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PSYCHOPHARMACOLOGICAL RELEVANCE OF CUCURBITACEAE PLANTS: A REVIEW OF PHYTOCHEMICALS AND FUTURE APPLICATIONS

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ABSTRACT

The Cucurbitaceae family, commonly known as the gourd or squash family, comprises a diverse group of plants widely cultivated and consumed across tropical and subtropical regions. Traditionally recognized for their nutritional and medicinal value, recent phytochemical and pharmacological studies have drawn attention to their potential role in neuropharmacology. This review consolidates current knowledge on the major bioactive constituents of Cucurbitaceae plants, including cucurbitacins, flavonoids, alkaloids, triterpenoids, phenolic acids, sterols, and saponins. These phytochemicals exhibit a broad spectrum of central nervous system (CNS) activities such as anxiolytic, antidepressant, anticonvulsant, neuroprotective, and cognitive-enhancing effects. Special emphasis is placed on the mechanisms by which these compounds modulate neurotransmitter pathways, oxidative stress, and neuroinflammation. Furthermore, the review explores the chemotaxonomic relevance of these metabolites and discusses future directions in drug discovery, including bioassay-guided fractionation, preclinical validation, and translational research. Overall, this work highlights the neurotherapeutic potential of the Cucurbitaceae family and supports its further exploration as a promising source for novel CNS-active agents.

KEYWORDS: Cucurbitaceae; Phytochemicals; Cucurbitacins; Flavonoids; Alkaloids; Medicinal plants; Psychopharmacology etc.

INTRODUCTION

The Cucurbitaceae, commonly known as the gourd family, belongs to the order *Cucurbitales* and comprises over 800 species distributed worldwide.[1] This diverse family includes economically and nutritionally important crops, many of which are cultivated extensively for their edible fruits. Botanically, most Cucurbitaceae members are annuals, with a few rare perennials. They typically possess herbaceous, angular stems that trail or climb with the aid of tendrils. The leaves are generally lobed or divided, palmately veined, and borne on long, hollow petioles. Both stems and leaves contain a watery, mucilaginous sap, and the roots and branches often thicken due to the storage of nutrients and water. The flowers are usually white or yellow and predominantly unisexual.[2]

Phytochemically, members of the Cucurbitaceae family are rich in diverse bioactive compounds. These include non-nutritive phytochemicals such as tannins, saponins, carbohydrates, and cardiac glycosides, as well as potent constituents like triterpenes, sterols, alkaloids, and terpenoids compounds biosynthesized from isoprene units.[3] These secondary metabolites contribute to the family's notable pharmacological properties.

Prominent species within this family include *Benincasa hispida* (wax gourd), *Benincasa fistulosa* (apple gourd), *Coccinia grandis* (ivy gourd), *Lagenaria siceraria* (bottle gourd), *Cucumis melo* (musk melon), *Cucumis sativus* (cucumber), *Cucurbita maxima* (pumpkin), *Cucurbita pepo* (field pumpkin), *Citrullus lanatus* (watermelon), *Luffa acutangula* (ridge gourd), *Luffa cylindrica* (sponge gourd), and *Trichosanthes dioica*, among others.[4]

Globally, cucurbits such as watermelon, melon, cucumber, squash, pumpkin, and zucchini hold major agricultural and commercial importance. Conservation of genetic resources within the Cucurbitaceae family is critical. A global strategy should emphasize both effective utilization and economical conservation, particularly through ex situ methods such as seed banking, where viable seeds are preserved under controlled conditions for long-term storage.[5] Beyond their economic value, Cucurbitaceae crops are recognized for their extensive medicinal potential. Nearly all plant parts roots, leaves, fruits, and seeds have been investigated for various pharmacological activities, establishing the family as a significant source of bioactive natural products.[6]

The Future of Therapy with Cucurbits

The rising incidence of antibiotic resistance among bacterial and fungal pathogens poses a significant global health threat, prompting urgent action to discover alternative therapeutic options for both human and veterinary medicine. The World Health Organization (WHO) has emphasized the alarming rate of resistance among bacterial strains, drawing attention to the need for novel bioactive agents. In this context, the Cucurbitaceae family commonly known as cucurbits offers promising potential through bioprospecting.[7]

Cucurbits have long been valued in Ayurvedic and traditional folk medicine systems due to their rich repertoire of primary and secondary metabolites, which contribute to a wide range of therapeutic effects.[8] Botanically, the family is classified into several tribes, with detailed taxonomic studies highlighting key species, such as those within the genus *Cucumis*, based on revised classifications.[9]

Despite their ethnomedicinal relevance and widespread consumption as vegetables and salads, many wild and cultivated cucurbit species remain underutilized and undervalued. Greater awareness of their traditional Unani applications and pharmacological properties could promote conservation efforts and justify further scientific exploration. Enhancing productivity on a sustainable basis particularly through breeding programs aimed at improving resistance to biotic and abiotic stressors while maintaining desirable quality traits is critical for future utilization.[10]

Phytochemical investigations have unveiled a broad spectrum of secondary metabolites in cucurbits, including cucurbitacins, flavonoids, alkaloids, saponins, and terpenoids. These compounds not only serve as natural defense agents for the plants but also exhibit potent pharmacological activities. Their roles in modulating inflammation, combating cancer, managing metabolic disorders, and influencing central nervous system function have gained increasing attention. This review seeks to consolidate the extensive phytochemical knowledge of the Cucurbitaceae family, emphasize the therapeutic relevance of individual constituents, and explore their emerging potential in psychopharmacological research.[11]

2. Major Phytochemicals Identified in Cucurbitaceae and Their Importance

2.1 Cucurbitacins: Cucurbitacins are a group of highly oxygenated tetracyclic triterpenoids classified as secondary metabolites, originally isolated from members of the Cucurbitaceae

family. They are well known for their diverse biological activities, including analgesic, anti-inflammatory, antimicrobial, antiviral, and anticancer properties.[12]

2.2 Flavonoids: Flavonoids, another class of secondary metabolites present in the Cucurbitaceae family, are primarily recognized for their antimicrobial, antioxidant, and anti-inflammatory effects.[13]

2.3 Saponins: Saponins, found in various Cucurbitaceae species, are secondary metabolites known for their surfactant properties and a wide range of pharmacological activities, including antimicrobial and immunomodulatory effects. They have also been identified in the bark of *Acacia arabica*, highlighting their broader occurrence beyond cucurbits.[14]

2.4 Alkaloids: Alkaloids are nitrogen-containing secondary metabolites with notable pharmacological potential. Phytochemical screening of Cucurbitaceae family plants such as *Coccinia indica*, *Momordica dioica*, *Praecitrullus fistulosus*, and *Trichosanthes dioica* has confirmed the presence of alkaloids.[15]

2.5 Triterpenoids: Triterpenoids, especially tetracyclic compounds, are significant secondary metabolites found in the Cucurbitaceae family. These compounds have been identified through various phytochemical screening studies and are known for their anti-inflammatory and hepatoprotective activities.[16]

2.6 Glycosides and Sterols: *Coccinia grandis*, a member of the Cucurbitaceae family, contains several secondary metabolites, including glycosides, sterols, and alkaloids. These compounds contribute to the plant's medicinal value, particularly in traditional systems of medicine.[17]

2.7 Phenol Derivatives: A specific phenolic compound, 3, 5-bis (1, 1-dimethyl) phenol, has been isolated from Cucurbitaceae species and is noted for its anthelmintic activity, demonstrated using *Pheretima posthuma* as the animal model.[18]

3. MATERIALS AND METHODS

This review was conducted through a comprehensive literature search using databases such as PubMed, ScienceDirect, Scopus, and Google Scholar. The inclusion criteria focused on original research and reviews from 2000 to 2025, specifically addressing phytochemical investigations in Cucurbitaceae species. Relevant keywords used included "Cucurbitaceae

phytochemicals," "cucurbitacins," "neuropharmacology," and "plant secondary metabolites." Data were systematically extracted, classified by compound type, and evaluated for pharmacological relevance.

4. Role of Cucurbitaceae Family Plants in Psychopharmacological Treatment

Emerging research highlights the Psychopharmacology potential of various phytochemicals present in the Cucurbitaceae family. Several species within this family have demonstrated significant psychotropic activities in preclinical models

- **Cucumis melo var. momordica**: The ethanolic extract of this variety has shown notable antianxiety effects.[19]
- ***Lagenaria siceraria* (Bottle Gourd)**: Studies have investigated its antipsychotic potential, emphasizing the mechanisms of action of different active fractions.[20]
- ***Momordica charantia* Linn.** The methanolic extract exhibits both antidepressant and anxiolytic properties, supporting its therapeutic relevance in mood disorders.[21]
- ***Telfairia occidentalis* (Fluted Pumpkin)**: This plant has been reported to produce anticonvulsant, muscle relaxant, and antidepressant effects in murine models.[22]
- ***Cucurbita pepo* L.**: The ethanolic seed extract has been shown to enhance cognitive function and rejuvenate brain antioxidant markers, including modulation of acetylcholinesterase activity in a scopolamine-induced dementia model.[23]
- ***Citrullus lanatus***: The hexane seed extract has been evaluated for central nervous system (CNS) activity, revealing promising neuroactive effects.[24]
- ***Momordica cymbalaria* Hook. f.**: The fruit's hydroalcoholic extract has demonstrated significant antidepressant effects in animal behavioral models.[25]

These findings collectively suggest that members of the Cucurbitaceae family hold considerable promise in the development of novel psychopharmacological agents.

5. Future Potential of Cucurbitaceae in Neuropharmacology

Recent studies indicate that several Cucurbitaceae species possess promising Psychopharmacological properties, positioning them as potential candidates for the development of novel CNS-active agents. Notable examples include

- ***Cucurbita maxima*, *Lagenaria siceraria*** (Bottle Gourd), and Sechium edule (Chayote/Mirliton Squash): These species have demonstrated general central nervous system (CNS) activity in preclinical evaluations.[26]

- ***Benincasa hispida***: Exhibits notable antidepressant and antiepileptic effects.[27]
- ***Cucurbita pepo***: Seeds rich in flavonoids have shown significant anti-stress activity.[28]
- ***Lagenaria siceraria***: Further studies support its antidepressant potential.[29]
- ***Praecitrullus fistulosus*** (Indian Squash): Contains bioactive flavonoids and alkaloids that contribute to observed anti-stress effects.[30]

These plants exhibit multitarget mechanisms, including modulation of neurotransmitter systems, attenuation of oxidative stress, and reduction of neuroinflammatory responses. Such a broad spectrum of activity supports their potential utility in the treatment of various neuropsychiatric and neurodegenerative disorders.

These plants may serve as candidates for developing novel neuropharmacological agents due to their multitarget effects on neurotransmitter systems, oxidative stress, and neuroinflammation.

CONCLUSION

The Cucurbitaceae family stands out as a valuable reservoir of phytochemicals with significant therapeutic promise, particularly in the field of Psychopharmacology**.** Traditional knowledge and modern research collectively highlight the wide-ranging biological effects of its key constituents, including flavonoids**,** alkaloids**,** and terpenoids, which are increasingly recognized for their ability to influence critical neurological pathways. Evidence from preclinical studies suggests beneficial effects in managing conditions such as anxiety**,** depression**,** cognitive impairment**,** and neurodegenerative disorders**.** However, the transition from traditional use and experimental findings to clinically approved therapies necessitates rigorous bioassay-guided isolation**,** mechanistic elucidation, and clinical trials. Advancing such research will not only validate the neurotherapeutic potential of cucurbitaceous plants but also contribute to the discovery of novel, plant-based CNS drugs**.** Continued exploration of this underutilized botanical family may thus offer new avenues for safe, effective, and affordable treatments for neurological disorders.

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