A Review on Phytochemical Analysis of *Gmelina asiatica* L.

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ABSTRACT

Gmelina asiatica L., is a large sized deciduous thorny shrub, has long been utilized in traditional medicine, yet only a limited number of phytochemical and pharmacological studies have been substantiated thus far. This in-depth analysis explores into the phytochemical compounds of G. asiatica, presenting a thorough examination of its chemical composition across various plant parts such as leaves, stems, bark, roots, and essential oil extracted through diverse solvents. This analysis encompasses various techniques such as preliminary screening, TLC, HPLC, FT-IR, and GC-MS. Furthermore, the review encompasses the determination of total flavonoid and tannin content, providing a holistic understanding of the plant's chemical profile. Pharmacological reviews of the stem, root, leaf, bark and oil are also documented, revealing a spectrum of potential therapeutic activities such as antipyretic, antibacterial, antimicrobial, anti-inflammatory, antidiabetic, antihaemolytic, antidandruff, nematicidal, larvicidal, antioxidant, antifungal, anticancer, and other properties attributed to G. asiatica. In summation, the review's findings underscore the rich phytopharmaceutical importance of G. asiatica, shedding light on the diverse chemical constituents present in the plant and their potential applications in various pharmaceutical domains.

Keywords: *Essential oil, Gmelina asiatica, Phytochemical analysis, Phytoconstituents, Solvent extracts*

Introduction

Across the ages, herbs have served a dual purpose as both a nutritional source and a remedy for various health conditions. The burgeoning demand for these botanical wonders is fuelled by their potent health properties, crucial in preventing a myriad of human diseases [1]. This trend is particularly pronounced in both developing and developed nations, where the utilization of plants for traditional herbal remedies is on the rise because of their accessibility and cost-effectiveness [2]. Delving into the realm of traditional medicine poses an intriguing challenge for ethnobotanists, given the expanding landscape of herbal applications [3]. Plants have wielded a profound influence on culture, cognition, and economic activities dating back to ancient times [4]. With approximately 80% of the global population relying on plant extracts

for primary healthcare, and nearly 90% of traditional medicine prescriptions derived from plant-based drugs [5]. The importance of investigating these natural remedies cannot be overstated. In this review, our focus is directed towards elucidating the chemical compounds found in various parts of plants through various phytochemical investigations.

Description

Gmelina asiatica L. (Syn: *Gmelina parvifolia* Roxb.) is a foliage-dropping thorny shrub belongs to the family Verbenaceae which after phylogenetic studies declared to be belonging to Lamiaceae. It is commonly known as Asian Bushbeech, and “Nilakumizhal” in Tamil and also known by the intriguing moniker 'Ladies nose flower'. It is reaching heights of 4m to 8m and characterized by extensive branching. The wood is hard and grey colour, with twigs featuring spines. The leaves are relatively small, possessing petioles measuring 0.5-3 cm in length. Leaf-blades obovate, sub-rhomboid or triangular, ranging from 1-9.5 cm in length and 1.5-6 cm in width with a minutely white-glanduliferous underside adorned with round glands. The inflorescence is both auxiliary and terminal, often nodding or pendulous and mostly terminal fulvous-tomentose racemiform panicles measuring 2.5-5 cm in length. The corolla is bright sulphur-yellow colour, spans 4-5cm and is bilabiate. The tube is narrow, curved below and bell-shaped. The fruits are drupes, ovoid-pyriform in shape, turning yellow when ripe, and containing 1-2 seeds. These drupes exude a watery, soapy substance. This shrub thrives in a range of environments, including dry evergreen to dry deciduous forests, plains, wastelands, roadsides and native to Southeastern Asia [6].

Ethnomedicinal Uses

Ethnomedicine, a field that explores traditional medical practices within a cultural context, delves into the cultural interpretations of health, diseases and illness, encompassing

the healthcare-seeking process and various healing practices [7]. In the case of *G. asiatica*, the entire plant holds medicinal significance and numerous survey findings underscore the extensive use of *G. asiatica* in traditional medicine, where leaves, aerial parts and roots are utilized for treating a spectrum of conditions. These include rheumatism, diabetes, syphilis, gonorrhoea, burning sensation of eyes, fever, dysuria, wounds, jaundice, dandruff, hepatic diseases, and the reduction of body heat [8-14]. The roots of *G. asiatica* serve various medicinal purposes, acting as demulcents, antiseptics, astringents, and mucilaginous agents, playing a vital role in both traditional medicine and the production of official drugs [15-17]. In Sri Lanka, virtually all parts of the plant find applications in the preparation of traditional medicines [18]. Additionally, Savaras in Andhra Pradesh employed the fruit rind of *G. asiatica* for topical application, using it to address issues such as dandruff and wound treatment [19]. The whole plant is employed as an herbal treatment for issues like gonorrhoea, bladder catarrh and as a blood purifier [20-22].

Phytochemical Evaluation

Phytochemicals are bioactive plant-derived compounds have been acknowledged for their role in protecting human health from chronic degenerative diseases [23].

In qqualitative phytochemical analysis, Vinitha and Prasanna conducted parallel investigations, unveiling the existence of carbohydrates, coumarins, glycosides, phytosterols, tannins, and phenolic compounds in the methanolic extract from the bark of *G. asiatica* [24]. Florence and Regini Balasingh have reported that the qualitative phytochemical analysis of the aqueous, petroleum ether, chloroform, ethanol and acetone extracts from *G. asiatica* leaves indicated the presence of alkaloids, carbohydrates, glycosides, coumarins, quinones, saponins, steroids, terpenoids, proteins, phytosterols, tannins, and flavonoids, with the highest concentration found in the ethanolic extract [25]. Silvia and Satyanarayana have concentrated on the mitigating impact of hexane, chloroform, methanol and aqueous extracts of G. asiatica stem and root revealed the presence of various phytoconstituents, including carbohydrates, amino acids, proteins, fats and oils, alkaloids, phytosterols, triterpenoids, furan, flavonoids, cardiac glycosides, tannins, steroids, saponins, and phenolic compounds [26]**.**

Savithramma and her group have studied the 31 medicinal plants for qualitative phytochemical estimation on the aqueous extract of *G. asiatica* leaves showed alkaloids, antroquinones, emodins, fatty acids, flavonoids, phenols, lignins, reducing sugars, steroids, tannins and saponins [27]. Vikneshwaran and his team have contemplated the 12 medicinal plants from India for qualitative phytochemical analysis on the aqueous and methanolic extracts of *G. asiatica* plant posses the phytoconstituents are saponins, cardiac glycosides

steroids and alkaloids. Tunalier along with a group of researchers investigated the qualitative plant chemistry assessment on the aqueous, acetone, petroleum ether, chloroform, ethanol extracts of *G. asiatica* leaf shown the presence of phytoconstituents like flavonoids, carbohydrates, steroids, terpenoids, tannins, alkaloids glycosides, quinones, coumarins proteins, phytosterols, terpenoids and saponins [28].

In their quantitative phytochemical analysis, Florence and Regini Balasingh have reported that the total tannins content in the ethanolic leaf extract was estimated as 0.042µg/µl, while the flavonoid content was estimated as 0.045µg/µl [25]. Silvia and Satyanarayana recorded the total phenolics content as gallic acid equivalent was measured at 4800 ±24.53, and the total flavonoid content as quercetin equivalent were measured at 28.54 ± 0.18 [26]

Gas Chromatography-Mass Spectrometry (GC-MS) is an excellent method for identifying bioactive compounds. In GC-MS analysis, Azhagumurugan and Rajan identified 7 bioactive phytochemical compounds found in the ethanolic extract of *G. asiatica* leaf such as Pregnane – 3,11,12,14,20 – pento l,3,12,20, triacetate 11 (hydroxyacetate), (3a,11a,12a,14a), Tridecanoic acid, methyl ester, 10-Octadecenoic acid, methyl ester, 16-Octadecenoic acid, methyl ester, 2,7– Diphenyl -1, 6-dioxopyridazino (4,5:2,3) pyrrolo (4,5,-d) pyridazine, Spiro (androstane-3,2 - thiazolidine), (5a) [29]**.** Similar studies conducted by Anjaneyulu and co-researchers reported that the methanolic extract of heart wood powder fraction contains crystalline components such as methyl *p*-methoxy-cinnamate, sitosterol, paulownin, gmelinol, methyl-p-hydroxy-cinnamate and cycloolivil lignans [30]. Satyanarayana and his coworkers as well as Balijepali and his colleagues isolated the phytoconstituents from the *G. asiatica* roots contains **(+)** sesamin, (-) pinoresinol, **(-)** piperitol, sakuranetin and ovalifolin [31,32]. Similar work conducted by Gakunju and his coworkers identified nitidine compound isolated from the *G. asiatica* roots [33]. Furthermore, a comprehensive investigation conducted by Florence and Jeeva identified 50 minor phytochemical compounds present in the ethanolic extract of *G. asiatica* leaf including Ethyl α-D-glucopyranoside (21.86%), 2-Hexadecen-1-OL, 3,7,11,15-Tetramethyl, [R-(R*,R*)-(E)] (14.96%), 9,12,15-Octadecatrienoic acid (14.96%), Pentadecanoic acid (10.71%), and Ethyl (9Z,12Z)-9,12-Octadecadienoate (7.12%) found in the ethanolic extract of *G. asiatica* leaves [34].

The High-Performance Thin Layer Chromatography (HPTLC) method emerges as a potent tool for detecting the presence of adulterants in herbal products, relying on distinctive visual characteristics. This method proves highly beneficial not only for identifying inadvertent substitution but also for detecting intentional adulteration in prescription drugs [35].

Visualizing the TLC plate at 254 and 356nm post-derivatization enhances its efficacy. In a specific application of this method to *G. asiatica*, the TLC plate revealed a quercetin peak aligning precisely with the standard quercetin peak (Rf 0.63) when observed at 254 and 356nm. Through quantification, the bark extract of G. asiatica was determined to contain 0.0640%w/w of quercetin [25]. Another insightful Thin Layer Chromatographic analysis, focused on *G. asiatica* seeds, unveiled the presence of triglycerides (10.1%) and two monoglycerides (1.6%) in the study conducted by Gunstone and Quresh [36]. This underscores the versatility of HPTLC is valuable not only identifying but also quantifying specific constituents within herbal products, contributing to the overall quality assessment.

FT-IR spectroscopy stands out as a accurate and precise technique for unravelling the diverse functional groups within plant samples. This is accomplished by examining the Infrared region spanning from 400-4000 cm^{-1}. A widely used approach involves comparing the spectrum of an unknown compound compared to a library of known compounds [37]. In a specific application to *G. asiatica*, FT-IR spectrum analysis played a pivotal role in identifying functional groups in the methanolic extract of bark showed alcohol, alkane, fatty acids, alkyne, nitrite, amide, acid, nitro, amine, alkyl halide and ether recorded by Vinitha and Prasanna [24]. Additionally, FTIR analysis of the ethanolic extract from *G. asiatica* leaves, conducted by Florence and Jeeva, revealed the presence of various functional groups such as alcohols, alkanes, phenols, alkyl halides, carboxylic acids, alkynes, aldehydes, aromatics, nitro compounds, and amines [34]. This thorough analysis offers valuable insights into the chemical composition of *G. asiatica*, aiding in its characterization and potential applications.

Florence and Jeeva have investigated essential oils from the leaves of *G. asiatica* using the hydro distillation method with a Clevenger apparatus and its fatty acids composition was determined by GC-MS analysis. Eight bioactive compounds were identified as linoleic acid; E-11-hexadecanoic acid; (E)-9-octadecanoic acid; benzene, hexadecenoic acid; heptadecanoic acid; 1, 2-benzenedicarboxylic acid; (1-butylhexadecyl) and cholesterol trimethylsilyl ether. The bioactive compounds were utilized to treat a range of diseases by the traditional medics [38]. Gunstone and Qureshi reported the appearance of chemical constituents from the *G. asiatica* oil consisting 2 monoglycerides (1.6%) and 10.1% of triglycerides [36].

Conclusion

Gmelina asiatica L. is a vital medicinal plant deeply ingrained in traditional Indian medicine, reveals its significance through a thorough exploration of the literature, unveiling its medicinal prowess as documented in ancient Indian texts. This review meticulously synthesizes the results of phytochemical studies on *G. asiatica*, highlighting its diverse chemical

compounds. The focus extends to the plant's phytochemical investigations, emphasizing the extraction of crucial principles that contribute to its therapeutic potential. The isolation and characterization of bioactive compounds hold the promise of a more thorough understanding of the pharmacological uses of *G. asiatica*, providing essential support for future studies in this field.

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