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A REVIEW ON PHYTOMORPHOLOGICAL, PHYTOCHEMICAL AND PHYTOPHARMACOLOGICAL PROFILE OF IPOMOEA CARNEA AND FUTURE PERSPECTIVE

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Abstract:

Phytopharmacology is the field of study of the effects of drugs on plants. The term has since changed its meaning to become an established field of drug research, where the active substances come from. The advantages of seeking medicines from plants are due both to the millions of years of co-evolution between plants and animals which has led to interactions between their bioactive molecules and the nature of enzyme driven synthesis leading to optically pure chiral molecules whose reactions in the mammalian body can be very specific. Phytomedicines were increasingly being established in modern medical science. The shrub Ipomoea carnea has been used traditionally for thousands of years. However, there are few scientific studies on this medicinal plant, and most of the information are scattered. In this review, I elaborately displayed the existing knowledge and recent progress in phytomorphology, bioactive compounds and therapeutic actions of Ipomoea carnea. Ipomoea carnea plant possessed a wide range of pharmacological activity such as anti-bacterial, anti-fungal, anti-oxidant, anti-cancer, anti-convulsant, immunomodulatory, anti-diabetic, hepatoprotective, anti-inflammatory, anxiolytic, sedative and wound healing, anti HIV activities.

Key Words: *Phytopharmacology; bioactive molecules; chiral molecules; phytomorphology; immunomodulatory etc.*

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INTRODUCTION:

Ipomoea carnea, the pink morning glory, is a species of morning glory. This flowering plant has heart-shaped leaves that are a rich green and 6–9 inches (15–23 cm) long. It can be easily grown from seeds which are toxic and it can be hazardous to cattle; the toxicity is related to the swainsonine produced by endophytes [1] and to bioaccumulation of selenium species in leaves but mostly in seeds [2]. The stem of I. carnea can be used for making paper. The plant is also of medicinal value. It contains a component identical to marsilin, a sedative and anticonvulsant. A glycosidic saponin has also been purified from I. carnea with anticarcinogenic and oxytoxic properties. I. carnea is known as canudo-de-pita, literally "pipe-cane", as its hollow stems were used to make tubes for tobacco pipes [3].

Fig. 1: Leaves of Ipomoea carnea plant

Fig. 2: Flowers of Ipomea

SCIENTIFIC CLASSIFICATION [3]

Kingdom:	Plantae
Clade	Angiosperms
Clade	Eudicots
Clade	Asterids
Order	Solanales
Family	Convolvulaceae
Genus	*Ipomoea*
Species	*I. carnea*
Binomial name	*Ipomoea carnea* Jace.
Synonyms	*Ipomoea fistulosa* Mart. ex Cho

BOTANY [4]

Plant Morphology: Growth Form: A robust, fast-growing, erect shrub or climber that constantly produces eye-catching pink trumpet-like flowers pleasantly accompanied by light green heart-shaped leaves.

Foliage: Leaves simple, ovate-lanceolate (oval to lance-shaped; narrow and tapering to a pointed apex), alternate, light green, 10 to 25 cm long, pubescent (covered with soft, short hair) especially beneath; petioles 4.2 to 6.2 cm long.

Stems: Stem woody, light brown to beige, hollow, slender, glabrous (smooth; not rough or hairy).

Flowers: Flowers in cymes, trumpet-shaped, a smooth blend of white with pale pink to purple, with a darker purplish corolla throat, 5 to 9 cm long, up to 11 cm in diameter, clustering at end of branches; pedicel 0.5 to 1.5 cm long, perianth 2, whorled; calyx 5 to 6 mm long, corolla 4 to 8 cm long; sepals 5, all of which free; petals 5, all joined in a funnel shape; stamens 5,

Fruits: Fruits ovoid (oval), glabrous, capsule-like, non-fleshy, dehiscent, up to 2 cm long and 1.5 cm wide, pale brown brown when ripe; seeds black, about 1 cm long, covered with long, woolly, brown trichomes (hair-like outgrowth).

Cultivation: Being a robust perennial and able to adapt to a wide range of soil types, it is grown best in well-draining, fertile soils. It prefers full sun to partial-shade, but requires a structure like a trellis, fence or wall for support should it be grown as a tall, erect shrub. Alternatively, allow branches to arch downwards for a more natural look. Drought tolerant once established. Propagate by seeds and (soft wood) stem cuttings. Caution: Seeds are toxic to livestock and should be monitored with the presence of pets. Plant is also known to be allelopathic (having the ability to release chemical substances that inhibits the growth of other species of plant(s) around it. Note: Plant is easily differentiated from other morning glory species by its distinctive shrubby, not vine-like habit.

Etymology: The genus epithet 'Ipomoea' derives from the Greek 'ips', 'a worm', and 'homoios', 'like or same', in reference to the trailing or creeping habit of the plants in this genus. The species epithet 'carnea' means 'flesh-coloured' in Latin, which refers to the pale, flesh pink flowers of the plant.

Its subspecies epithet 'fistulosa' means 'hollow like a pipe but closed at both ends', an allusion to its hollow stems.

Ethnobotanical Uses : Medicinal (Roots have laxative effects and are boiled and used to provoke menstruation, and are traditionally a treatment for skin diseases. Milky sap of plant has been traditionally used to treat Leucoderma and other related skin diseases (only external applications have been recommended due to the plant's poisonous nature). Plant has depressant effect on central nervous system and also shows muscle relaxant properties.)

PHYTOCHEMISTRY:

The literature survey reveals that the plant possess various bioactive compounds such as glycosides, alkaloids, reducing sugars, flavonoids, fatty acid, esters, alcohol1 and tannins [5]. The leaves of this 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 [6, 7].

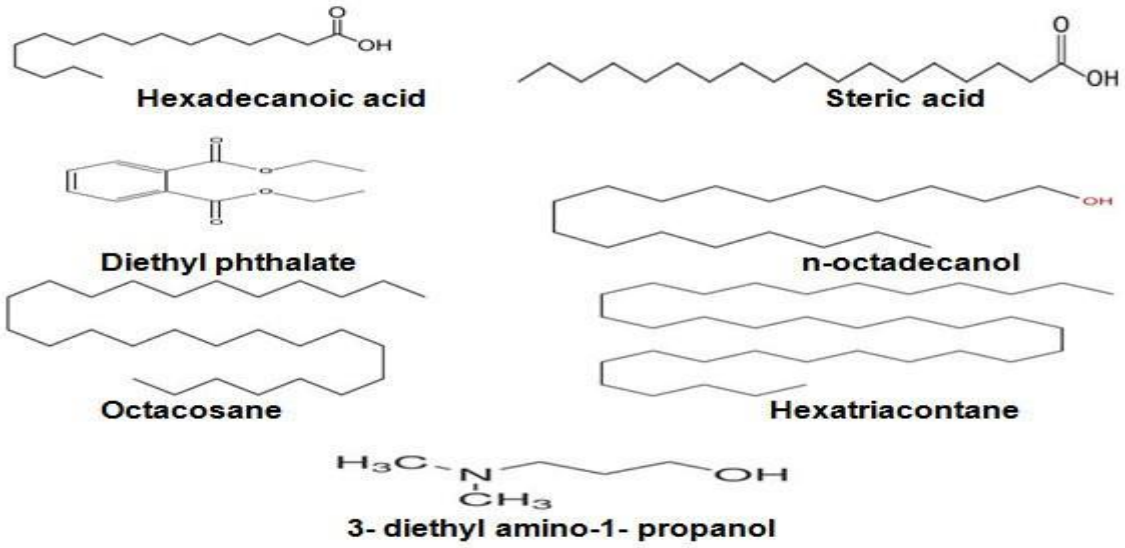

Fig. 3: Structure of compounds present in Ipomoea Carnea

(A) One study shows that Ethanol – Water (80: 20) extract of Ipomoea Carnea contains appreciable amount of flavonoids and phenol. Flowers contain maximum amount of phenoliccompounds while stem contain their minimum amount. Phenolic values lies between 45 to 73 mg catechol equivalent / gm [8, 9]. Ipomoea Carnea is a rich source of chemical compounds, pigments, steroid etc [10]. Chloroform extract of Ipomoea Carnea showed the presence of steroids, carbohydrates, alkaloids, phenolic compounds, saponins, xanthoproteins and flavonoids.

(B) Gupta A et al studied that when Ipomoea Fistulosa flowers were analyzed with Petroleum ether and Hydro alcoholic treatment then Flavonoids, Tannins, Glycosides, Alkaloids, Carbohydrates, and Phenolic compound were observed [11].

(C) In another study, leaves, flowers and seeds of Ipomoea Carnea were treated with aqueous ethanol. The extracts obtained were purified with Amberlite IR-120B (H+ form). After this they were treated with N-methyl-N (trimethylsilyl) trifluoroacetamide. These derivatives were analysed by capillary GCMS presence of swainsonine and calystegines B1, B2, B3, and C1 are found in all parts of the plant Ipomoea Carnea. Swainsonine are found in all parts of Ipomoea Carnea. It is lysosomotropic compound which produces neurological disorders. The nortropane alkaloids calystegines B2 and C1, together with swainsonine have been detected in the leaves collected in Mozambique where goats were intoxicated [12].

(D) Khatiwora E. et al and Adsul V. et al studied that when bioactive secondary metabolite dibutyl phthalate was separated from Ipomoea Carnea. Its structure was studied by HPTLC, IR, MS, 1H-NMR, ^{13}C-NMR [13, 14].

(E) Saleem M. et al and Sahayaraj K et al studied that when bioactive secondary metabolites isolated from the n-hexane soluble part of the ethanolic extract of Ipomoea Carnea, which were identified as octyl-p-coumarate, umbelliferon, β-sitosterol, stigmasterol, dodecyl-p-coumarate, methyl-p-coumarate, scopoletin and 3-oleanone [15].

(F) Latex of Ipomoea Carnea contains a compound Carnein. It is 80 kDa subtilisin-like serine protease. It shows exceptionally high resistance to chemical and thermal denaturation. Carnein were isolated from Ipomoea Carnea latex, purified and crystallized by the hanging-drop vapour - diffusion method [16].

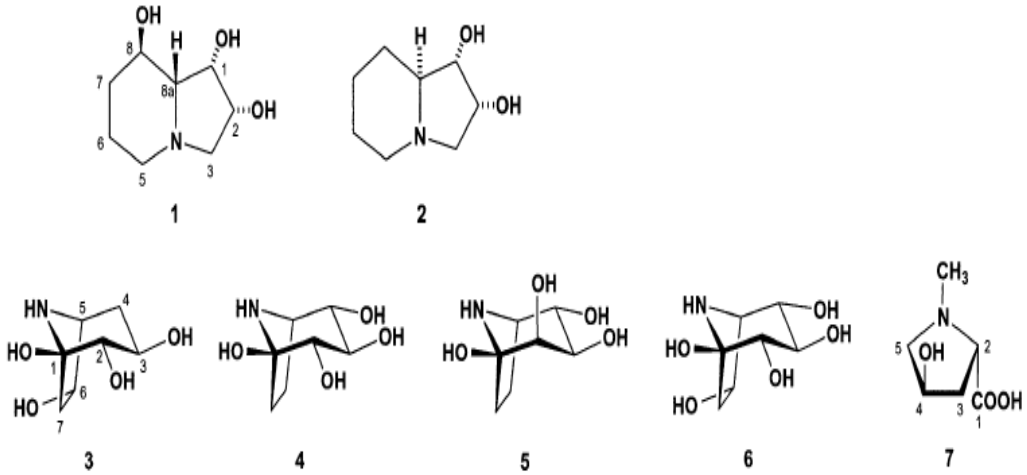

Fig. 4: Alkaloids present in Ipomoea Carnea

PHARMACOLOGY:

(i) Glycosidase Inhibitory Activities: Analysis of Ipomoea Carnea plant material by gas chromatography–mass spectrometry established 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) [12].

(ii) Anti-Inflammatory Activity: Aqueous extracts of mature green leaves of Ipomoea Carnea were used 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 posses a strong anti- inflammatory activity at dose of 500 mg/kg and possesses better result as compare to Etoricoxib 6 mg/kg [17].

(iii) Antioxidant Activity: In one research study the methanolic extract of Ipomoea Carnea was dissolved in distilled water and partitioned with n-hexane, chloroform, ethyl acetate and n-butanol successively. The antioxidant potential of all these fractions and remaining aqueous fraction was evaluated by four methods: DPPH free radical scavenging activity, total antioxidant activity, FRAP assay and ferric thiocyanate assay and total phenolics were also determined. Different fraction show variable activities with respect to different values. 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) [18].

(iv) Antidiabetic Activity: In one study antidiabetic property of Ipomoea Carnea leaves were carried out in normal rats and in streptozotocin induced diabetic rats. The aqueous extract of Ipomoea Carnea significantly reduces the blood glucose level of rats. It increases the glucose tolerance in normal rats [19].

(v) Antimicrobial Activity: In one study n- hexane (1), ethyl acetate (2), acetone (3), ethanol (4) and acetone fraction (A) extract were prepared from Ipomoea Carnea leaves. Crude extracts were prepared from leaves of Ipomoea Carnea in n- hexane (1), ethyl acetate (2), acetone (3), ethanol (4) and acetone fraction (A). Crude acetone extracts shows activity against Proteus vulgaris and Salmonella typhimurium, while the crude ethanol extract elucidates antimicrobial activity against pseudomonas aeruginosa. This is 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 [20]. Antimicrobial activity of metal complexes prepared from leaf proteins of Ipomoea Carnea was reported [21].

(vi) Antibacterial Activity of nanoparticles synthesized from Ipomoea Carnea extract: Recently biosynthetic method has been developed using plant resources, Ipomoea Carnea has also been used for this purpose. It contains polyphenols and alkaloids which can be used as reducing agents in the synthesis of nanoparticles. Thus Ipomoea Carnea has additional antimicrobial use. The weed is extracted and silver nitrate is added to it. Silver nanoparticles are obtained by this method. The weed extract-based synthesis of silver nanoparticles is very efficient against selected human pathogens and can be used in the fabrication of hospital clothes, gloves and masks to avoid the spread of infection among healthcare workers [22].

(vii) Wound Healing Activity: Ambiga S et al studied fresh flowers of Ipomoea Carnea extracted with 95% ethanol. 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 found to possess appreciable 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 concurrent but independent of each other. These activities are comparable to Sulphathiazole and significantly improved than untreated wounds [23].

(viii) Immunomodulatory Activity: Ipomoea Carnea is a poisonous plant. Toxic component in it are- the nortropane alkaloid calystegines B1, B2, B3 and C1 and the indolizidine alkaloid swainsonine (SW) [18, 26]. Effects of swainsonine (SW) in female rats were (a) Reduction in body weight (b) Increase in spleen/body weight ratio, (c) Decrease in the thymus/body weight ratio, and (d) 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 significantly 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). So swainsonine modulates immune function [24, 25].

(ix) Cardiovascular Activity: When aqueous extract of Ipomoea Carnea was introduced 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 may be suggested that Ipomoea Carnea produces a positive inotropic effect on isolated frog heart by sodium extrusion or release of the intracellular calcium [26]. When atropine 1 µg/ml was introduced in extract then the initial different phase was blocked used stimulant effect become stronger.

(x) Embryotoxic effect: Dried leaves of Ipomoea Carnea were used to prepare an aqueous extract of prenatal daily exposure to 0.0, 0.7, 3.0 or 15.0 mg/kg. When these extract were introduced to rats following result were observed.

a) Maternal reproductive performance showed adverse effect.

b) Skeletal and visceral abnormalities.

c) Malformations were observed.

Prenatal ingestion of the Ipomoea Carnea AQE in rats induces embryo toxicity. These effects are associated to an active principle from Ipomoea Carnea acting on maternal homeostasis, or directly in the conception [27].

(xi) Antifungal Activity: Antifungal activity of Ipomoea Carnea has been identified against Alternaria alternate and curvularia lunata [28, 29]. Chloroform and Methanol extract of Ipomoea Carnea show antifungal activity against eleven pathogenic and nonpathogenic fungi [30]. Antifungal fractions of the leaves of Ipomoea Carnea were achieved using Colletotrichum gloeosporioides and Cladosporium cucumerinum as test organisms. The activity of the purified fraction was further confirmed by the dose dependent inhibition of the spore germination of Alternaria alternata and A. porri. The active fraction was identified as a mixture of (E)-octadecyl p-coumarate and (Z)-octadecyl p-coumarate [31].

(xii) Hepatoprotective Activity: Liver diseases are serious health problem whose treatment is limited. Ipomoea Carnea can be a promising bioactive substance for prevention and treatment of liver injury [32]. Ipomoea Carnea possesses hepatoprotective activity using CCl_4 induced hepatotoxicity in rat. This hepatotoxicity is due to free radical CCl_3 which is metabolite. It reduces alkalization of cellular proteins and other macromolecules with simultaneous attack on polyunsaturated fatty acids to produce lipid peroxide. It results in liver damage [33].

(xiii) Effect of Ipomoea Carnea on Nervous System: Ipomoea Carnea is a poisonous plant, it affects central nervous system adversely. When goats were fed with fresh leaves flowers and stems of Ipomoea Carnea for 45 to 60 days then Hirsute coat, depression, difficulty to stand up, ataxia, hypermetria, wide–based stance, incoordination of muscular movements, intense tremors, spastic paresis, abnormal postural reactions, nystagmus, hyperreflexia, hypersensitivity to sound, head tilting and loss of equilibrium were observed in all treated animals. The cerebellum is one of the main affected organs in the Ipomoea Carnea intoxication. This organ processes information from other nervous areas, mainly spinal cord and sensory receptors, with the purpose to coordinate skeletal muscle movements [34]. The functional units of the cerebellum cortex are the Purkinje cells; these cells send inhibitory projections to the deep cerebellar nuclei. These neurons were severely affected in this intoxication, including necrosis in some of them [35].

(xiv) Anxiolytic Activity: Ipomoea Carnea appears 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 16.25 mg/kg i.p.) was evaluated 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 showed greater anxiolytic effect as compared to ICLAE (doses of 32.5 mg/kg and 16.2 mg/kg) and diazepam. The effect of the ICLAE and ICLME showed a dose dependent significant increased the number of head dipping behaviour in hole board test at doses 32.5 and 16.2 mg/kg when compared with control and diazepam 1mg/kg, 2 mg/kg as a standard. These observations indicate that ICLAE and ICLME showed an anxiolytic activity [36, 37].

Anti HIV activity [38, 39]: In study for screening the HIV-1 RT inhibitory potential of medicinal plant, at a concentration of 200 µg/mL, crude water extracts of I. carnea subsp. fistulosa (aerial parts), proved to be strongly active with 98.95% of inhibition). Other study for evaluation of immunomodulatory activity of this species on peritoneal cells of rats suggest that low dosages of I. carnea induced enhanced phagocytosis activity and hydrogen peroxide production by macrophages. The extract of I. carnea subsp. fistulosa presents antiinflammatory activity when tested in rats The extract from the leaves of this species was tested in vitro against the adenocarcinoma de colon (L-HT29C) and human lymphocyte (L-THP) and presented no cytotoxicity).

CONCLUSION:

The traditional and ethno medicinal literatures showed that the plant is very effective and safe for medicinal uses. By using the reverse pharmacological approaches in natural drug discovery a potent and safe drug can be investigated from the plant for various chronic diseases. Although, an extensive amount of research work has been done on plant of genus Ipomoea carnea to date, but a large number of activities was not done from all the parts of plant. Consequently, a broad field of future research remains possible in which the isolation of noble active biomolecules from this species would be of great scientific merit in phytochemistry and phytopharmacology Furthermore, some plant extracts were only preliminarily studied for their in vitro activities, so, the advance clinical trial of them deserves to be further investigated.

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