Borreria And Spermacoce Species-A Review on Their Phytochemical Screening and Pharmacological Activities

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Abstract: The genera Borreria and Spermacoce, belonging to the family Rubiaceae, represent taxonomically intricate and pharmacologically significant groups of herbaceous angiosperms widely distributed in tropical and subtropical regions. Although traditionally distinguished by fruit dehiscence patterns and seed morphology, clear separation between the two genera remains contentious due to overlapping morphological traits and molecular evidence suggesting close phylogenetic relationships. Members of these genera typically exhibit opposite leaves, interpetiolar stipules, actinomorphic bisexual flowers, and capsular fruits—features characteristic of Rubiaceae. Ecologically adaptable, they thrive in open and disturbed habitats, including grasslands, roadsides, and cultivated lands, with some species regarded as weeds while others contribute to ecological balance. Ethnomedicinally, numerous species are employed in traditional healthcare systems across Asia, Africa, and the Americas for managing fever, inflammation, gastrointestinal disorders, infections, and liver ailments. Phytochemical investigations reveal a rich diversity of secondary metabolites, including alkaloids, flavonoids, iridoids, triterpenoids, saponins, and phenolic compounds, which underpin their reported therapeutic properties. Experimental studies have demonstrated antimicrobial, anti-inflammatory, antioxidant, antidiabetic, hepatoprotective, and antimalarial activities, supporting several traditional claims. Despite promising pharmacological findings, comprehensive clinical studies and toxicity assessments remain limited. An integrated, systematic and pharmacological approach is therefore essential to clarify taxonomic boundaries and validate the therapeutic potential of these medicinally important genera

Keywords: Borreria; Spermacoce; Rubiaceae; Phytochemistry; Ethnomedicine.

I. INTRODUCTION

The genera Borreria and Spermacoce, members of the family Rubiaceae, represent taxonomically challenging yet medicinally valuable groups of flowering plants. Rubiaceae is among the largest angiosperm families, encompassing thousands of species distributed mainly in tropical and subtropical regions, and includes economically important plants such as Coffea. Species of Borreria and Spermacoce are predominantly annual or perennial herbs widely adapted to open and disturbed habitats, including grasslands, roadsides, and cultivated lands. Their tolerance to drought, poor soils, and fluctuating environmental conditions reflects strong ecological adaptability. (1) Morphologically, both genera exhibit characteristic Rubiaceae features such as opposite leaves, interpetiolar stipules, small actinomorphic flowers, and capsular fruits. However, delimitation between them remains controversial due to overlapping characters in floral structure, seed morphology, and fruit dehiscence. While traditional taxonomy relied heavily on morphological distinctions, recent molecular phylogenetic studies suggest close evolutionary relationships, sometimes questioning the separation of Borreria from Spermacoce. This taxonomic complexity underscores the need for integrated systematic approaches combining morphological and molecular evidence. (2) Beyond classification issues, these genera possess significant ethnomedicinal relevance. Various species are used in traditional medicine across Asia, Africa, and the Americas to treat infections, inflammation, gastrointestinal disorders, fever, and liver ailments. Phytochemical investigations reveal the presence of

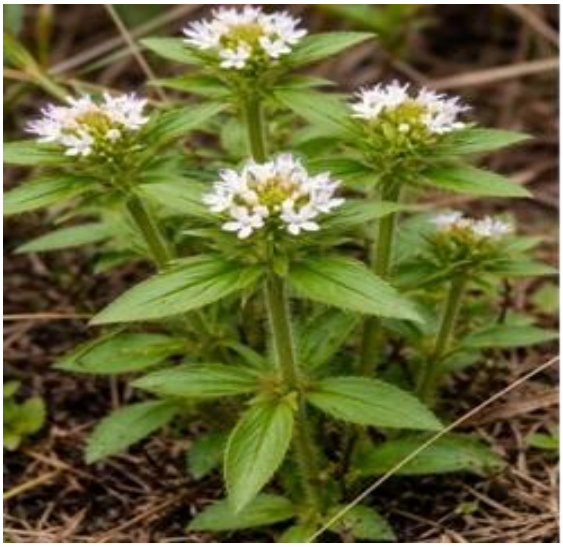
alkaloids, flavonoids, iridoids, saponins, and phenolic compounds, which contribute to their antimicrobial, antioxidant, anti-inflammatory, and hepatoprotective activities. Although preliminary pharmacological studies support traditional claims, comprehensive clinical evaluation and safety assessment remain essential to fully establish their therapeutic potential. (3)

II. PHYTOCHEMISTRY

1. Borreria alata

Accepted name: Spermacoce alata

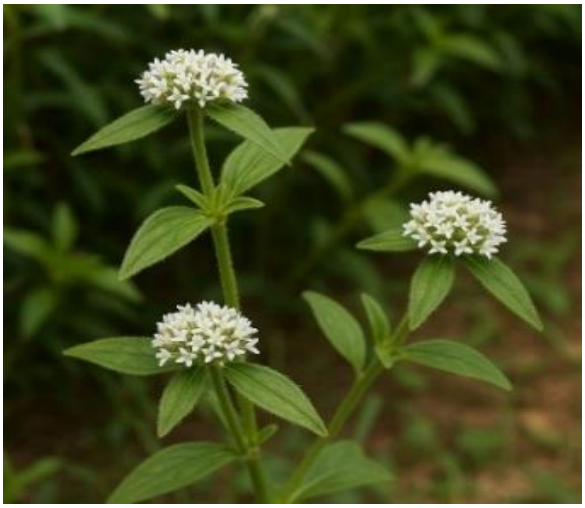
Phytochemical evaluations reveal the presence of indole alkaloids and related nitrogen-containing compounds typical of Rubiaceae. Flavonoids such as quercetin, kaempferol, luteolin, and apigenin contribute significantly to antioxidant and anti-inflammatory effects. Iridoid derivatives, including asperuloside-type compounds, are associated with liver-protective and immune-supportive properties. Triterpenes like ursolic acid and oleanolic acid, along with phytosterols such as β-sitosterol and stigmasterol, demonstrate antimicrobial and anti-inflammatory actions. (4)



2. Borreria articularis

Accepted name: Spermacoce articularis

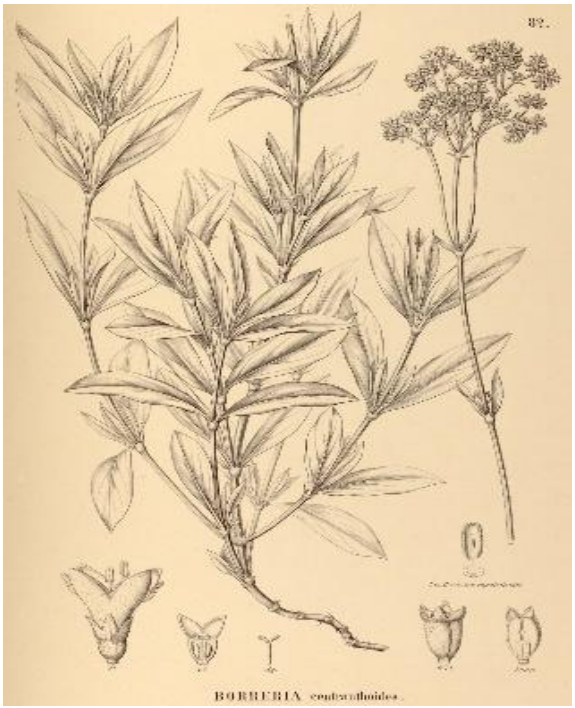
This species contains alkaloids, flavonoids, iridoids, and triterpenoids comparable to other members of the genus. Flavonoids such as quercetin and kaempferol contribute to antioxidant effects, while iridoid glycosides support hepatoprotective and anti-inflammatory responses. Sterols and phenolic acids enhance antimicrobial activity, and tannins with saponins aid in tissue repair and oxidative stress reduction.(5)



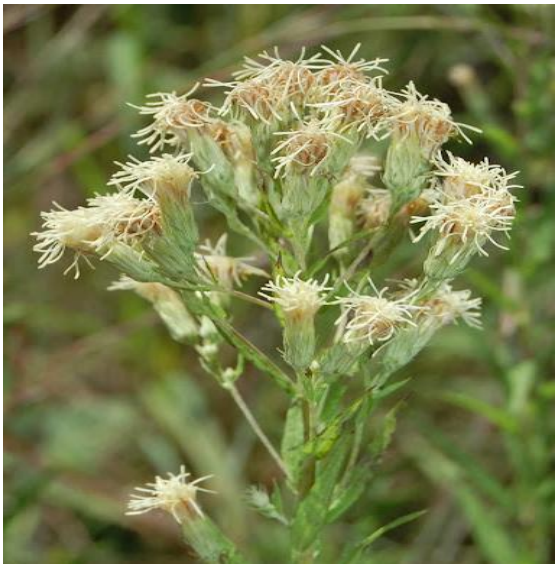
3. Borreria centranthoides

Accepted name: Spermacoce centranthoides

This plant synthesizes indole alkaloids, flavonoids, iridoid glycosides, and various phenolics. Asperuloside-like iridoids act as characteristic chemical markers. Its pharmacological profile includes antioxidant, anti-inflammatory, and hepatoprotective activities attributed to synergistic interactions among flavonoids, triterpenoids, and phenolic acids.(6)



4. Borreria eupatorioides
Accepted name: Spermacoce eupatorioides
Phytochemical studies indicate the presence of alkaloids, iridoids, flavonoids, sterols, and phenolic compounds. These metabolites collectively contribute to antimicrobial, antioxidant, and immune-regulating properties. Pentacyclic triterpenes such as ursolic and oleanolic acids are linked to anti-inflammatory mechanisms. (7)



5. Borreria hispida
Accepted name: Spermacoce hispida
Among the most extensively researched species, it contains alkaloids, asperuloside-related iridoids, flavonoids, and triterpenoids. Documented activities include liver protection, antimicrobial effects, antioxidant action, and anti-inflammatory responses. Traditionally, it is used in managing hepatic disorders and certain skin conditions. (8)

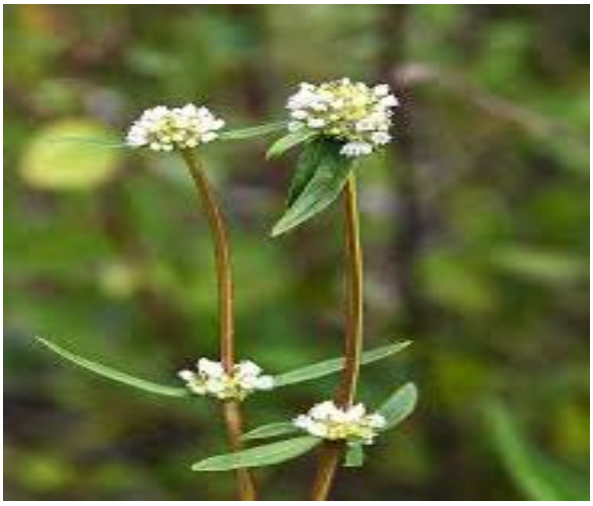
6. Borreria laevis
Accepted name: Spermacoce laevis
This species reflects typical Rubiaceae chemistry with alkaloids, flavonoids, iridoids, and sterols. Reported biological properties include antioxidant, antimicrobial, and anti-inflammatory activities. (9)

7. Borreria ocymoides
Accepted name: Spermacoce ocymoides
Chemical investigations reveal alkaloids, iridoids, flavonoids, and triterpenoids. Phenolic acids enhance antioxidant efficiency, whereas saponins and tannins contribute to antimicrobial and wound-repair actions. (10)

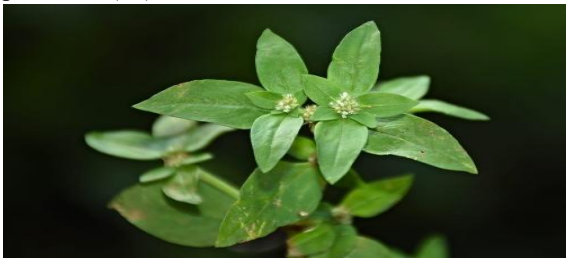
8. Borreria pusilla
Accepted name: Spermacoce pusilla
This plant contains alkaloids, iridoid glycosides, flavonoids, sterols, triterpenoids, and phenolic compounds. Pharmacological studies highlight antioxidant, hepatoprotective, and anti-inflammatory effects. (11)


Borreria pusilla

9. Borreria verticillata
Synonym: Spermacoce verticillata
Common name: Buttonweed
A chemically well-characterized species, it possesses iridoids, flavonoids, alkaloids, sterols, and triterpenoids. The plant demonstrates notable antioxidant, antimicrobial, liver-protective, and anti-inflammatory properties.(12)



10. Spermacoce exilis
Although comparatively less studied, available reports indicate the presence of alkaloids, iridoid glycosides, flavonoids, and phenolic substances typical of Rubiaceae, supporting antioxidant and antimicrobial potential. (13)



III. PHARMACOLOGY OF BORRERIA AND SPERMACOCE

Members of the genera Borreria and Spermacoce, belonging to the Rubiaceae family, possess a wide spectrum of biological activities that correlate with their rich phytochemical composition. These plants contain alkaloids, iridoid glycosides, flavonoids, triterpenoids, sterols, and phenolic compounds, which collectively contribute to their therapeutic potential. Experimental and ethnomedicinal evidence supports their antioxidant, anti-inflammatory, Mantimicrobial, hepatoprotective, antipyretic, analgesic, antidiabetic, diuretic, antidiarrheal, and wound-healing properties. The antioxidant and anti-inflammatory effects are largely associated with iridoids and flavonoids, while alkaloids and terpenoids often account for antimicrobial and cytotoxic activities. Some extracts have also demonstrated antiproliferative effects in laboratory studies, indicating possible relevance in anticancer research. Overall, these genera remain important in traditional medicine and represent promising candidates for future pharmacological investigations.

1. Antimicrobial activity
Species such as Borreria verticillata and Borreria hispida have shown inhibitory effects against various pathogenic microorganisms. Alkaloids, including compounds like borrerine, exhibit antibacterial activity against organisms such as Staphylococcus aureus and Vibrio cholerae. Traditionally, plant extracts are applied in the treatment of skin infections and certain chronic infectious conditions.

2. Anti-inflammatory Activity
Plants like Borreria alata and Borreria laevis are commonly used to manage inflammatory disorders, hemorrhoids, erysipelas, and menstrual discomfort. Their anti-inflammatory effects are mainly attributed to iridoid glycosides and flavonoids, which modulate inflammatory mediators and reduce oxidative stress.

3. Antipyretic Activity
The flowers of Borreria verticillata are traditionally administered to alleviate fever. Herbal decoctions prepared from different plant parts are widely used in tropical regions to manage febrile conditions.

4. Analgesic Activity
Certain species within these genera exhibit mild analgesic properties. They are traditionally employed to relieve headaches, muscular pain, and general body aches, likely due to the combined action of flavonoids and terpenoids.

5. Hepatoprotective Activity
Borreria centranthoides is traditionally recommended for liver-related ailments. Its protective action on hepatic tissue may be linked to antioxidant iridoids and phenolic constituents that help reduce oxidative liver damage.

6. Antidiabetic Activity
Borreria hispida is reported in traditional systems as supportive therapy for diabetes. Experimental observations suggest that plant extracts may help regulate blood glucose levels, possibly through antioxidant mechanisms and improved metabolic function.

7. Diuretic Activity
Borreria laevis is used in folk medicine to enhance urine output. This diuretic effect supports its application in conditions involving fluid retention and urinary disturbances.

8. Antidiarrheal Activity
Roots and leaves of various Borreria and Spermacoce species are traditionally utilized to manage diarrhoea and dysentery. Tannins and other astringent compounds likely contribute to intestinal protective effects and reduced gastrointestinal inflammation.

9. Wound-Healing and Dermatological Activity
Borreria ocymoides and Borreria princeae are used externally for treating wounds, eczema, and other skin disorders. The presence of flavonoids, saponins, and tannins supports tissue repair, antimicrobial protection, and anti-inflammatory response. (14)

IV. CONCLUSION

The genera Borreria and Spermacoce (family Rubiaceae) represent an important group of medicinal plants with significant ethnopharmacological relevance. Across tropical and subtropical regions of Africa, Asia, and the Americas, various species have been traditionally employed for the treatment of fever, infections, inflammatory disorders, liver diseases, diabetes, gastrointestinal disturbances, and skin ailments. Scientific investigations conducted over the past decades have provided substantial evidence supporting many of these traditional claims, highlighting the therapeutic promise of these plants. Anti-inflammatory and antioxidant activities are also prominent features of these species. The presence of flavonoids and phenolic compounds contributes to free radical scavenging and reduction of oxidative stress, which play crucial roles in preventing chronic inflammatory conditions. These antioxidant properties may also underlie the hepatoprotective effects observed in certain species traditionally used for liver ailments. Additionally, antipyretic and analgesic activities reported in experimental studies support their use in managing fever and pain. Some species demonstrate promising antidiabetic potential, as evidenced by their traditional application and preliminary pharmacological studies suggesting possible effects on glucose metabolism. Diuretic, antidiarrheal, and emetic activities further expand their therapeutic profile, particularly in the management of urinary and gastrointestinal disorders. Topical applications for eczema, skin infections, and wound healing emphasize their dermatological significance.
In conclusion, Borreria and Spermacoce species constitute valuable reservoirs of bioactive compounds with diverse pharmacological properties. Their traditional uses are increasingly supported by scientific evidence, highlighting their potential as sources for novel therapeutic agents. Continued research integrating phytochemistry, pharmacology, and clinical validation will be crucial for translating their traditional knowledge into modern medicinal applications.

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