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EXPLORING THE PHYTOCHEMISTRY AND PHARMACOLOGICAL SIGNIFICANCE OF *CASSIA SPECTABILIS*

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Abstract:
Cassia spectabilis, a member of the Fabaceae family, is a tropical ornamental plant known for its vibrant yellow flowers and a wide range of therapeutic properties. This review highlights the phytochemical composition and pharmacological potential of C. spectabilis extracts. Various studies have identified the presence of flavonoids, alkaloids, tannins, saponins, and phenolic compounds that contribute to its biological activities. The plant exhibits multiple pharmacological properties, including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, and anticancer effects. These activities are attributed to its bioactive constituents that interact with cellular pathways and free radical scavenging mechanisms. Despite extensive preliminary findings, further studies are required to isolate, characterize, and validate the therapeutic potential of its active compounds through advanced pharmacological and clinical evaluations. This review aims to provide comprehensive insight into the phytochemistry and pharmacological importance of Cassia spectabilis, emphasizing its potential as a source of novel bioactive agents in drug discovery.

Keywords: Cassia spectabilis, phytochemical screening, pharmacological activity, antioxidant, medicinal plants, bioactive compounds.

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INTRODUCTION:

Medicinal plants have long served as an essential source of therapeutic agents for treating a wide range of diseases. According to the World Health Organization (WHO), more than 80% of the world's population relies on traditional medicines, primarily of plant origin, for their primary healthcare needs (WHO, 2013). Among the diverse medicinal flora, the genus *Cassia* (family: Fabaceae) comprises more than 500 species distributed in tropical and subtropical regions and is well known for its pharmacological importance (Kumar et al., 2020).

Cassia spectabilis DC., commonly known as Golden Shower or Yellow Cassia, is an ornamental tree widely distributed in tropical Asia and South America. Traditionally, various parts of *C. spectabilis*, including leaves, flowers, bark, and seeds, have been used for their medicinal properties, such as antibacterial, antifungal, antioxidant, anti-inflammatory, antimalarial, and antidiabetic activities (Nirmal et al., 2015; Rahman et al., 2018). The plant is rich in a variety of phytoconstituents such as flavonoids, alkaloids, tannins, phenolic compounds, saponins, and glycosides, which are largely responsible for its diverse pharmacological effects (Arunachalam et al., 2014).

Phytochemical screening of *C. spectabilis* extracts has revealed the presence of bioactive compounds that contribute to its potent antioxidant potential. These natural antioxidants play a vital role in neutralizing free radicals, thereby preventing oxidative stress-related disorders such as diabetes, cardiovascular diseases, neurodegenerative conditions, and cancer (Ali et al., 2020). Recent studies have demonstrated that the ethanolic and aqueous extracts of *C. spectabilis* possess significant free radical scavenging activity against DPPH, hydrogen peroxide, and nitric oxide radicals, suggesting its potential application in natural antioxidant therapy (Jaiswal et al., 2022).

Given the growing global interest in plant-based therapeutics, this review aims to provide a comprehensive overview of the phytochemical composition and pharmacological significance of *Cassia spectabilis*. It also highlights recent advances in the understanding of its bioactive constituents, mechanisms of action, and therapeutic potential, thereby emphasizing its value as a promising candidate for future drug development.

Phytochemical Constituents of *Cassia spectabilis*

The therapeutic efficacy of *Cassia spectabilis* is largely attributed to its diverse array of bioactive phytoconstituents. Phytochemical investigations of various parts of the plant including leaves, flowers, seeds, and bark have identified the presence of flavonoids, alkaloids, glycosides, phenolics, tannins, saponins, and terpenoids (Rahman et al., 2018; Arunachalam et al., 2014). These compounds play crucial roles in the plant's biological activities, acting as antioxidants, antimicrobial agents, and enzyme inhibitors.

Flavonoids and phenolic compounds are among the most abundant secondary metabolites in *C. spectabilis*. They are known for their potent free radical scavenging activity, metal chelation ability, and role in preventing oxidative stress-related diseases (Ali et al., 2020). Ethanolic and aqueous extracts of *C. spectabilis* have demonstrated significant levels of total phenolic and flavonoid contents, suggesting their potential as natural antioxidants (Jaiswal et al., 2022).

Alkaloids and glycosides identified in *C. spectabilis* contribute to its antimicrobial, antimalarial, and antidiabetic properties (Nirmal et al., 2015). Studies have reported the isolation of specific bioactive compounds such as spectaline, spectalinone, and cassiarin A a potent antimalarial alkaloid structurally related to acridone derivatives (Viegas et al., 2004). Cassiarin A has been shown to exhibit strong activity against *Plasmodium falciparum*, highlighting the plant's potential as a source of novel antimalarial agents (Abe et al., 2010).

Furthermore, triterpenoids and saponins present in the plant are associated with anti-inflammatory and cytoprotective effects. These compounds stabilize biological membranes, modulate oxidative pathways, and enhance immune responses (Kumar et al., 2020). The presence of tannins and diterpenes has also been linked to the plant's antimicrobial and hepatoprotective actions (Arunachalam et al., 2014).

Phytochemical profiling using chromatographic and spectroscopic techniques including TLC, HPLC, and GC-MS has provided valuable insights into the chemical diversity of *C. spectabilis*. Recent GC-MS studies of ethanolic extracts revealed the presence of bioactive molecules such as phytol, linoleic acid, and stigmasterol, which contribute to the plant's antioxidant and anti-inflammatory activities (Akinmoladun et al., 2021).

Collectively, these findings emphasize that *Cassia spectabilis* is a rich reservoir of pharmacologically active compounds, which warrant further exploration for the development of plant-derived therapeutic agents.

Pharmacological Activities of *Cassia spectabilis*

Cassia spectabilis possesses a wide spectrum of pharmacological activities due to its rich phytochemical composition. Various preclinical and experimental studies have demonstrated its antioxidant, antimicrobial, anti-inflammatory, antimalarial, antidiabetic, and hepatoprotective potential (Nirmal et al., 2015; Rahman et al., 2018).

1. Antioxidant Activity

Reactive oxygen species (ROS) are major contributors to oxidative stress, which plays a key role in the pathogenesis of several chronic diseases. The ethanolic and aqueous extracts of *C. spectabilis* have shown strong free radical scavenging activity in DPPH, hydrogen peroxide, and nitric oxide assays, with IC_{50} values indicating significant antioxidant potential (Jaiswal et al., 2022). The presence of flavonoids and phenolic compounds is mainly responsible for this activity, as these compounds neutralize free radicals and inhibit lipid peroxidation (Ali et al., 2020).

2. Antimicrobial and Antifungal Activity

Extracts from the leaves and flowers of *C. spectabilis* have demonstrated potent antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, as well as antifungal activity against *Candida albicans* (Rahman et al., 2018). The observed antimicrobial effect is attributed to bioactive constituents such as alkaloids, flavonoids, and saponins, which disrupt microbial cell membranes and inhibit enzyme synthesis (Akinmoladun et al., 2021).

3. Anti-inflammatory and Analgesic Activity

The anti-inflammatory potential of *C. spectabilis* has been confirmed through in vivo studies using carrageenan-induced paw edema and formalin-induced inflammation models. Ethanolic extracts reduced inflammation significantly, suggesting inhibition of cyclooxygenase and prostaglandin pathways (Arunachalam et al., 2014). The analgesic activity of the plant may be linked to its ability to modulate nociceptive mediators through the presence of flavonoids and triterpenoids (Kumar et al., 2020).

4. Antimalarial Activity

One of the most remarkable pharmacological effects of *C. spectabilis* is its antimalarial activity. The alkaloid Cassiarin A, isolated from the leaves, has demonstrated strong inhibitory action against *Plasmodium falciparum* with activity comparable to chloroquine (Viegas et al., 2004; Abe et al., 2010). This makes *C. spectabilis* a promising source for the development of new antimalarial agents.

5. Antidiabetic and Hepatoprotective Activity

In streptozotocin-induced diabetic models, ethanolic extracts of *C. spectabilis* have been reported to reduce blood glucose levels and improve lipid profiles (Rahman et al., 2018). The plant's hepatoprotective potential has also been documented, where extracts significantly decreased elevated liver enzymes and restored normal histopathological architecture in toxin-induced hepatic injury models (Arunachalam et al., 2014).

Collectively, these studies confirm that *Cassia spectabilis* exhibits multifaceted pharmacological actions, validating its traditional medicinal uses and encouraging its further exploration as a source of therapeutic compounds.

CONCLUSION:

Cassia spectabilis has emerged as a promising medicinal plant with diverse pharmacological properties and a rich phytochemical profile. Numerous studies have confirmed the presence of bioactive compounds such as alkaloids (Cassiarin A and B), flavonoids, phenolics, glycosides, and terpenoids, which contribute to its wide range of therapeutic actions, including antioxidant, antimicrobial, anti-inflammatory, antidiabetic, hepatoprotective, and antimalarial effects. Among these, the antimalarial alkaloid Cassiarin A represents a particularly valuable natural compound with significant pharmacological potential.

The antioxidant potential of *C. spectabilis*, primarily associated with its flavonoid and phenolic content, highlights its capacity to combat oxidative stress and related degenerative disorders. Likewise, the plant's antimicrobial and anti-inflammatory activities support its traditional uses in treating infections and inflammatory conditions. Despite these encouraging findings, most studies have been limited to preliminary in vitro or in vivo evaluations.

Future research should focus on the isolation, structural elucidation, and pharmacokinetic evaluation of specific bioactive constituents to establish detailed mechanisms of action. Advanced analytical tools such as LC–MS/MS, NMR, and molecular docking studies could help in correlating the phytochemical composition with therapeutic activity. Furthermore, toxicological assessments and clinical investigations are essential to confirm the safety and efficacy of *C. spectabilis*-based formulations.

Cassia spectabilis represents a valuable source of natural compounds with significant pharmacological relevance. Continued exploration through systematic pharmacognostic, pharmacological, and biotechnological studies may pave the way for the

development of novel phytopharmaceuticals and standardized herbal formulations derived from this plant.

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