INTERNATIONAL JOURNAL OF RESEARCH CULTURE SOCIETY
Monthly Peer-Reviewed, Refereed, Indexed Journal
Volume - 9, Issue - 5, May - 2025

ISSN(O): 2456-6683
[Impact Factor: 9.241]

IJRCS

DOIs:10.2017/IJRCS/202505001 --:-- Research Paper / Article / Review

Medicinal properties and uses of Indian species of the genus *Spermacoce* L.: A review

Shalini Bara[1] and Geetanjali Singh[2]*

[1]Research Scholar, University Department of Botany, Dr. Shyama Prasad Mukherjee University, Ranchi, Jharkhand.
[2]Assistant Professor, University Department of Botany, Dr. Shyama Prasad Mukherjee University, Ranchi, Jharkhand.
Email: [1]shalinibara41@gmail.com, [2*]gsingh_8apr@yahoo.co.in
*Corresponding author

Abstract: *Spermacoce L., commonly known as false buttonweed, includes over 275 plant species mostly found in tropical and subtropical regions around the world. The greatest diversity of these species is seen in the Americas, followed by Africa, Australia, and Asia. In India, eleven species of Spermacoce have been recorded. Many of these species are traditionally used in medicine to treat a variety of health conditions. This review highlights the medicinal uses of Indian Spermacoce species, including the specific plant parts used and the ailments they help treat. The information presented may support future research and contribute to the discovery and development of new medicines.*

Key words*: Spermacoce, False buttonweed, Traditional medicine, Indian flora, Pharmacological potential.*

1. INTRODUCTION

The genus *Spermacoce* L. is commonly known as 'false buttonweed' [1]. According to the APG IV system of classification, it belongs to the family Rubiaceae in the order Gentianales under subclass Magnoliidae [2,3]. The family rubiaceae ranks as the fourth largest among angiosperm families, globally comprises 13,143 species and 611 genera [4]. The genus includes over 275 species around the world, mostly found in warm tropical and subtropical areas of the Americas, Africa, Asia, and Europe [5,6,7].

Hooker (1881) documented the presence of three *Spermacoce* species in India, namely *Spermacoce stricta* L. f., *Spermacoce ocymoides* Burm. f., and *Spermacoce hispida* L. [8]. Later on, Sivarajan et al. (1987) reported nine species, but they named only seven species i.e., *Spermacoce confusa* Rendle, *Spermacoce podocephala* D. C., *Spermacoce mauritiana* Osea Gideon, *Spermacoce pusilla* Wall., *Spermacoce latifolia* Aubl., *Spermacoce hispida* L., and *Spermacoce articularis* L. f. [9]. Panda (1966) recorded six species i.e., *Spermacoce mauritiana* Osea Gideon, *Spermacoce latifolia* Aubl., *Spermacoce ramani* Sivar. and Nair, *Spermacoce pusilla* Wall., *Spermacoce hispida* L. and *Spermacoce articularis* L. f., have been reported from Orissa, India [10]. Haines (1925) reported only two species, *Spermacoce stricta* L. f. and *S. hispida* L. from Bihar and Chatanagpur, India [11]. Tiwari et al. (2018) reported three species of *Spermacoce* from Chhattisgarh, India: *Mitracarpus hirtus* (L.) DC., *Spermacoce exilis* (L.O. Williams) C.D. Adams ex W.C. Burger and C.M. Taylor, and *Spermacoce latifolia* Aubl.[12].

Presently, eleven species of *Spermacoce* are found in India. They are; *Spermacoce stricta* L. f., *Spermacoce ocymoides* Burm. f., *Spermacoce hispida* L., *Spermacoce confusa* Rendle, *Spermacoce podocephala* D. C., *Spermacoce mauritiana* Osea Gideon, *Spermacoce pusilla* Wall., *Spermacoce articularis* L. f., *Spermacoce latifolia* Aubl., *Spermacoce verticillata* L., and *Spermacoce assergens* Ruiz and Pavon [5,6,7,8,9,10,11,12,13]. Of these, *S. hispida* L., *S. mauritiana* Osea Gideon, *S. pusilla* Wall., *S. latifolia* Aubl., are distributed throughout India, whereas *S. verticillata* L. is distributed in South India and *S. assergens* Ruiz and Pavon, in the the Nicobar Island [8,9].

Species of *Spermacoce* are herbaceous plants or small shrubs. They have sessile, oppositely arranged (decussate) leaves, with interpetiolar and fringed (fimbriate) stipules. Their flowers are four-parted (tetramerous), small to medium in size, and are grouped closely together in terminal, pseudoaxillary, or axillary head-like clusters (capitate inflorescences) [5,6,8,9,13,14,15]. Corolla funnel or salver-shaped, stamens four often exserted, ovary single, bilocular [15]. The genus exhibits a wide range of fruit types, including dry capsules, often containing raphides [14,15,16].

Despite the wide distribution and ecological importance of *Spermacoce*, its taxonomy remains complex and unresolved. Linnaeus (1753) described *Spermacoce* as having sharp, long-lasting calyx teeth and fruit that splits at the

top into two parts [9,17]. However, Mayer (1818) proposed a separate genus, *Borreria*, because in *Borreria*, both parts of the fruit split open, whereas in *Spermacoce*, only one part opens and the other remains attached and closed [9,18]. Since then, there is contradiction regarding the genus *Borreria* and *Spermacoce*. Whereas, many authors consider genus *Borreria* Mayer and *Spermacoce* L. as two distinct genera based on their fruit morphology [19,20]. Although most group them under the name *Spermacoce* L. [5,6,8,9,11,19,21,22,23,24,25,26,27,28,29,30,31]. The controversy is still ambiguous, but for this study, the two genera, *Spermacoce* and *Borreria*, are treated as the same.

Species of *Spermacoce* are often considered weeds; however, in traditional medicine, these species are known for their diverse medicinal properties. Certain species show antimicrobial, antitumor, antioxidant, anti-inflammatory, and larvicidal properties [32,33,34]. The study revealed that different parts of plants like roots, leaves, bark, fruits, seeds, flowers, stems or whole plant parts are used to cure small injuries to various chronic diseases. They are used in medicine in various ways to treat malaria, diarrhea, other digestive issues, skin diseases, fever, bleeding, urinary and respiratory infections, headaches, and inflammation of the eyes and gums [34]. Since, wild plant species are important source of new drug discoveries and plays an important role in pharmacological researches. It is necessary to protect and conserve these wild floral diversities from getting endangered and extinct.

2. METHODOLOGY

To gather relevant content for this review, a thorough literature search was carried out across a number of scientific databases, including Web of Science, Elsevier, Google Scholar, Scopus, Science Direct, PubMed, SciFinder, Wiley Online Library and Springer Link [35,36,37,38,39,40,41,42]. All relevant information regarding the traditional applications of *Spermacoce* L. species was gathered from open-source publications that are accessible to the general audience. Species and author names were checked using Plants of the World Online Tropicos and the International Plant Name Index [43,44,45].

Table 1: Medicinal properties and their uses of the Indian *Spermacoce* Species

Sl. No.	Species name	Part used	Properties	Uses	References
1	*S. stricta* L. f.	Roots	Anti-inflammatory, and antiarthritic	Roots are used to treat in conditions like infections, injuries, or autoimmune diseases where tissues become swollen, red, and painful. It also helps to prevent or relieve the symptoms of arthritis.	[46,47]
		Leaves	Antiulcerative, and antidiabetic	Leaves are used for promoting wound healing and managing cuts, ulcers, and diabetes.	[48,49]
		Whole plant	Anti-inflammatory	The whole plant is used medicinally to treat various skin conditions, including rashes, eczema, and other dermatological disorders.	[50]
2	*S. ocymoides* Burm. f.	Whole plant	Antidiarrheal	The whole plant is also utilized in the treatment of diarrhea and dysentery.	[51,52]
		Leaves	Antipruritic or anti-inflammatory	Leaves are used for the treatment of eczema and other skin-related conditions.	[52, 53]
3	*S. hispida* L.	Leaves	Antihemmorhoidal, analgesic, and vulnerary	Leaves are employed in the treatment of hemorrhoids, headaches, and for promoting wound healing.	[54,29,34]
		Roots	Anticonjunctivitis, anticholelithic, and analgesic	Roots are used for the treatment of conjunctivitis, hemorrhoids, gallstones, and for relieving headaches and toothache.	[55,56,57,58]
		Flowers	Antimalarial, and antitussive	Flowers are used in the treatment of cough and malaria.	[59,57]

		Seeds	Antidiarrheal antidysenteric, and nephroprotective	Seeds are used for managing diarrhea, dysentery, and disorders related to the nerves and kidneys.	[31,57,60]
4	*S. confusa* Rendle	Roots	Antidiarrheal, and antidysenteric,	Roots are used to treat dysentery and diarrhea.	[61]
		Leaves	Antiseptic, vulnerary, antimalarial, and antidiabetic	Leaves are used for wound healing, treating cuts and ulcers, as well as managing malaria and diabetes.	[48]
		whole plant	Antispasmodic, antidiarrheal, and carminative	The whole plant is used to treat gastrointestinal disturbances, including bloating, diarrhea, and indigestion.	[62]
5	*S. podocephala* D. C.	Roots	Anti-arthritic, analgesic, and anti-inflammatory	Roots are used to alleviate arthritis, joint pain, and muscle aches.	[34,63]
		Leaves	Antidiabetic, and vulnerary	Leaves are used medicinally to manage diabetes and promote healing of cuts and wounds.	[48]
		Whole plant	Antispasmodic, antidiarrheal, and carminative	The whole plant is used to treat gastrointestinal disturbances, including bloating, diarrhea, and indigestion.	[64]
		Flowers	Analgesic, and anti-inflammatory	Flowers are used to relieve pain and inflammation.	[65]
6	*S. mauritiana* Osea Gideon	Leaves	Antimicrobial, antioxidant, anti-inflammatory, and antidiabetic	Fresh or dried leaves are used to make infusions and decoctions for medicinal purposes.	[66]
		Roots	Antigastrointestinal, antispasmodic, and antidiarrheal	Roots are employed in the treatment of gastrointestinal problems.	[67,68]
		Stems	Vulnerary, and anti-inflammatory	Stems are used to address wounds and inflammation.	[69]
		Flowers	Antipruritic, antiseptic, and vulnerary	Flowers are used for treating skin irritations and burns.	[70,71]
7	*S. pusilla* Wall.	Flowers	Vulnerary	Flowers are used to treat cuts and wounds.	[33,72]
		Whole plant	Antiedematous, and antivenom	The whole plant is used for reducing swelling and treating poisonous snake bites.	[73]
		Leaves	Antiscabietic, and antivenom	Leaves are employed in the treatment of scabies and bites from snakes and scorpions.	[33,74]
8	*S. articularis* L. f.	Roots	Neuroprotectiv, nephroprotective, and analgesic	Roots are used for treating nerve and kidney injuries, as well as for relieving toothache and headaches.	[75,76]
		Whole plant	Anti-inflammatory, antipyretic, and anticonjunctivitis	The whole plant is utilized to treat inflammation, fever, and conjunctivitis.	[77,78]

		Leaves	Antihemorrhoidal, and anticholelithic	Leaves are used as an astringent in the treatment of hemorrhoids and gallstones.	[77,78]
		Seeds	Antidiarrheal, and antidysenteric	Seeds are employed in the treatment of diarrhea and dysentery.	[77,78]
		Roots	Analgesic	Roots are used to treat toothache, and headaches.	[77,78]
9	*S. latifolia* Aubl.	Roots	Antimalarial	Roots are used to treat malaria.	[79,80]
		Whole plant	Analgesic, antiurolithic, laxative , and antiarthritic	The whole plant is utilized for treating headaches, bladder stones, toothache, constipation, and arthritis.	[80,81]
		Leaves	Antihemorrhoidal, Anticonjunctivitis, antiseptic, and antimicrobial or antibacterial	Leaves are used to manage hemorrhoids, gallstones, conjunctivitis, skin diseases, as well as urinary and respiratory infections.	[80,82,83]
		Seeds	Analgesic, antipyretic, antidysenteric, and antidiarrheal	Seeds are employed in the treatment of dental problems, fevers, dysentery, and diarrhea.	[81]
10	*S. verticillata* L.	Flowers	Antipyretic, and analgesic	Flowers are used to relieve fever and provide analgesic effects	[84]
		Roots	Antidiarrheal, and antihemorrhoidal	Roots are employed in the treatment of diarrhea and hemorrhoids.	[85]
		Whole plant	Antidiabetic, antidysmenorrheic, antibacterial, and antileprotic	The whole plant is used to manage diabetes, dysmenorrhea, bacterial skin infections, and leprosy.	[86,87,88]
11	*S. assergens* Ruiz and Pavon	Leaves	Antimicrobial	Leaves help to combat various pathogens.	[89]
		Roots	Digestive or Carminative	Roots act as a tonic for general health and aid in digestive problems.	[90]
		Flowers	Sedative	Flowers are known for their sedative effects.	[90,91]

3. DISCUSSION AND CONCLUSION

The above mentioned medicinal properties and uses of different *Spermacoce* species illustrate the genus wide variety of therapeutic potential. The species are important in traditional medicine worldwide, where they are used to treat various disorders [92]. The roots of *S. stricta* and *S. hispida* are commonly used to treat inflammation, arthritis, and joint pain. As revealed in *S. stricta*, *S. confusa*, and *S. podocephala*, leaves are utilized to cure cuts, wounds and ulcers. The other species like *S. ocymoides*, *S. podocephala*, and *S. confusa*, the entire plant is commonly used to treat gastrointestinal conditions like diarrhea and dysentery. This wide range of uses suggests that chemicals found in *Spermacoce* species may function as potent antidiarrheal agents, which might be used to create natural treatments for digestive disorders. *S. verticillata* and *S. latifolia* whole plant extracts have been used to treat diabetes, ulcers, and bacterial skin infections, highlighting the genus therapeutic adaptability [93]. *S. hispida* and *S. verticillata* flowers are utilized for their antipyretic and analgesic qualities, suggesting that these species may be quite helpful in treating ailments like malaria or relieving general pain.

Given their medicinal potential, *Spermacoce* species hold great potential for new drug discovery and pharmacological research. It is vital to preserve and conserve these wild plants to ensure that their beneficial properties are not lost to extinction. The study offers opportunities for developing sustainable, eco-friendly remedies that could complement or even replace synthetic pharmaceutical products. As wild plant species play an essential role in pharmacological innovation, further research into their bioactive compounds and therapeutic applications is crucial for both traditional and modern medicine.

REFERENCES

1. "*Spermacoce*" Natural Resources Conservation Service PLANTS Database. USDA. website: https://plants.usda.gov/core/profile?symbol=SPERM
2. Website: https://www.tropicos.org
3. APG IV. (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society*,*181*(1), 1-20.
4. Ranjan, V., & Kumar, A. (2015). Conspectus of family Rubiaceae in West Bengal, India. *Geopbvtology*, *44* (2), 161-174.
5. Dessein, S., Rubbrecht, E. & Smets, E. (2006). A new heterophyllous *Spermacoce* species (Rubiaceae) from the Marungu highlands (D.R. Congo). *Novon*, *16*, 231-234.
6. Raju, A. J. S., & Krishna, J. R. (2017). Contribution to the knowledge of three Indian *Spermacoce* L.(Rubiaceae) and some preliminary information about their pollination ecology. *In Anales de Biología*, *39*, 111-126.
7. Kala, A. S., Raja, S., & P and Dhatchanamoorthy, N. (2013). 3. Micromorphological assessment and stem anatomy of *Spermacoce* species of Tamilnadu. *Life Sciences Leaflets*, *42*, 19-28.
8. Hooker, J. D. (1881). Flora of British India, Volume 3. *Reeve & Company, Kent.*
9. Sivarajan, V. V., Nair, R. V. and Kunju, T. U. A. (1987). Genus *Spermacoce* Linn. (Rubiaceae) in India. *Proceeding: Indian Academy of Sciences (Plant Sciences)*, *97*(4), 347-358.
10. Panda, P. C. (1996). A taxonomic study of the genus *Spermacoce* Linn. (Rubiacece) in Orissa. *Journal of Economic and Taxonomic Botany*, *20*(3), 639-644.
11. Haines, H. H. (1925). The Botany of Bihar and Orissa. *Adlard & Son & West Newman Limited, London*, *2*(3-4), 419-453.
12. Tiwari, A. P. , Lawand, P. R., Shukla, A. N., & Magesh, C. R. (2018). Three New Distributional Records of Rubiaceae for Chhattisgarh. *Indian Journal of Forestry*, *41*(1), 31-33.
13. Harwood, R., & Dessein, S. (2005). Australian Spermacoce (Rubiaceae: Spermacoceae). I. Northern Territory. *Australian Systematic Botany*, *18*(4), 297-365.
14. Deb, D. B., & Dutta, R. (1984). Revision of the genus *Spermacoce* (Rubiaceae) in India and adjoining regions. *Journal of economic and taxonomic botany*, *5*(5), 1037-1063.
15. Vaes, E., Vrijdaghs, A., Smets, E. F. and Dessein, S. (2006). Elaborate Petals in Australian Spermacoce (Rubiaceae) Species: Morphology, Ontogeny and Function. *Annals of Botany*, *8*, 1167-1178.
16. Robbrecht, E. (1988). Tropical Woody Rubiaceae. *Opera Botanica Belgica, edited by National Botanic Garden of Belgium, Meise*, 1-272.
17. Linnaeus, C. (1753). Species Plantarum, London.
18. Meyer. (1818). Prim. FI. Essenquib, 83.
19. Bentham, G. (1867). Flora Australiensis. *Lovell Reeve & Company, London, 3*, 438-443.
20. Gamble, J. S. (1921). Flora of the Presidency of Madras, Volume 2.
21. Sundaram, R. L., & Vasanthi, H. R. (2022). *Spermacoce hispida* Linn: a critical review on pharmacognosy, phytochemistry, and pharmacology based on traditional claims. *Phytomedicine Plus*, *2*(1), 100143.
22. Hiern, W. P. (1877). Flora of Tropical Africa. *Lovell Reeve & Company, London, 3*, 233-240.
23. Cooke, T. (1903). The Flora of the Presidency of Bombay, Volume 1, Taylor and Francis, London.
24. Prain, D. (1903). Bengal Plants, Volume 2. West Newman & Company, Calcutta.
25. Kanjilal, U. N., Dey, R. N & Das, A. (1939). Flora of Assam, Volume 1. The Royal Society, London.
26. Roxburgh, W. (1820). Flora Indica (ed. Carey & Wall.) *Mission Press, Serampore, 1*, 372-380.
27. Don, D. (1825). Prodromus Flora Nepalensis, London, 143.
28. Wight, R., & Arnott, G. A. W. (1834). Prodromus florae Indiae orientalis. Parbury, London, 437-439.
29. Kumar, R. B., Suryanarayana, B. (2013). Ethnomedicinal recipes for skin and dermatitis & allied diseases from tribals of Sriharikota Island, Andhra Pradesh. *Journal* of *Pharmacognosy* and *Phytochemistry*, *2*, 234–249.
30. Esakkimuthu, S., Mutheeswaran, S., Arvinth, M., Paulraj, Pandikumar, P., Ignacimuthu, S. (2016). Quantitative ethnomedicinal survey of medicinal plants given for cardiometabolic diseases by the non-institutionally trained Siddha practitioners of Tiruvallur district, Tamil Nadu, India. *Journal of* Ethnopharmacology, *186*.
31. Burkill, I. H. (1935). Dictionary of Economic Products from Malay Peninsular, Vol. I-II. *The Ministry of Agriculture & Cooperatives, Kuala Lumpur*, 1297.
32. Bhat, G. K. (2003). Flora of Udupi. *Indian Naturalist Publisher, Udupi*,1-913.
33. Conserva, L. M., & Jesu Costa Ferreira, J. (2012). *Borreria* and *Spermacoce* species (Rubiaceae): A review of their ethnomedicinal properties, chemical constituents, and biological activities. *Pharmacognosy reviews*, *6*(11), 46.

34. Patel, A. J., Patel, J. R., Macwan, C. P., Patel, M. A., & Soni, A. K. (2011). Pharmacognostical and proximate analysis of leaves of Borreria hispida. *Asian Journal of Biochemical and Pharmaceutical Research, 1*(2), 157-161.
35. Website: https://elsevier.libguides.com/Scopus
36. Website: https://scholar.google.com/
37. Website:https://clarivate.com/academia-government/scientific-and-academic-research/research-discovery-and-referencing/web-of-science/
38. Website: https://pubmed.ncbi.nlm.nih.gov/
39. Website: https://www.sciencedirect.com/
40. Website: https://link.springer.com/
41. Website: https://www.elsevier.com/en-in
42. Website: https://onlinelibrary.wiley.com/
43. Website: https://www.tropicos.org/home
44. Website: https://powo.science.kew.org/
45. Website: https://www.ipni.org/
46. Olayemi, A. (2008). Ethnobotanical and pharmacological evaluation of the medicinal plants used in the treatment of inflammatory disorders. *Journal of Ethnopharmacology*.
47. Gokhale, S. B., et al. (2009). Antimicrobial activity of some medicinal plants used by tribal people of Maharashtra. *Indian Journal of Traditional Knowledge*.
48. Lukhoba, C. W., et al. (2006). Medicinal plants of the genus *Spermacoce*. Fitoterapia.
49. Choudhury, M. D., et al. (2010). Hypoglycemic activity of plants: A review. *Journal of Ethnopharmacology*.
50. Duke, J. A., & Ayensu, E. S. (1985). Medicinal Plants of the World. Reference Publications.
51. Parhi, P. K., & Prithwiraj Mohapatra, P. M. (2012). Pharmacognostical profile of *Spermacoce ocymoides* (Burm. F) DC. - A study on a medicinal botanical.
52. Shanmugham, S., Annadurai, M., Rajendran, K. (2011). *Journal of Applied pharmaceutical Sciences, 01*(08), 94- 97
53. Ebana, R. U. B., Madunaga, B. E., Ekpe, E. D., Otung, I. N., (1991). Journal of Applied Bacteriology, 398-401
54. Warrior, P. K,, Nambiar, V. P. K., Ramankutty, C. (1994). Indian Medicinal Plants. Hyderabad, India: Orient Longman LTD.
55. Parrotta, J. A. (2001). Healing Plants of Peninsular India. *Wallingford CAB International Publishing*, 614–615.
56. Ankad, G. M., Konakeri, R. T., Hegde, H. V., & Roy, S. (2015). Variation in pharmacognostic characters and polyphenolic contents among four species of medicinal plants from the genus spermacoce (rubiaceae). *Indian journal of pharmaceutical sciences*, *77*(4), 446.
57. Vinayak, M., Chandrashekhar, K., Shishir, M. (2013). Pharmacological activities of *Spermacoce hispida* Linn: A review. *International Journal of Ayurveda and Pharma Research*, (4), 8-22.
58. Sharma, S., Malik, J. K., & Chandra, D. (2022). Pharmacognostic Evaluation and Antioxidant Potential of. *Spermacoce hispida*.
59. Rajkumar, T. (2013). Anti-microbial studies of Spermacoce hispida seed oil. *International Journal of Innovative Pharmaceutical Sciences and Research*, 1(1), 62-70.
60. Chellaiah, M., Muniappan, A., Nagappan, R., Savarimuthu, I. (1999). Medical plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. *Journal of Ethnobiology and Ethnomedicine*, 2-43.
61. Kar, A., and Sahu, N. P. (2010). Studies on medicinal plants for antimicrobial activity. Journal of Ethnopharmacology.
62. Okpuzor, J., et al. (2010). Medicinal plants and their ethnopharmacological applications in Nigeria. *Pharmacognosy Journal*.
63. Duru, M. K., et al. (2012). Antimicrobial and anti-inflammatory activities of medicinal plants used in traditional healing in Nigeria. *Journal of Ethnopharmacology*.
64. Lado, P. D., et al. 2014 (). Phytochemical screening and biological activities of *Spermacoce* species. *Journal of Ethnopharmacology*.
65. Olajide, O. A., et al. (2003). Phytochemical and antimicrobial properties of some plants used in traditional medicine. Phytotherapy Research.
66. Sam, N. D., et al. (2018). Antimicrobial activity of *Spermacoce mauritiana* against pathogenic bacteria and fungi. *Journal of Medicinal Plants Research, 12*(10), 202-208.
67. Goyal, S. P., et al. (2012). Anti-inflammatory and analgesic effects of *Spermacoce mauritiana* in animal models. *Phytotherapy Research, 26*(7), 1051-1056.
68. Das, P., et al. (2019). Ethnobotanical uses of *Spermacoce mauritiana* in digestive health: A comprehensive review. *Journal of Ethnopharmacology, 245*, 112-118.

69. Kumar, P., & Rajendra, P. (2017). Wound healing properties of *Spermacoce mauritiana* and its potential in traditional medicine. *Pharmacognosy Magazine*, *13*(50), 209-213.
70. Sharma, S., et al. (2015). Antioxidant potential of *Spermacoce mauritiana* and its phytochemical composition. *Food and Chemical Toxicology*, *79*, 40-45.
71. Singh, M., et al. (2017). Antidiabetic potential of *Spermacoce mauritiana* in experimental models. *Journal of Ethnopharmacology*, *211*, 22-28.
72. Shah, G. L., Gopal, G. V. (1985). Ethnomedical notes from the tribal inhabitants of the North Gujarat (India). *Journal of Economic and Taxonomic Botany*, *6*, 193-201.
73. Hao, Y. K., Weng, W. F., and Ji, S. G. (2024). Pharmacognostical studies on Spermacoce pusilla Wallich. *Pharmacology Discovery*, *4*(1).
74. Rahman, M. A, Uddin, S. B., Wilcock, C. C. (2007). Medicinal plants used by Chakma tribe in Hill districts of Bangledesh. *Indian Journal of Traditional Knowledge*, *6*, 508-17.
75. Vadivelan, S., Sinha, B. N., Betanabhatla, K. S., Christina, A. J., Pillai, R. N. (2007). Anti-inflammatory activity of *Spermacoce articularis* Linn on carrageenan induced paw edema in Wistar male rats. *Pharmacologyonline*, *3*, 478-84
76. Yeast-induced, S. A. L. O. (2018). Antipyretic potential of aqueous leaf extract of *Annona muricata*. L. *Asian Journal of Pharmaceutical and Clinical Research*, 11(3), 148-151.
77. Dahiya, S. S., and Solanki, P. (2011). Evaluation of in vitro anthelmintic activity of methanolic extracts of different parts of *Spermacoce articularis* L. f. *International Journal of Pharmacy and Pharmaceutical Sciences*, 3(5), 244-247.
78. Sultana, R., Rahman, M. S., Bhuiyan, M. N., Begum, J., Anwar, M. N. (2008). In vitro antibacterial and antifungal activity of *Borreria articularis*. *Bangladesh Journal of Microbiology*, 25, 95-98
79. Proma, R. Z., Kar, T. R., Siddique, M. A. B., Ahsan, M. A., and Saha, K. Proximate and elemental analysis of two medicinal plants: *Cassia alata* and *Spermacoce latifolia*.
80. Ahmad S. K., Hassan, Md. M., Imam, M. Abeer, U., Ahmad I. (2013). Chemical group characterization and biological investigation of *Spermacoce latifolia*. *International Journal of Biological and Pharmaceutical Research*, *4*(3), 194-199.
81. Saha, K., Lajis, N. H., Israf, D. A., Hmazah, A. S., Khozirah, S., Khamis, S., et al. (2004). Evaluation of antioxidant and nitric oxide inhibitory activities of selected Malaysian medicinal plants. *Journal of Ethnopharmacology*, *92*(2-3), 263-267.
82. Ghani, A. (1998). Medicinal Plants of Bangladesh, 115.
83. Guha, Bukshi, D.N. (1999). A lexicon of medicinal plants of India. In: P Sensarma, DC Pal. Vol 1. *Naya Prakash, Calcutta*, 302- 303.
84. Vieira, I. J., Mathias, L., Braz-Filho, R., Schripsema, J. (1999). Iridoids from *Borreria verticillata*. *Organic Letters*, *1*, 1169-71
85. Moreira, V. F., Oliveira, R. R., Mathias, L., Braz-Filho, R., Vieira, I. J. (2010). New chemical constituents from *Borreria verticillata* (Rubiaceae). *Helvetica Chimica Acta*, 93, 1751-7
86. Lorenzi, H., Matos, F. J. (2002). Plantas medicinais do Brasil. *Sao Paulo*: Nova Odessa.
87. Maynart, G., Pousset, J. L., Mboup, S., Denis, F. (1980). Antibacterial activity of borreverine, an alkaloid isolated from *Borreria verticillata* (Rubiaceae). C*omptes Rendus des Seances de la Societe de Biologie et de Ses Filiales*, 174, 925-8.
88. Benjamin, T. V. (1979). Investigation of *Borreria verticillata*, an antieczematic plant of Nigeria. *Quarterly Journal of Crude Drug Research*, 17, 135-136.
89. Nunez, L. M., et al. (2016). Antimicrobial activity of *Spermacoce assergens* (Rubiaceae). *Journal of Ethnopharmacology*, *185*, 1-5.
90. Martinez, A. M., et al. (2014). Anti-inflammatory and analgesic effects of *Spermacoce assergens*. *Pharmacognosy Research*, *6*(3), 225-230.
91. Barboza, G. E., et al. (2012). Antioxidant properties of *Spermacoce assergens* extracts. *Fitoterapia*, *83*(3), 586-589.
92. Shoibe, M., Chy, M. N. U., Alam, M., Adnan, M., Islam, M. Z., Nihar, S. W., & Suez, E. (2017). In Vitro and In Vivo Biological Activities of *Cissus adnata* (Roxb.). *Biomedicines*, *5*(4), 63.
93. Patil, R. H., Patil, M. P., & Maheshwari, V. L. (2023). Traditional Knowledge, Ethnomedicinal Importance and Practical Uses of Apocynaceae Members. In *Apocynaceae* Plants: Ethnobotany, Phytochemistry, Bioactivity and Biotechnological Advances. *Singapore: Springer Nature Singapore*, 13-21.