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Ipomoea carnea Jacq.: An Ethnomedicinal Plant Rich in Phytoconstituents for Pharmaceuticals

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BANOTH VITTAL, CHAKRAVARAM LAKSHMAN KUMAR, MOODE JAHNAVI CHOWHAN, SOLLU SNEHA, NAREDDY YESHWANTH REDDY, VASUDHA BAKSHI, NARENDER BOGGULA*

Department of Pharmaceutical Chemistry, School of Pharmacy, Anurag Group of Institutions, Venkatapur, Ghatkesar, Telangana, India.

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ABSTRACT

Phytomedicines are increasingly being established in modern medical science. 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. About 600-700 species of *Ipomoea*, Convolvulaceae, are found throughout tropical and subtropical regions of the world. Several of them have been used as ornamental plants, food, medicines or in religious ritual. These species are used for the treatment of several diseases, such as fatigue, inflammations, hypertension, diabetes, dysentery, constipation, rheumatism, arthritis, meningitis, and hydrocephaly. Some of these species showed anti-microbial, anti-coagulant, analgesic, hypoglycemic and anti-cancer activities. The uses and ecology of *Ipomoea carnea* is reviewed based on published data. It was used in ancient system of medicine and the fact that the plant had immense potential for pharmacological and insecticidal properties. *Ipomoea carnea* has great importance in Ayurveda.

INTRODUCTION

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. In biological systems a variety of naturally occurring compounds and their association with the prevention in various ailments like cardiovascular diseases, liver, kidney disorders, chronic diseases and certain forms of cancer have been investigated and several studies have shown that diet rich in fresh food and vegetables like carrot, beetroot, tomato, grapes, Spanish, green tea, garlic and turmeric etc. provide a shield against degenerative diseases. In the recent years, natural compounds isolated from several plants have attracted the focus of researchers for their medicinal and dietary values. Plants have been used for medicinal purposes long before prehistoric period. Ancient Unani manuscripts Egyptian papyrus and Chinese writings described the use of herbs. Evidence exist that Unani Hakims, Indian Vedas and European and Mediterranean cultures were using herbs for over 4000 years as medicine. Indigenous cultures such as Rome, Egypt, Iran, Africa and America used herbs in their healing rituals, while other developed traditional medical systems such as Unani, Ayurveda and Chinese Medicine in which herbal therapies were used systematically.

Medicinal plants have been identified and used throughout human history. Plants make many chemical compounds for biological, physiological actions, including defence against insects' fungi and herbivorous mammals At least 12,000 such compounds have been isolated; this is estimated to be less than 10% of the total. These chemicals work on the human body in exactly the same way as pharmaceutical drugs so herbal medicines can be beneficial and have harmful side effects just like conventional drugs. Further, plants may contain many different substances, so plant extracts may have multiple side effects. Medicinal plants are considered as rich resources of ingredients which can be used in drug development either pharmacopoeia, non-pharmacopoeial or synthetic drugs. A part from that, these plants play a critical role in the development of human cultures around the whole world. Moreover, some plants are considered as important source of nutrition and as a result of that they are recommended for their therapeutic values. Some of these plants include ginger, green tea, walnuts, aloe, pepper and turmeric etc. Some plants and their derivatives are considered as important source for active ingredients which are used in aspirin and toothpaste etc.

Recently, WHO (World Health Organization) estimated that 80 percent of people worldwide rely on herbal medicines for some aspect of their primary health care needs. According to WHO, around 21,000 plant species have the potential for being used as medicinal plants.

The family Convolvulaceae is acknowledged as Morning glory family. About 2000 species of 58 genera are distributed overall the world, mainly in the tropics and subtropics region, approximately one third of the species are included into major genera *Ipomoea* and *Convolvulus*. Genus *Ipomoea* represented by 650 species distributed worldwide. In India, family Convolvulaceae is represented by 20 genera and 158 species occurring chiefly in the southern and western India. Over 60 species of Ipomoea are reported in India distributed and occurs especially in damp places of Gujarat, Bihar, West Bengal, Chhattisgarh, Maharashtra, Western Ghats, Goa and Karnataka. Many investigators have worked on various topics of *Ipomoea* biodiversity, distribution, structure, distribution, development and taxonomic importance of stomata and epidermal studies. This review paper highlights the morphology, medicinal importance and toxicity plant of *Ipomoea carnea*. The genus *Ipomoea* consists of mainly climbing herbs and weeds which are distributed on disturbed sight or unused areas. Due to lack of knowledge about the utility of the plant, these species are rapidly destroyed from various places. Some species like *Ipomoea batatas aquatica* are however cultivated but many species like *carnea* and *Ipomoea cairica* are treated as weeds. Recent research has shown that these and many other plants of this genus possess medicinal potential in various diseases. So their conservation is needed and also the knowledge of their utility so that their protection can be assured by local people.

Ipomoea carnea was introduced to Egypt for ornamental purpose. It was recorded as a naturalized species along canals and drains, road sides, railways, waste lands and field edges in the Nile Delta. This plant propagates vegetative by stems which are capable of rooting within a few days. The farmers use it as ornamental and hedge plant along the banks of irrigation and drainage canals. These ornamental uses and reproduction by seeds often lead to increase the plant dissemination into new regions. Recently, it has become widely spread in other terrestrial habitats and may cause obstruction and difficulties in many habitats in the Nile Delta. The rapid growth rate, spread, and adaptability from aquatic to xerophytic habitats indicate that this plant may potentially become another ecological disaster like water hyacinth.

Bush Morning Glory botanically named as "*Ipomoea carnea*" from the family of Convolvulaceae. It is a large, diffuse or straggling perennial shrub. Plant originally from

tropical America; it was introduced to India at the end of the last century as a garden and hedge plant now days it is well distributed in India and found particularly in Chhattisgarh and Madhya Pradesh. In Hindi it is known as *besharam/behaya*, its meaning shameless. This genus is except-tonally diverse, containing over 600 species of vines and shrubs widely distributed throughout the tropics and subtropics region.

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. In Brazil, *I. carnea* (in addition to other common names) is known as *canudo-de-pito*, literally "pipe-cane", as its hollow stems were used to make tubes for tobacco pipes.

Synonyms:

English: Bush Morning Glory

Hindi: Beshram

Oriya: Behayo

Marathi: Beshram

Bengali: Beshram

Taxonomic classification:

Kingdom: Plantae

Subkingdom: Tracheobionta

Division: Spermatophyta

Subdivision: Magnoliophyta

Class: Magnoliopsida

Subclass: Asteridae

Order: Solanales

Family: Convolvulaceae

Genus: *Ipomoea*

Species: *I. carnea*

Botanical Name: ***Ipomoea carnea*** **Jacq.**

Figure 1: ***Ipomoea carnea*** **plant**

Figure 2: ***Ipomoea carnea*** **root**

Figure 3: *Ipomoea carnea* flowers

Figure 4: *Ipomoea carnea* leaf

Figure 5: *Ipomoea carnea* fruits

Figure 6: *Ipomoea carnea* seed

Figure 7: *Ipomoea carnea* stem

Macroscopic Characters

Ipomoea carnea grows to a height of 6m on terrestrial land, but acquires a shorter height in the aquatic habitats.

Stem:

The stem is erect, woody, hairy, and more or less cylindrical in shape and greenish in colour, monopodially branched, and bearing alternate leaves. It attains 1.25-2.75m long and 0.5-0.8cm diameter. The fresh stem is somewhat flexible, but the dry one breaks with a fibrous fracture exposing a whitish green interior, with hollow internodes and solid nodes. The internodes

measure 3.5-6.0cm in length. The plant is vine like but stems can grow upwards to a height up to 6 m on terrestrial land, but shorter in the aquatic habitats. The branches are found mostly at the base of the stem which is short and stout, but firmly rooted in the soil. Sometimes the stem bends along the soil-water surface producing small adventitious roots on the ventral side.

Root:

The plant has a tap root, bearing numerous lateral rootlets. The root measures 50-60cm long and 2.0-3.0cm diameter. Externally, the root is yellowish brown in colour, with a rough surface showing longitudinal striation, cylindrical in shape, solid, with flexible fracture when fresh, becoming fibrous when dry.

Leaf:

The leaf is simple, alternate, exstipulate and petiolate. Petiole is cylindrical, attains 4-7.5cm length and 2.5-3.0mm diameter. The leaf blade is cordate with symmetric base, measures 13-23cm in length and 5.5-9.5cm in width, with entire margin and reticulate pinnate venation, slightly hairy on both surfaces, the upper surface is dull green and the lower one is paler. Leaf plasticity related to light and moisture conditions. Shaded leaves may grow larger than leaves fully exposed to sunlight. In aquatic conditions differences between sun and shade leaves appeared to be higher than in dry conditions. *Ipomoea carnea* possesses the most complex extrafloral nectary structure known in the genus. The nectary is sunken in the cortex and opens by a narrow orifice in a raised, almost circular mound that is devoid of hairs which are so abundant on the leaf. The mound is visible to the naked eye, and nectar production is copious. A wide duct leads to the orifice from the expanded cortical chamber, which is lined with closely- packed, multicellular, nectar - secreting trichomes. The locule of the chamber is mostly filled by large, irregular lobes of cortical tissue which are largely devoid of secreting trichomes. The nectary of *Ipomoea carnea* is located adjacent to the primary phloem, and there is usually a laticifer between the chamber and the phloem.

Flower:

The flowers are axial, solitary or arranged in monochasial scorpioid cymose inflorescence. The pedicel is green in colour, erect, cylindrical, solitary slightly pubescent, measures 1.5-2.2cm long and 0.15-0.20cm diameter. The calyx is persistent, consisting of 5 free quincuncial sepals, ovate in shape, with entire margin, symmetric base and acute apex, green in colour, nearly

glabrous, measure 0.5-0.7cm long and 0.6-0.7cm width. The corolla is formed of 5 united petals (sympetalous), delicate, pinkish white in colour, with 5 pink to violet coloured strands in the regions of cohesion with each other. The mouth of the corolla has an entire margin, with slight conspicuous depressions at the points of the cohesion of the petals, measure 5.2-6.0cm long and 1.6-1.8cm width at its mouth. The androecium is formed of 5 free epipetalous stamens, which are unequal in length; two of them being longer than the others. They are united to the base of the petals for a distance of 4 mm. The basal part of the filament is hairy, pinkish red in colour and swollen, while the upper part is filiform in shape and white in colour. The filament measures 1.6-2.1cm long and 0.20-0.25cm width at its swollen base. The anthers are whitish yellow in colour, oblong, basifixed and bilobed opened laterally, and contain yellow pollen grains. The anther attains 0.5-0.7 cm long and 0.20-0.25cm width. The gynoecium, shows a superior ovary which is bicarpellary, and bilocular. Each locule contains one or two small anatropous basally placenta ovules. The ovary is conical in shape, whitish yellow in colour and carried on yellowish green hypogenous disc. The ovary measures 0.3-0.4cm long and 0.15-0.20cm width. The style is cylindrical, yellowish white in colour, measures 1.4-1.6cm long and 1-2mm width and ending with a bilobed stigma, each attains 0.7-1.0mm long, and 0.3-0.6mm width.

Fruit:

The fruit is a simple dry dehiscent capsule, which opens septifragally and is derived from a superior gynoecium. It is pedicellate, subglobular in shape, with pointed apex and spherical base, greyish green in colour when unripe, turning greyish brown on ripening. The fruit shows five persistent sepals and remains of the style at the apex. It measures 1.0-1.5cm in height, 0.8-1.3 cm in width and contains usually four dark brown coloured seeds densely covered with hairs. The pericarp is thin, measuring about 0.1 cm thick, smooth and glabrous with yellowish grey inner surface.

Seed:

The seed measures 0.4-0.6cm in length and 0.2-0.3cm in diameter, dark brown to black in colour and derived from an anatropous ovule. It is covered with an easy removable dense pale brown to greyish brown trichomes, which attain 0.7-1.0cm in length. The seed is three sided, with two flat ventral surfaces that may have a central depression and one convex dorsal surface. The micropyle is represented by a palar scar near the hilum in the central depression of the

ventral surface. The raphe is represented by a raised ridge which extends from the hilum at the base to the chalaza at the apex. The seeds are covered by a dense, cottony, furry indumentum consisting of slightly glossy, and 0.01-0.02 mm thick hairs that are slightly swollen at the base. Hairs are much longer on the edge of the rounded abaxial surface of the seeds (at the top and at the base of the elliptically complanate cross section). The seeds have a black, 0.3 mm thick, very hard, bilayered testa. Clonality however is an important feature of the species. The nautability (ability to float on the water surface) of seed material of *Ipomoea carnea* subsp. *fistulosa* population was tested under different conditions. These tests provided data on the rate of infection by insects, the nautability of un-parasitized seeds in fresh water amounted to 11-16 days. Without indumentum the seeds immediately sank. Thus, it may be concluded that seeds are probably water-dispersed.

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).

Associated Species

The total number of species associated to *Ipomoea carnea* populations in the Nile Delta was 84 species: 49 annuals (58.3 %), 2 biennials (2.4 %) and 33 perennials (39.3 %). They belong to 28 families and 71 genera. The grasses had the highest contribution to the total associated species (20.2%), followed by composites (19.0%), legumes (8.3%), chenopods (7.1%), and crucifers (7.1%). Three species only were recorded in more than 40 % of the studied stands (*Cynodon dactylon*: 72.3%, *Phragmites australis*: 58.5% and *Rumex dentatus*: 43.1%) while four species were recorded in 30-40% (*Aster squamatus*, *Chenopodium murale*, *Convolvulus arvensis* and *Polypogon monspeliensis*). Six species were recorded in 30-20% (*Sonchus oleraceus*, *Malva parviflora*, *Ammi majus*, *Imperata cylindrica*, *Phalaris minor* and *Persicaria*

salicifolia). The species inhabiting the canal banks were the highest (63 species: 27.4% of the total), followed by those of drain banks (41 species: 17.8%), field edges (32 species: 13.9%) and waste lands (32 species: 13.9%). On the other hand, the Mediterranean taxa had the highest percentage (27.0%) followed by Irano-Turanian (20.1%), Euro-Sibarian (13.2%), Tropical (13.2%) and Cosmopolitan taxa (11.9%).

Population Dynamics

The growth of *Ipomoea carnea* follows a seasonal pattern where its growth was fastest during September and October. Wide ecological amplitude of this plant has been demonstrated. These results indicated significant differences between its populations in different habitats, regarding to the growth variables (e.g. height, crown diameter, volume and size index); reproductive variables (e.g. number of flowers and fruits); and demographic variables (e.g. natality, mortality and survival). Generally, *Ipomoea carnea* populations along the railway sides and field edges in the Nile Delta had the lowest means of most of the growth and reproductive variables, while those of the road dividers, road sides and canal banks had the highest. On the other hand it had the highest values of most of these variables during September and October and the lowest during June and July. The highest flower and fruit production occurred during the period from September to December. It was indicated that, the flowering time of *Ipomoea carnea* exhibited differences between different habitats in Nile Delta. The flowering began earlier in some habitats (e.g. road sides and canal banks) and later in some others (e.g. railway sides, road dividers and waste lands). Generally, its population in the wet habitats (e.g. drain and canal banks) had leaf area larger than this of the other habitats.

The literature indicated also that the size frequency distributions of *Ipomoea carnea* populations in different habitats tend to approximate the negative skewed distributions where the big ramets are more preponderant than the small ones. Population natality varies in relation to habitat and time. Waste lands experienced the highest natality, while the road sides and drain banks had the lowest. On the other hand, the natality was higher during the period of October, December and May comparing with the other months. The population of road sides, canal banks and road dividers attained the highest standing-crop, while, the field edges attained the lowest.

Phytochemical Constituents

The literature survey showing that the plant possess various bioactive compounds such as glycosides, alkaloids, reducing sugars, flavonoids, fatty acids, esters, alcohols and tannins. 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.

GC-MS analysis for the leaves extracts of benzene and chloroform showed the presence of Neophyadien, 1-Decanol, Tetradecanoic acid, Pentadecane, 1-Iodo 2-methylundecane, Trans-caryophyllene, Eicosane, 2-Butenoic acid, Cholestan-3-one. The phenolic compound present in flavonoids and phenolic compound one of the most important constituent of a plant for their pharmacological action. From the different parts of this poisonous plant (leaves, flowers, and seeds) lots of polyhydroxylated alkaloids were isolated, which named as an enzyme Carnein, a Serine protease isolated from noxious plant weed *Ipomoea carnea.*

When we go for the chemical analysis of leaf and flower then we saw a wide range occurrence of complex organic components i.e. resins - sitosterol, triacontane, kaempferol, anthocyanin, agroclavine and dihydrolysergol.

Toxicology

Most of the toxic study of this plant performs on sheep, goat and cattle. In all of these cattle goat is perfect for the study. Toxicity of *Ipomoea carnea* concluded by its clinical and morphological changes in ewes and fetuses. Toxicity of *Ipomoea carnea* showed the significant changes which are as follows weight loss, abnormal behaviour, cytopalsmic vacuolation etc as neurologic abnormalities. *Ipomoea carnea* subsp. fistulosa induces an intralysosomal accumulation of mannose-containing oligosaccharides in guinea pigs, which makes it a valuable animal model for the reproduction of induced alpha-mannosidosis. Carnein is an 80 kDa subtilisin-like serine protease isolated from the latex of the plant *Ipomoea carnea*, which is purified and crystallized by the hanging-drop vapour-diffusion method.

Extract of the flower of *Ipomoea carnea* show significant wound healing activity against the male Wistar rats by Excision wound model Incision wound model. The aqueous extract of *Ipomoea carnea* initial blockade the isolated frog heart for 5-10 sec followed by dose dependent increase in both amplitude and rate that lasts up to 2 min. The aqueous extract of

Ipomoea carnea produces positive inotropic effect on isolate frog heart possibly by sodium extrusion or release of the intracellular calcium. Because decrease in sodium chloride concentration or increase in potassium chloride concentration or calcium chloride concentration in physiological salt solution inhibited the responses to aqueous extract while an increase in sodium chloride concentration or decrease in potassium chloride or calcium chloride concentration in physiological salt solution potentiated the responses to the aqueous extract of *Ipomoea carnea.*

Monoamine levels were pragmatic by giving the extract of *I. carnea* leaves to guinea pigs. The poisoned animals show increased, lethargy, vocalization, and a reduction in the locomotion frequency after the fourth week of intoxication, as demonstrated in the open-field test. *I. carnea* ingestion in guinea pigs induced neurological toxicity with physical and behavioural impairment. Specific neuropathological lesions and changes in concentrations of euro transmitters were observed: serotonin decreased in plasma, whereas dopamine decreased and noradrenaline increased in urine. We can utilize this model for studying the pathogenesis of plant-induced lysosomal storage diseases. Swainsonine is a phytoconstituent of *Ipomoea carnea* and cause a neurologic disease in grazing livestock. Fungal endosymbiont in legumes of the Astragalus and Oxytropis genera produced Swainsonine, and it causes a similar neurologic disease in grazing livestock called locoism. If *Ipomoea carnea* plants are infected with a fungal endosymbiont and culture from its seeds which produced swainsonine. Randomly selected 47 goats were selected for this activity and significantly it shows study of treatogenicity by the use of ultrasonography in goats ingested with *Ipomoea carnea.*

A mixture of (E)-octadecyl p-coumarate and (Z)-octadecyl p-coumarate obtained from leaves of *Ipomoea carnea* were tested against the *Colletotrichum gloeosporioides* and *Cladosporium cucumerinum*. The mixture and isomer of above mention compound showed the significant anti-fungal active for the above organism. Swainsonine is a toxic indolizidine alkaloid isolated from *Ipomoea carnea*. By inhibiting the glycoprotein metabolism it reveals the immunomodulatory effects. Two parameters evaluated for evaluating the immune power. The result was found to be doubtful but the alkaloid did not make down in humoral immune response. Aqueous Spray of leaf extract of *Ipomoea carnea* showed the significant inhabitation of *in vitro* mycelial growth of *Rhizoctonia solani* (plant pathogenic fungus), and effectively reduce the incidence of sheath blight disease in rice.

Proximate chemical analysis

Proximate Chemical analysis includes- Cold water solubility , Hot water solubility, Ether Solubility, Alcohol benzene solubility, 1% NaOH solubility, pentosan content, lignin content, holocellulose, hemicellulose, alpha cellulose, acetyl content, methoxyl content, uronic anhydride and ash Content were 8.43, 12.60, 3.04, 8.46, 28.6, 17.60, 18.08, 67.49, 22.40, 46.45, 4.32, 4.76, 3.45 and 6.14 respectively. The values are expressed in % on OD woody material basis.

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.

Uses:

♥ The stem of I. carnea can be used for making paper.

♥ Stem is also used as fire wood.

♥ It contains a component identical to marsilin, a sedative and anticonvulsant.

♥ A glycosidic saponin has also been purified from I. carnea with anti-carcinogenic and oxytoxic properties.

♥ The leaves are used as fertilizer.

♥ The plants are also used for fencing.

♥ Colourful flowers are often grown as ornamentals, and a number of cultivars have been developed. Their deep flowers attract Butterflies and hummingbirds.

***Ipomoea carnea* as a Bio-compost**

Composting is one of the most promising ways to recycle the wastes generated from power plants, as the process reduces the volume and stabilizes the waste. The high organic matter

content in the compost product also preserves soil fertility. A large variety of thermophilic microorganisms have been reported in composting and other self-heating organic materials. *Ipomoea carnea* is useful to increase the microbial activity of bio-compost. The organic content of bio-compost also increases after treatment of *Ipomoea carnea*.

As a raw material for paper making: Soda lignin and Soda Anthraquinone lignin obtained from wood and *Ipomoea carnea* is almost same. Their functional groups are highly similar. In both the lignin samples the presence of vanillin and syringaldehyde was found. Addition of anthraquinone to the pulping process does not affect the quality of lignin precipitated from soda black liquor; even though it nearly doubles the amount of lignin precipitated from black liquor. Rate of delignification was higher with 0.1% addition of anthraquinone (Nand Kumar, 2011a). *Ipomoea carnea* had been found that very useful for paper making.

Raw material for Activated Carbon: *Ipomoea carnea* is effective in the removal of copper from aqueous solution. It was concluded that the activated carbon produced from morning glory by zinc chloride activation has better adsorbing capacity of copper than the raw adsorbent. After activation with zinc chloride lot of micro pores were produced. With the increase in micro pores the adsorption percentage of copper was increased. The adsorption of copper was found to be maximum at its natural pH. The adsorption of copper by raw adsorbent and activated carbon both follows pseudo second order rate kinetic.

As a potential source of energy: *Ipomoea carnea* is a potential biogas source of Energy. *Ipomoea carnea* biomass and distillery waste admixture proved to be the best substrate. The plant has a suitable methane content which makes *Ipomoea carnea* suitable for energy production.

Insecticidal property: In *Ipomoea carnea* benzene and chloroform extracts yielded the compounds such as neophyadiene, 1-decanol, tetradecanoic acid, pentadecane, 1-iodo 2-methylundecane, trans-caryophyllene, eicosane, 2-butenoic acid and cholestan-3-one. Cholestan-3-one is a steroidal compound and it has a high insecticidal property.

Mechanical properties: Cellulose content of this shrub is over 55% and lignin content is about 17% which indicates it is a fibrous material and can be used as filler for making light weight polymer composite which provides an effective means of utilization of a large quantity of this diffuse shrub. Investigation can be used as an effective reinforcement in polymeric composite creating a variety of technological applications beyond its traditional uses. It can also be used

as a substitute for wood based composite. The composite prepared have low density compared to synthetic fibers and also to some natural fibers. Therefore, it can judiciously be used for producing light weight composite materials. Reinforcement of *Ipomoea carnea* particulate into the epoxy matrix shows improvement in both the tensile and flexural properties compared to pure epoxy.

Pharmacological Importance

The plant had immense potential as an anti-inflammatory activity, anti-oxidant activity, anti-diabetic activity, anti-microbial activity, wound healing activity, immunomodulatory activity, cardiovascular activity, embryotoxic effect, anti-fungal activity, hepatoprotective activity, glycosidase inhibition activity, anti-cancer activity and anxiolytic properties.

Anti-microbial activity

In one study n- hexane, ethyl acetate, acetone, ethanol and acetone fraction extract were prepared from *Ipomoea carnea* leaves. Crude acetone extracts shows activity against *Proteus vulgaris* and *Salmonella typhimurium*, while the crude ethanol extract elucidates 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. A secondary metabolite dibutyl phthalate isolated from stem of *Ipomoea carnea* has also been recorded for anti-bacterial activity.

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). 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.

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 16.25mg/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 32.5mg/kg and 16.2mg/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, 2mg/kg as a standard. These observations indicate that ICLAE and ICLME showed an anxiolytic activity. 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.

Anti-fungal activity

Anti-fungal activity of *Ipomoea carnea* has been identified against *Alternaria alternate* and *curvularia lunata*. Chloroform and Methanol extract of *Ipomoea carnea* show antifungal activity against eleven pathogenic and non-pathogenic fungi. Anti-fungal 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 alternate* and *A. porri*. The active fraction was identified as a mixture of (E)-octadecyl p-coumarate and (Z)-octadecyl p-coumarate.

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. *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.

Anti-malarial activity

Synergistic effect of insecticides with plant extracts of *Ipomoea carnea* is reported against malarial vector, *Anopheles stephens.*

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. When atropine 1µg/ml was introduced in extract then the initial different phase was blocked used stimulant effect become stronger.

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 embryotoxicity. These effects are associated to an active principle from *Ipomoea carnea* acting on maternal homeostasis, or directly in the conception.

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). 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 7gm/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.

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, in-coordination 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. 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.

Anti-HIV activity

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 anti-inflammatory 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.

Glycosidase inhibitory activity

Analysis of *Ipomoea carnea* plant material by Gas Chromatography-Mass Spectrometry (GC-MS) 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).

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 250mg/kg and 500mg/kg body weight. The study concluded that *Ipomoea carnea* leaves posses a strong anti- inflammatory activity at dose of 500mg/kg and possesses better result as compare to etoricoxib 6mg/kg.

Anti-oxidant 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 ± 1.8µg of trolox equivalents). Total phenolic contents were maximum for chloroform fraction (113.05 ± 1.2mg of gallic acid equivalents).

Anti-diabetic activity

In one study anti-diabetic 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.

Anti-cancer activity

On the basis, the in-vitro and in-vivo studies it was found that hydroalcoholic extract of *Ipomoea carnea* leaves possess significant anticancer property with the dose dependent effect. This may probably due to the presence of phytochemicals such as alkaloids, phenols and flavonoids.

CONCLUSION

The biological importance and the few phytochemical studies reported on *Ipomoea carnea* encouraged the author to undertake this study to validate scientifically its reported uses in folk medicine and to trace new biological activities. This study insists the compilation of knowledge about the utility of the plant so their protection can be assured. The plant shows the presence of many active chemical constituents which are responsible for various pharmacological medicinal uses. Hence *Ipomoea carnea* has a leading role for the development of novel efficacious drugs in future and, *Ipomoea carnea* has a capacity for the development of new medicines in future. The above discussion shows that *Ipomoea carnea* is an ethnic valuable plant and it is used in a number of activities.

Ipomoea carnea as seen from the present investigation can also be used as Bio-pesticide, an effective reinforcement in polymeric composite creating a variety of technological applications beyond its traditional uses. The present study is aimed at identifying pharmaceutical potentials of locally available non-economical weed plants namely *Ipomoea carnea* commonly found in waste lands. The plant shows the presence of many chemical constituents which are responsible for various pharmacological medicinal properties. 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.

Declarations

Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

Conflict of interest

All authors declare that there is no conflict of interests regarding publication of this paper.

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Ethical approval

Not required.

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