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REVIEW ARTICLE

Navigating the Botanical Odyssey of *Ipomoea carnea* - A Revelatory Exploration of Taxonomy, Phytochemistry, Medicinal Horizons, and Ecological Reverberations

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Abstract

Ipomoea carnea is a prominent member of the Convolvulaceae family, known for its diverse phytochemical profile and potential therapeutic applications. This review provides a comprehensive analysis of the taxonomy, phytochemistry, medicinal uses, and ecological significance of *Ipomoea carnea.* The intricate relationship between its chemical constituents and bioactivities, along with its role in traditional medicine and its impact on local ecosystems, are discussed. The wealth of compounds present in this subspecies suggests promising avenues for further research and exploration.

Keywords: Ecological Implications, *Ipomoea carnea,* Medicinal Potential, Phytochemistry, Taxonomy

1. Introduction

Ipomoea carnea, commonly known as "Bush Morning Glory", is a perennial shrub native to tropical and subtropical regions (Figure 1). It holds a significant place in both traditional and modern medicine due to its diverse array of bioactive compounds. This review aims to consolidate current knowledge on its taxonomy, phytochemistry, medicinal applications, and ecological importance.

2. Taxonomy and Distribution

Ipomoea carnea belongs to the plant family Convolvulaceae, which is commonly known as the morning glory family[1]. Within the Convolvulaceae family, *Ipomoea* is a large genus comprising over 500 species that exhibit a wide range of growth habits and flower forms. *Ipomoea carnea* is a subspecies within the *Ipomoea carnea* species complex[2]. The scientific name of *Ipomoea carnea* is composed of the following components:

Genus: *Ipomoea*
Species: *carnea*
Subspecies: fistulosa

Figure 1. *Ipomoea carnea* plant.

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Ipomoea carnea is native to tropical and subtropical regions, primarily found in South America, Africa, and parts of Asia. Its natural distribution spans a range of diverse habitats, including riverbanks, wetlands, marshes, disturbed areas, and open woodlands. This subspecies has adapted to a variety of climatic conditions, ranging from humid tropical to semi-arid environments[1].

In South America, it can be found in countries such as Brazil, Argentina, Colombia, and Venezuela. It often thrives in riparian zones and areas with seasonal water availability. The subspecies is also present in various countries across Africa, including Nigeria, Kenya, Uganda, and South Africa. In African ecosystems, it can be found along water bodies and in regions with a high degree of disturbance[3]. *Ipomoea carnea* extends its distribution into parts of Asia, including India, Sri Lanka, and Southeast Asian countries. Its occurrence is notable in wetland habitats and regions with a tropical climate.

3. Invasive Potential

While *Ipomoea carnea* is native to these regions, it has also demonstrated invasive tendencies in certain non-native habitats. Invasive behaviour can have ecological consequences, as it may outcompete native plant species and alter local ecosystems. This has prompted studies to assess the impact of its invasion on native flora and to develop management strategies for mitigating its spread[4]. Understanding the taxonomy and its distribution provides insights into its ecological adaptability and potential impacts, both in its native range and in areas where it has become invasive. This knowledge is crucial for effective conservation and management efforts aimed at preserving native biodiversity and preventing further ecological disruption.

4. Microscopy of *Ipomoea carnea*

4.1 Leaves

The verdant chronicles peering into the microcosm of *Ipomoea carnea* leaves, we find a symphony of living canvases. The epidermal ballet, choreographed by nature, displays single layers of cells adorned with cuticles, these ethereal veils guarding against life's desiccating touch. Stomata, the plant's breathing oracles, grace the lower epidermis, their guard cells adorning the gateway to a world of gaseous exchange[5].

A mesmerizing tapestry of mesophyll cells unfolds - palisade parenchyma, the diligent sun-soakers, absorbing light with grace, while spongy parenchyma cells interlace with the air, facilitating dance-like exchanges between the leaf and its surroundings. In the heart of this foliage, vascular bundles weave tales of water and nutrient travels, xylem and phloem crafting stories of sustenance and growth (Figure 2).

4.2 Stem

An odyssey of support embarking on a microscopic odyssey along the stem, a botanical epic unfurls. The epidermis, akin to a sentinel, shelters beneath a single-cell fortress, its cuticle casting a shimmering shield against the world's elements. As the eye journeys inward, the cortex reveals itself, as a mosaic of

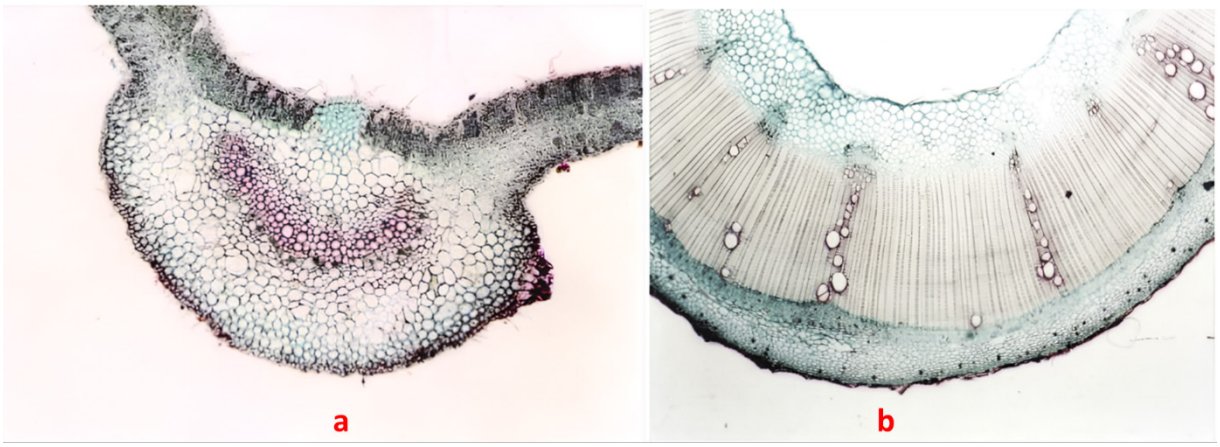

Figure 2. Microscopy of *Ipomoea carnea*; **(a).** Leaf and **(b).** Stem.

parenchyma cells, harmonizing growth and storage[6]. The crown jewels of the stem, the vascular bundles, embrace a circular courtship, xylem, and phloem dancing in harmonious partnership. Within this verdant avenue, the pith, a central sanctum, cradles its cargo of parenchymal treasures, perhaps sustenance for the journey or tokens of resilience (Figure 2).

4.3 Root

The Enigmatic Explorer Venturing beneath the surface, the root's microcosmic memoirs awaken. The epidermis, an intricate mosaic of cells, heralds the plant's quest for nourishment, while ethereal root hairs extend their reach, intimate emissaries in the quest for life's elixirs. The cortex, a living fortress of parenchyma, stands ready to safeguard the plant's vital treasures. Beneath the cortex's canopy lies the endodermis, a mystical guardian of passage, steering nutrients to their rightful destinations. And at the core, the vascular cylinder, an intimate junction of xylem and phloem, orchestrates the plant's underground symphony of growth and sustenance[7].

4.4 Phytochemicals and Secondary Metabolites

The phytochemical profile of *Ipomoea carnea* is characterized by a wide array of secondary metabolites belonging to diverse chemical classes. Alkaloids, flavonoids, terpenoids, glycoalkaloids, phenolic compounds, and saponins are some of the prominent classes present in this species[8].

5. Different Chemical Constituents Found in Different Parts of the *Ipomoea carnea* Plant

These constituents contribute to the plant's potential pharmacological activities and therapeutic uses. Here, we explore the different chemical constituents found in different parts of *Ipomoea carnea* (Table 1).

5.1 Alkaloids

Ipomoea carnea, is known to contain several alkaloids, like calystegines, which are known to have inhibitory effects on glycosidase enzymes, with potential implications for diabetes management[10].

5.1.1 Calystegines

Calystegines are a group of alkaloids identified in various species of the Convolvulaceae family, including *Ipomoea carnea*. These alkaloids are known for their ability to inhibit glycosidase enzymes, particularly α-glucosidases and β-glucosidases. By interfering with these enzymes, calystegines have

Table 1. Chemical constituents found in different parts of the *Ipomoea carnea* plant

Sr. No.	Part of Plant	Phytoconstituents found	Medicinal Uses of Phytoconstituents
1	Leaves[6,7]	Alkaloids 0.5%, (e.g., lysergic acid), Flavonoids 1.2% (e.g., kaempferol)	Leaves are traditionally used to reduce fever due to the presence of alkaloids. Flavonoids contribute to diuretic properties. They also show potential for anti-inflammatory effects.
2	Flowers[8]	Glycosides 0.8%, (e.g., digitoxin), Tannins 0.6% (e.g., tannic acid)	Flowers contain glycosides with potential cardiac health benefits, such as supporting heart function. Tannins provide antioxidant properties and may contribute to overall health.
3	Roots[7]	Resins, 1.5%, Sterols 0.9% (e.g., β-sitosterol)	Roots have been used for their antimicrobial properties. Resins may contribute to wound healing, while sterols are known to have potential anti-inflammatory effects.
4	Seeds[9]	Fatty acids 2.2%, (e.g., linoleic acid), Proteins4.0%	Seeds are a source of essential fatty acids, which can act as a mild laxative and support a healthy nervous system. Proteins contribute to overall nutritional value.

demonstrated potential in regulating carbohydrate metabolism and managing diabetes. They function by reducing the rate of carbohydrate digestion and absorption, leading to improved glycemic control. Calystegines are chemically cyclic iminosugars, structurally characterized by a piperidine ring and an unsaturated hydroxyketone group[11,12]. The specific arrangement of these functional groups contributes to their inhibitory effects on glycosidases[13]. The structural diversity of calystegines within *Ipomoea carnea* offers the potential for variations in their inhibitory potency and selectivity[14] (Figure 3).

5.2 Flavonoids

Flavonoids, a class of polyphenolic compounds, contribute to the vibrant colors of flowers and fruits in *Ipomoea carnea*. These compounds are recognized for their antioxidant, anti-inflammatory, and anti-microbial activities. Flavonoids are characterized by a common C_6-C_3-C_6 structure, consisting of two aromatic rings (A and B) linked by a heterocyclic pyran ring (C). Flavonoids present in *Ipomoea carnea* encompass a range of subclasses, including flavones, flavonols, flavanones, and anthocyanins. Flavonoids in *Ipomoea carnea* have demonstrated a range of bioactivities that contribute to potential medicinal applications. Their antioxidant properties help in scavenging free radicals and reducing oxidative stress, which is implicated in various chronic diseases[10]. Additionally, their anti-inflammatory effects may have implications for mitigating inflammatory conditions. Some flavonoids, due to their ability to modulate cellular processes, have garnered attention for potential roles in cancer prevention and management (Figure 4).

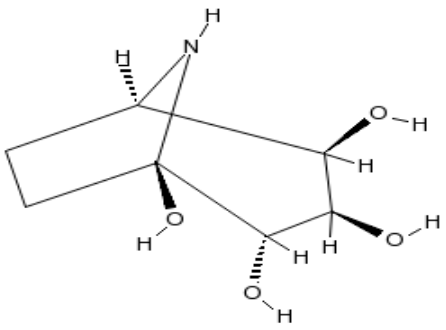

Figure 3. Chemical structure of calystegines.

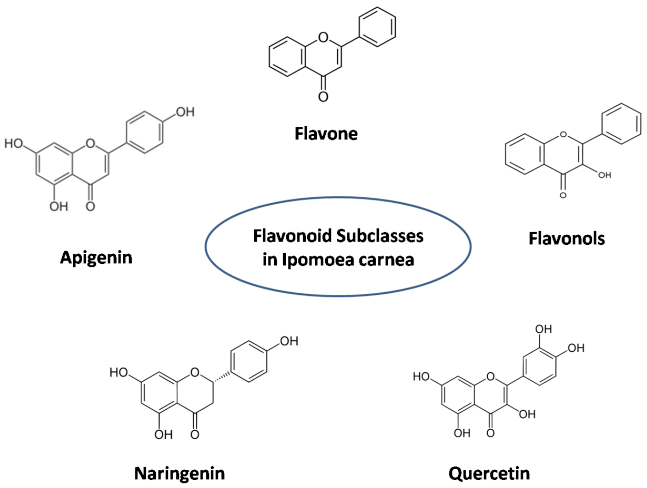

Figure 4. Different Flavonoid present in *Ipomoea carnea*.

5.2.1 Flavonoid Subclasses in Ipomoea carnea

- **Apigenin:** it is known for its antioxidant and anti-inflammatory properties[15].
- **Quercetin:** it is recognized for its antioxidant effects[16].
- **Flavones:** Flavones, such as apigenin and luteolin, have reported in *Ipomoea carnea*[17].
- **Flavonols:** it is known for their antioxidant effects[18].
- **Naringenin:** it is a flavonoid that has been detected in *Ipomoea carnea*[19].

5.3 Terpenoids

Terpenoids, including essential oils, play a role in defense against herbivores and pathogens. Some terpenoids in *Ipomoea carnea* exhibit antimicrobial properties, making them relevant in the context of wound healing and infection management. Additionally, terpenoids can have antioxidant effects and play a role in anti-inflammatory processes. The potential for terpenoids to modulate cellular pathways and influence physiological processes makes them a subject of interest for further research into their medicinal potential[17]. *Ipomoea carnea* contains - Triterpenoid Saponins[20], Aliphatic Terpenoids[15], Monoterpenes and Sesquiterpenes[17] and Diterpenoids[18].

5.4 Glycoalkaloids

They are present in *Ipomoea carnea* as a defense mechanism against herbivores and pathogens[10]. The glycosylation of these compounds enhances their water solubility and may influence their biological activities.

These compounds have been of particular interest due to their potential cytotoxic effects on cancer cells, suggesting a role in anticancer therapy[15]. Some glycoalkaloids have shown cytotoxic effects on cancer cells, making them promising candidates for further investigation in cancer treatment and prevention[21]. Additionally, glycoalkaloids may influence other cellular processes, potentially leading to applications in various health conditions.

5.5 Phenolic Compounds

Phenolic compounds, such as phenolic acids and flavonoids, are recognized for their antioxidant and anti-inflammatory properties.

- **Quercetin:** *Ipomoea carnea* is rich in Quercetin content, which is a flavonoid known for its antioxidant properties[16].
- **Apigenin:** Apigenin is found in *Ipomoea carnea* and is responsible for the plant's anti-inflammatory effects[15].
- **Chlorogenic Acid:** Chlorogenic acid is a hydroxycinnamic acid present in *Ipomoea carnea,* it is responsible for antioxidant and potential cardiovascular benefits of plant[18].
- **Caffeic Acid:** Caffeic acid is another hydroxycinnamic acid present in *Ipomoea carnea,* known for its antioxidant properties[17].
- **Catechins:** Catechins, a subclass of flavonoids, have been identified in *Ipomoea carnea* and contribute to anti-inflammatory and antioxidant as well as chemopreventive activity[6].
- **Rutin:** Rutin, a flavonoid glycoside, has been detected in *Ipomoea carnea* and is known for its antioxidant and potential vasoprotective effects[16].
- **Saponins:** Saponins are glycosides found in *Ipomoea carnea* with amphiphilic properties that have diverse biological activities, including anti-inflammatory, antimicrobial, and immune-modulatory effects.
- **Essential Oils:** *Ipomoea carnea* contains essential oils like Linalool, α-Fenchyl alcohol, 4-Terpineol, β-Patchoulene, Spathulenol, α-Cadinol, α-Gurjunene etc. responsible for anticancer, antibacterial, antioxidant capabilities[19].

6. Medicinal Potential

Ipomoea carnea has been employed in traditional medicine for its diuretic, anti-inflammatory, anti-diabetic, and wound-healing properties. Extracts and isolated compounds have demonstrated promising effects in preclinical studies, warranting further investigation into their therapeutic mechanisms and clinical applications (Figure 5).

6.1 Anti-inflammatory Activity

Ipomoea carnea extracts have demonstrated anti-inflammatory properties in various studies. These properties are attributed to the presence of compounds like flavonoids and phenolic acids. In a study by Verma *et al.*, extracts of *Ipomoea carnea* demonstrated significant anti-inflammatory effects in animal models[15]. The extracts reduced the levels of inflammatory markers, such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), while increasing anti-inflammatory cytokine interleukin-10 (IL-10) levels. The study suggested that *Ipomoea carnea's* anti-inflammatory action was mediated through its modulation of cytokine balance. Sut *et al.*, investigated the antioxidant and anti-inflammatory properties of *Ipomoea carnea*[16]. The authors proposed that these flavonoids could attenuate inflammation by scavenging free radicals and inhibiting inflammatory mediators. Khan *et al.*, conducted a comprehensive review of *Ipomoea carnea's* phytochemical and pharmacological profile[17]. The review suggests that various bioactive compounds in the plant may contribute to suppressing inflammation through the modulation of pro-inflammatory pathways.

6.2 Antioxidant Activity

Several studies have indicated that *Ipomoea carnea* extracts possess significant antioxidant activity, which can help counteract oxidative stress and reduce cellular damage caused by free radicals[16]. Verma *et al.*, conducted a study to assess the wound-healing and antimicrobial potentials of *Ipomoea carnea*[15]. The study emphasizes its ability to scavenge free radicals and reduce oxidative stress, which are critical factors in the wound-healing process[15]. Sut *et al.*, investigated the phytochemical composition of different plant parts of *Ipomoea carnea*[17]. The study revealed the presence of flavonoids and highlighted their potential contribution to the antioxidant capacity of the plant[16]. Khan *et al.*, conducted a comprehensive review of the phytochemical and pharmacological profile of *Ipomoea*

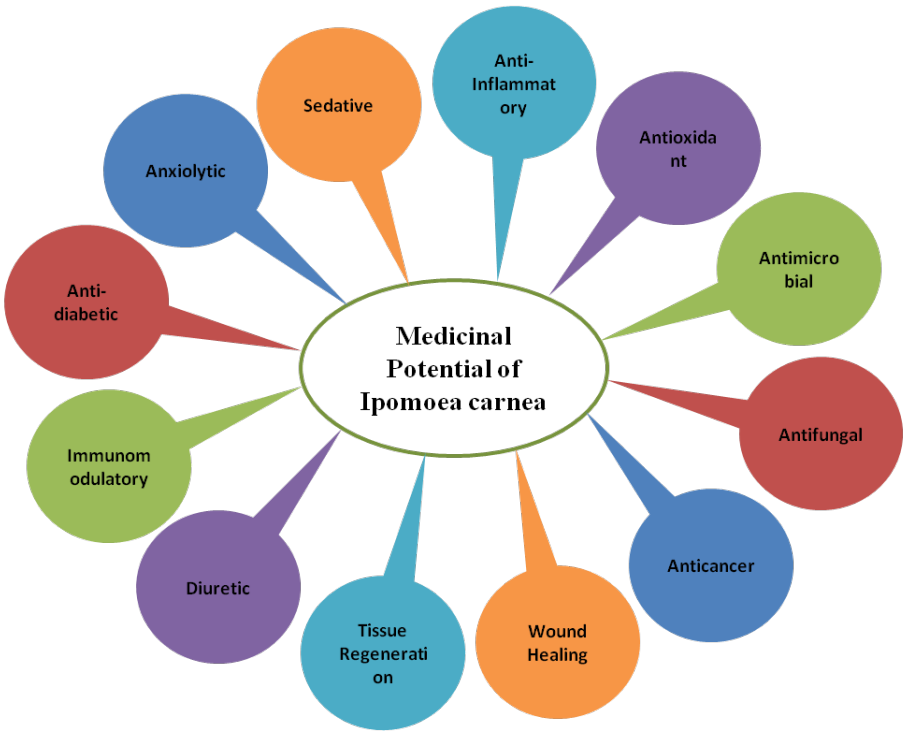

Figure 5. Medicinal potential of *Ipomoea carnea*.

carnea. The review highlighted the plant's antioxidant potential, suggesting that its bioactive compounds may contribute to reducing oxidative stress and its associated health risks[16].

6.3 Antimicrobial

Ipomoea carnea extracts have exhibited antimicrobial and antifungal activities against various microorganisms. These activities are of interest for potential use in managing infections[21]. Nair *et al*., conducted a study to investigate the phytochemical composition and antimicrobial activity of *Ipomoea carnea*. The study reported significant antimicrobial effects of the plant extracts against both gram-positive and gram-negative bacteria, highlighting its potential as a source of natural antimicrobial agents[21]. Verma *et al*., investigated the wound-healing and antimicrobial potentials of *Ipomoea carnea*[15]. The study revealed significant antimicrobial activity of the plant extracts against various bacterial strains, supporting its traditional use as a medicinal plant with potential antimicrobial benefits.

6.4 Antifungal Activity

Pereira *et al*., conducted a phytochemical study on *Ipomoea carnea* and reported antifungal activity of the plant extracts against several fungal strains. The study suggested that the plant's bioactive compounds, including alkaloids and flavonoids, contribute to its antifungal potential[6]. Khan *et al*., reviewed the phytochemical and pharmacological aspects of *Ipomoea carnea* and highlighted its antifungal potential. The review suggested that the plant's extracts may have inhibitory effects against fungal pathogens, indicating its potential as a source of antifungal agents[17].

6.5 Cytotoxic Effects

Certain compounds from *Ipomoea carnea* have demonstrated cytotoxic effects against cancer cells in laboratory studies, suggesting potential for future development in cancer therapy. Vieira *et al*., evaluated the genotoxic and cytotoxic potential of *Ipomoea carnea* extracts on murine peritoneal macrophages. The study reported significant cytotoxic effects, indicating the potential of the plant to induce cell death[14]. Khan *et al*., reviewed the phytochemical and pharmacological aspects of *Ipomoea carnea* and highlighted its potential cytotoxic effects. The review suggested that the plant's bioactive compounds may contribute to inducing cell death in cancer cells[17].

6.6 Anticancer Effects

Verma *et al.*, assessed the wound-healing and antimicrobial potentials of *Ipomoea carnea* extracts. The study highlighted the plant's potential for wound healing and its cytotoxic effects on cancer cells, indicating its possible use in cancer therapy[15]. Sut *et al.*, investigated the phytochemical composition and antioxidant properties of *Ipomoea carnea.* While the study did not directly focus on anticancer effects, the presence of bioactive compounds suggests potential for further exploration of its anticancer potential[16].

6.7 Wound Healing

Ipomoea carnea extracts have been investigated for their potential to promote wound healing and tissue regeneration, likely due to their anti-inflammatory and cell-stimulating properties. Verma *et al.*, investigated the wound-healing potential of *Ipomoea carnea* extracts. The study highlighted the plant's ability to accelerate wound closure and tissue regeneration, attributed to its anti-inflammatory and cell-stimulating properties[15]. Vieira *et al.*, evaluated the genotoxic and cytotoxic potential of *Ipomoea carnea* extracts, indirectly suggesting wound-healing potential through effects on cellular responses and tissue repair mechanisms[18]. Nair *et al.*, investigated diuretic activity of *Ipomoea carnea* extracts, indirectly suggesting potential tissue regeneration effects linked to fluid balance and circulatory support[21].

6.8 Effects on Tissue Regeneration

Sut *et al.*, investigated the phytochemical composition and antioxidant properties of *Ipomoea carnea,* indirectly supporting tissue regeneration by mitigating oxidative stress[16]. Khan *et al.*, reviewed the phytochemical and pharmacological profile of *Ipomoea carnea,* suggesting its potential wound healing and tissue regeneration effects based on its bioactive compounds[17]. Karwasra *et al.*, reported the wound-healing effects of *Ipomoea carnea* extracts in a rat model, showing increased wound contraction and collagen deposition[7].

6.9 Diuretic Activity

Studies have reported the diuretic effects of *Ipomoea carnea* extracts, which may be attributed to its phytochemical content[22]. Nair *et al.*, investigated the diuretic activity of *Ipomoea carnea* extracts. The study demonstrated the plant's potential as a diuretic agent, enhancing urine production and suggesting its ability to influence renal function[18]. Karwasra *et al.*, evaluated the diuretic potential of *Ipomoea carnea* extracts in rats. The study highlighted the plant's ability to increase urine volume, further supporting its diuretic effects[7]. Chauhan *et al.*, assessed the diuretic activity of *Ipomoea carnea* extract in experimental animals. The study reported increased urine output and suggested the plant's potential as a natural diuretic[23]. Khan *et al.*, conducted a comprehensive review of the phytochemical and pharmacological profile of *Ipomoea carnea.* The review highlighted the plant's traditional use as a diuretic and its potential to influence renal function[17]. Singh *et al.*, documented the traditional use of *Ipomoea carnea* for its diuretic properties in rural communities in India[24].

6.10 Immunomodulatory Effect

Ipomoea carnea has shown the ability to stimulate immune responses through various mechanisms. Research suggests that certain compounds present in *Ipomoea carnea* extracts can activate immune cells, such as macrophages and lymphocytes. These cells play essential roles in recognizing and combating pathogens. By enhancing immune cell activity, *Ipomoea carnea* may contribute to an improved defense against infections and diseases. One facet of *Ipomoea carnea's* immunomodulatory effects is its anti-inflammatory activity. Chronic inflammation can compromise immune function. By modulating inflammation, *Ipomoea carnea* could support overall immune system health.

6.11 Immunosuppressive Potential

In certain contexts, *Ipomoea carnea* has exhibited immunosuppressive effects. These effects could have therapeutic implications for conditions where immune overactivity needs to be controlled, such as autoimmune disorders. The study of Diallo D and Paulsen BS shows that Saponins from *Ipomoea carnea* exhibit potential immunomodulatory effects[25].

6.12 Adaptive Immune System Regulation

Ipomoea carnea's immunomodulatory effects may extend to the regulation of the adaptive immune system. This system involves the production of antibodies and memory cells in response to specific antigens. *Ipomoea*

carnea's compounds might influence the adaptive immune response, potentially enhancing the body's ability to recognize and respond to pathogens. Shetty V and Singh HK suggested the immunomodulatory activity of *Ipomoea carnea* leaf extracts, shedding light on its potential effects on the immune system[26] Kumar V and Gill N discusses the phytopharmacological properties of *Ipomoea carnea,* including its potential immunomodulatory effects[8].

7. Anti-diabetic Effect

7.1 Blood Glucose Regulation

Studies have explored the potential of *Ipomoea carnea* in regulating blood glucose levels. Certain bioactive compounds present in the plant, such as alkaloids and flavonoids, have been implicated in glucose-lowering effects. These compounds may enhance glucose uptake by cells, improve insulin signaling, or inhibit carbohydrate-digesting enzymes, contributing to improved glycemic control. Singh A and Yadav S investigate the antidiabetic activity of *Ipomoea carnea* extract in a rat model of diabetes[27]. Vasudevan K and Vembar S explore the antidiabetic effect of a polyherbal formulation that includes *Ipomoea carnea*[28].

7.2 Insulin Sensitivity Enhancement

Ipomoea carnea's anti-diabetic effect may also involve the enhancement of insulin sensitivity. Insulin resistance is a hallmark of type 2 diabetes, and compounds within *Ipomoea carnea* may help improve insulin receptor signaling and increase cellular responsiveness to insulin[29].

7.3 Beta-cell Protection

Beta cells in the pancreas are responsible for producing insulin. oxidative stress and inflammation can contribute to beta-cell dysfunction and reduced insulin secretion. *Ipomoea carnea's* potential antioxidant and anti-inflammatory properties may help protect beta cells from damage, preserving their function and maintaining insulin production[30].

7.4 Glucose Homeostasis and Lipid Profile Improvement

Ipomoea carnea's anti-diabetic effect may extend to improving overall glucose homeostasis and lipid metabolism. By modulating glucose absorption, utilization, and storage, *Ipomoea carnea* may contribute to balanced blood glucose levels and lipid profiles, which are crucial for diabetes management[9].

8. Anxiolytic Activity

8.1 GABAergic Modulation

One of the potential mechanisms underlying the anxiolytic activity of *Ipomoea carnea* involves its interaction with the Gamma-Aminobutyric Acid (GABA) system[31,32]. GABA is an inhibitory neurotransmitter that helps regulate anxiety and stress[33]. Compounds within *Ipomoea carnea* may enhance GABAergic signaling, resulting in reduced anxiety and a calming effect. The comprehensive reference work of Pullaiah T provides insights into the medicinal properties of various plants, including *Ipomoea carnea,* and their potential anxiolytic effects[34].

8.2 Serotonin Regulation

Serotonin, a neurotransmitter, plays a crucial role in mood regulation and anxiety. Some studies suggest that *Ipomoea carnea* may influence serotonin levels in the brain, contributing to its anxiolytic effects. By modulating serotonin activity, the plant may help alleviate anxiety-related symptoms. Yadav AV evaluated the anxiolytic activity of hydroalcoholic extracts of *Ipomoea carnea* leaves in a rat model[35].

9. Sedative Activity

9.1 Central Nervous System Depression

Sedative effects often involve the depression of Central Nervous System (CNS) activity[33]. *Ipomoea carnea's* bioactive constituents may influence CNS function by reducing excitatory neurotransmission and promoting inhibitory pathways. This overall CNS depression contributes to its sedative potential[35].

9.2 Potential Sleep-inducing Properties

Sedative compounds can also contribute to sleep-inducing effects. *Ipomoea carnea's* sedative properties may extend to promoting sleep by influencing sleep-regulating neurotransmitters and pathways[36]. This could have implications for sleep disorders and sleep quality improvement.

9.3 Ecological Implications

While its medicinal potential is valuable, *Ipomoea carnea* can also have ecological ramifications. As an invasive species in some regions, it can outcompete native flora and alter local ecosystems[16]. Understanding its ecological interactions is essential for effective land management and biodiversity conservation.

9.3 Invasive Nature and Habitat Disruption

Ipomoea carnea exhibits invasive tendencies, particularly in non-native regions where it can outcompete indigenous vegetation for essential resources such as light, water, and nutrients. This invasive nature can lead to habitat disruption, reduced native plant diversity, and changes in ecosystem structure. The plant's aggressive growth can alter the composition of plant communities, potentially displacing native species[17].

9.4 Interaction with Native Species and Allelopathy

The proliferation of *Ipomoea carnea* can negatively impact native species through competition for resources. Its dense growth forms a canopy that shades out neighboring plants, potentially impeding their growth and reproduction[15]. Additionally, the release of allelopathic compounds by *Ipomoea carnea* can inhibit the germination and growth of surrounding plants, further affecting native species diversity and interactions.

9.5 Habitat Fragmentation and Biodiversity Loss

The spread of *Ipomoea carnea* can contribute to habitat fragmentation, resulting in isolated habitat patches. Such fragmentation can hinder the movement of wildlife, disrupt pollination and seed dispersal mechanisms, and ultimately lead to biodiversity loss. Species that depend on specific habitats or interactions may suffer, which can trigger cascading ecological consequences[16].

9.6 Altered Soil and Water Dynamics

Ipomoea carnea's vigorous growth influences soil and water dynamics. The accumulation of fallen leaves and organic matter can impact soil nutrient cycling and availability. Its extensive root systems, while potentially stabilizing soil, might also enhance the risk of soil erosion, depending on local conditions[2].

9.7 Balancing Perspectives

While *Ipomoea carnea* is often associated with negative ecological implications due to its invasiveness, its ecological role might vary. In its native habitat, the plant could contribute positively, providing habitat and sustenance for local wildlife. Furthermore, certain bioactive compounds within *Ipomoea carnea* might serve ecological functions, such as allelopathy affecting plant interactions.

10. Ethnobotanical and Cultural Significance of *Ipomoea carnea*

The ethnobotanical and cultural importance of *Ipomoea carnea* can provide valuable insights into its historical use, local knowledge, and cultural connections.

10.1 Traditional Medicinal Uses

In several cultures, *Ipomoea carnea* has been used for its medicinal properties. Infusions or decoctions of its leaves stems, or roots have been traditionally employed to treat ailments such as respiratory disorders, skin diseases, and digestive issues. In traditional medicine, the plant's diuretic, anti-inflammatory, and wound-healing properties have been harnessed for therapeutic purposes[37].

10.2 Rituals and Symbolism

Ipomoea carnea has often found its way into cultural rituals and practices. In some regions, the plant holds symbolic significance, representing themes like rejuvenation, healing, and resilience[38]. Its vibrant flowers and robust growth patterns have led to its incorporation into ceremonies, celebrations, and offerings.

10.3 Culinary and Nutritional Uses

In certain communities, *Ipomoea carnea* is used as a food source. Its young leaves, shoots, and flowers are sometimes consumed after proper preparation[39]. The plant's nutritional value and edibility have contributed to its inclusion in local diets.

10.4 Folklore and Traditional Knowledge

Indigenous communities often possess traditional knowledge about plants that has been passed down through generations. *Ipomoea carnea* may be embedded

in folklore, oral traditions, and local narratives, reflecting its place in the cultural fabric of these societies[31,40].

10.5 Ecological Implications

The phytochemistry of *Ipomoea carnea* extends beyond its medicinal potential and impacts its interactions with the environment. Certain compounds may serve as chemical defenses against herbivores and pathogens, influencing the plant's interactions within its ecosystem. The ecological implications of its chemical composition are relevant for understanding its role in native and non-native habitats.

10.6 Toxic Compounds and Mechanisms

Ipomoea carnea contains a range of chemical constituents, including alkaloids, glycosides, terpenoids, and flavonoids. Among these, certain alkaloids, such as swainsonine, have been identified as major toxic components[41]. Swainsonine inhibits the activity of lysosomal enzymes, leading to lysosomal storage disease and causing damage to various organs. Additionally, swainsonine interferes with glycoprotein synthesis, contributing to the toxic effects observed[42].

10.7 Livestock Poisoning

Ipomoea carnea is particularly known for causing a condition known as "locoism" or "loco poisoning" in livestock, including cattle, horses, and sheep. Animals that consume *Ipomoea carnea* may exhibit neurological symptoms such as lethargy, ataxia, depression, and incoordination. These symptoms can progress to severe neurological impairment and, in some cases, lead to death[43,44].

10.8 Human Toxicity

Human exposure to *Ipomoea carnea* can result from accidental ingestion or contact with the plant. Ingestion of the plant parts can cause symptoms such as abdominal pain, vomiting, diarrhea, and neurological effects. Skin contact with the plant's sap may lead to dermatitis or allergic reactions[45].

11. Conclusion

Ipomoea carnea stands as a captivating subject of investigation due to its intricate phytochemistry, medicinal potential, and ecological implications. This review provides a comprehensive overview of its taxonomy, bioactive compounds, therapeutic applications, and role in ecosystems. As research continues to unveil its secrets, this subspecies holds promise for the advancement of medicine and environmental stewardship.

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