic acid, 1,2 diethyl phthalate, n-octadecanol, octacosane, hexatriacontane, tetracontane, 3-diethylamino-1-propanol (Turkey et al., 1988; Vaishali et al., 2009). Also the presence of swainsonine and calystegines B1, B2, B3, and C1 were detected in the aqueous ethanolic extract of leaf (Balogh et al., 1999).
Flowers	The flowers of the plant are reported to contain flavonoids, tannins, glycosides, alkaloids, carbohydrates and phenolic compound (Gupta et al., 2010). The presence of swainsonine and calystegines B1, B2, B3, and C1 confirmed in the aqueous ethanolic extract of flowers (Balogh et al., 1999).
Seeds	Presence of swainsonine and calystegines B1, B2, B3, and C1 are found in seeds of the plant <i>Ipomoea carnea</i> (Balogh et al., 1999).

Pharmacological potential

Antioxidant activity

It was studied that the methanolic extract of *Ipomoea carnea* was dissolved in distilled water and partitioned with *n*-hexane, chloroform, ethyl acetate and *n*-butanol consecutively. The antioxidant potential of all these fractions and remaining aqueous fraction was assessed by four methods: DPPH free radical scavenging activity, total antioxidant activity, FRAP assay and ferric thiocyanate assay and total phenolics were also determined. It was found that the percentage inhibition of DPPH radical was highest for *n*-Butanol fraction (91.11% ± 0.68), total antioxidant activity was highest for chloroform (0.9096 ± 0.1). FRAP value was highest for ethyl acetate fraction (511.99 ± 1.8 µg of trolox equivalents). Total phenolic contents were maximum for chloroform fraction (113.05 ± 1.2 mg of gallic acid equivalents) (Abbasi et al., 2010; Gaur et al., 2009; Adsul et al., 2012).

Wound healing activity

Ambiga et al. (2007) reported when fresh flowers of *Ipomoea carnea* extracted with 95% ethanol and the extract was concentrated in vacuum and the aqueous concentrate was treated with successive fraction of various solvents viz., diethyl ether, chloroform and ethyl acetate. The fresh flowers of *Ipomoea carnea* contain Kaempferol and its 3-O-β-D glucoside. These were known to retain considerable wound healing activity. Wound healing normally involves an initial inflammatory phase followed by fibroblast proliferation, formation of collagen fibres and shrinking and drying of the scar. These phases are simultaneous but independent of each other. These activities are comparable to Sulphathiazole and considerably improved than untreated wounds.

Antidiabetic activity

The study revealed that when antidiabetic property of *Ipomoea carnea* leaves were carried out in normal rats

and in streptozotocin induced diabetic rats; the aqueous extract of *Ipomoea carnea* considerably reduces the blood glucose level of rats. It increases the glucose tolerance in normal rats (Kadiyawala et al., 2012).

Antifungal activity

Antifungal activity of *Ipomoea carnea* has been demonstrated against *Alternaria alternata* and *Curvularia lunata* (Agarwal and Uppadhyay, 1997). Chloroform and Methanol extract of *Ipomoea carnea* revealed antifungal activity against eleven pathogenic and non-pathogenic fungi (Ikeda, et al., 2003). Antifungal fractions of the leaves of *Ipomoea carnea* were attained using *Colletotrichum loeosporioides* and *Cladosporium cucumerinum* as test organisms. The activity of the purified fraction was further established by the dose dependent inhibition of the spore germination of *Alternaria alternata* and *A. porri*. The active fraction was recognized as a mixture of (E)-octadecyl p-coumarate and (Z)-octadecyl p-coumarate (Nidiry et al., 2011).

Anti-inflammatory activity

Aqueous extracts of mature green leaves of *Ipomoea carnea* were tested for anti-inflammatory activity. The extracts were used at a dose of 250 mg/kg and 500 mg/kg body weight. The study concluded that *Ipomoea carnea* leaves possess a strong anti-inflammatory activity at dose of 500 mg/kg and possesses better result as compared to Etoricoxib 6 mg/kg (Khalid et al., 2011).

Hepatoprotective activity

Ipomoea carnea can be a favourable bioactive substance for prevention and treatment of liver injury (Gupta et al., 2012). *Ipomoea carnea* holds good hepatoprotective activity using CCl₄ induced hepatotoxicity in rat. This hepatotoxicity is due to free radical CCl₃ which is metabolite. It lessens alkalization of cellular proteins and other macromolecules with simultaneous attack on polyunsaturated fatty acids to produce lipid peroxide (Bishayee et al., 1995).

Glycosidase inhibitory activities

Analysis of *Ipomoea carnea* plant material was carried out by gas chromatography-mass spectrometry recognised the presence of the mannosidase inhibitor swainsonine and 2 glycosidase inhibitors, calystegine B2 and calystegine C1, consistent with a plant-induced a-

mannosidosis in the goats. The described storage disorder is analogous to the lysosomal storage diseases induced by ingestion of locoweeds (*Astragalus* and *Oxytropis*) and poison peas (*Swainsona*) (Balogh et al., 1999). *Ipomoea carnea* makes guinea pigs a valuable animal model for the reproduction of induced alpha-mannosidosis (Cholich et al., 2009).

Anti-cancer activity

In *in-vitro* and *in-vivo* studies it was found that hydroalcoholic extract of *Ipomoea carnea* leaves possess substantial anticancer property with the dose dependent effect. This may probably due to the presence of phytochemicals such as alkaloids, phenols and flavonoids (Kumar et al., 2013).

Immunomodulatory activity

Toxic component in it are- the nortropane alkaloid calystegines B1, B2, B3 and C1 and the indolizidine alkaloid swainsonine (SW) (Cook, 1987; Sahayaraj and Ravi, 2008). Effects of swainsonine (SW) in female rats were found that reduction in body, increase in spleen/body weight ratio, decrease in the thymus/body weight ratio and histological changes. When pregnant rats were treated with 7 gm/kg of *Ipomoea carnea* AF, all of the litters died immediately after birth. Rats consume considerably less food due to effect of *Ipomoea carnea*. Swainsonine has immune effect due to glycoprotein metabolism. Due to this rheumatoid arthritis (RA) was developed to both adult (70 days old) and juvenile rats (21 days old). Hence swainsonine modulates the immune function (Rosenberg, 1999; Lunardi et al., 2000).

Anxiolytic activity

Ipomoea carnea seems to fall under the sedative-hypnotic category of central depressants activity. The anxiolytic effects of the aqueous and methanolic extract of *Ipomoea carnea* leaves (32.50 and 16.25mg/kg i.p.) was assessed in mice using elevated plus maze, open field test and hole board test models, diazepam was used as positive standard. The intra-peritoneal (i.p.) LD50 of the *Ipomoea carnea* leaf aqueous extract (ICLAE) and *Ipomoea carnea* methanolic extract (ICLME) in mice was found to be 325 mg/kg i.p. body weight. ICLME exhibited greater anxiolytic effect as compared to ICLAE (doses of 32.5mg/kg and 16.2mg/kg) and diazepam. The effect of the ICLAE and ICLME revealed a dose dependent significant increased the number of head

dipping behaviour in whole board test at doses 32.5 and 16.2 mg/kg when compared with control and diazepam 1mg/kg, 2mg/kg as a standard. These observations indicate that ICLAE and ICLME showed an anxiolytic activity (Bidkar et al., 2012). In experimental studies in which the plant was given to adult goats, all animals showed disorders of behaviours and consciousness as well as abnormalities of goat (ability to stand and posture) and one goat died (Tokarnia et al., 2002; Rout et al., 2013).

Antimicrobial activity

In one study n- hexane, ethyl acetate, acetone, ethanol and acetone fraction extract were prepared from *Ipomoea carnea* leaves. Crude acetone extracts revealed activity against *Proteus vulgaris* and *Salmonella typhimurium*, while the crude ethanol extract explicates antimicrobial activity against *Pseudomonas aeruginosa*. This was the first report showing inhibition of *Proteus vulgaris* and *Salmonella typhimurium* by the acetone extract while ethanol extract exhibits promising inhibition against *pseudomonas aeruginosa* of *Ipomoea carnea* leaves (Adsul et al., 2012). A secondary metabolite dibutyl phthalate isolated from stem of *Ipomoea carnea* has also been recorded for antibacterial activity (Khatiwora et al., 2012).

Cardiovascular activity

When aqueous extract of *Ipomoea carnea* was hosted to isolated frog heart then initial blockade for 5-10 seconds was observed. When dose increased then the timing increased up to 2 minutes. It might be due to *Ipomoea carnea* produces a positive inotropic effect on isolated frog heart by sodium extrusion or release of the intracellular calcium (Bachhav et al., 1999). When atropine 1 µg/ml was introduced in extract then the initial different phase was blocked used stimulant effect become stronger.

Mosquitocidal activity

Synergistic effect of insecticides with plant extracts of *Ipomoea carnea* is reported against malarial vector, *Anopheles stephensi* has been reported (Kuppusamy and Manoharan, 1992).

Conclusion

The medicinal importance of the plant as discussed above evidently proves that *Ipomoea carnea* Jacq. is one of the

most promising shrub which possess a lot of therapeutic values. The present literature survey revealed that the plant *Ipomoea carnea* is a foundation of pharmacologically and medicinally vital phyto-constituents hence this plant has shown tremendous applications in both traditional as well as modern medical practices. Several mechanisms are likely to account for the observed pharmacological effects, the most important being the antimicrobial, antidiabetic, anti-inflammatory, antioxidant, antifungal, wound healing, cardiovascular, glycosidase inhibitory, anticancer, anxiolytic, mosquitocidal, immuno-modulatory, hepatoprotective activity. In future the standardization and stabilization studies on *Ipomoea carnea* need to be carried out which can help in proving it to be a promising source in pharmaceutical industry. It is also significant to recognize that its extract may be effective not only in the isolation but may have modulating effect when used in combination with other drug.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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