Report of Paper publication on the Topic Biotechnology for propagation and secondary metabolite production in Bacopa monnieri

Date of Event	26th February 2022
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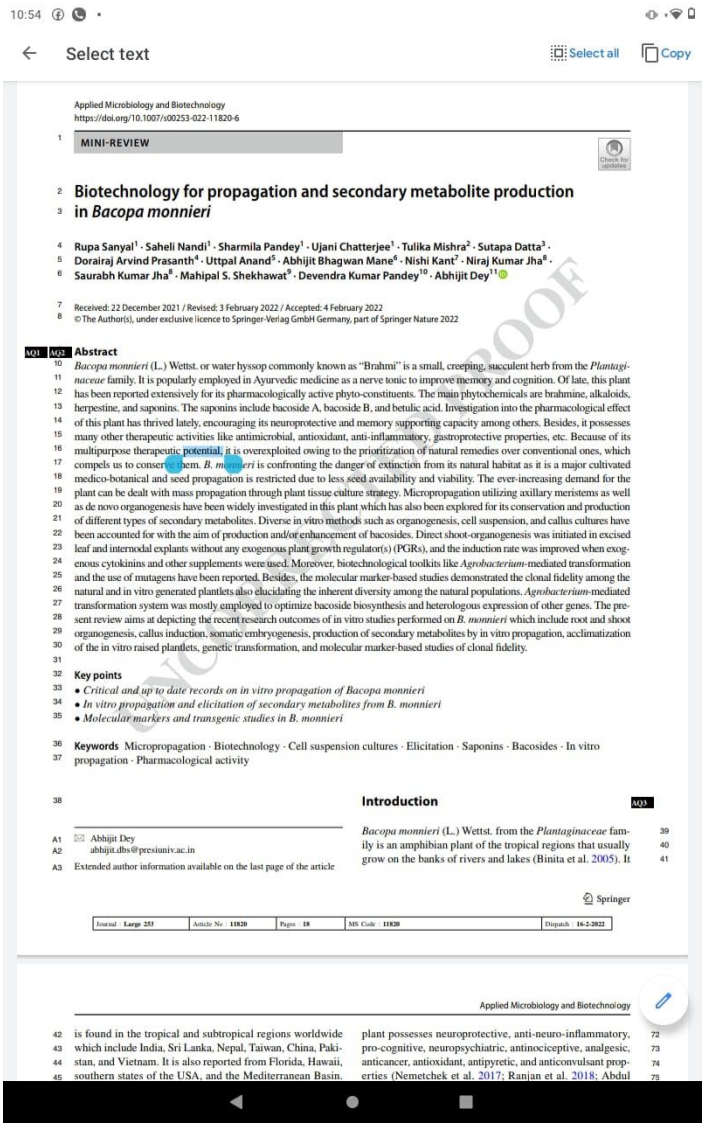
Conducted by	Department of Biotechnology
No. Of Participant	NA

Dr. Nishikant from Department of Biotechnology, School of Health & Allied science, AJU has published a Mini review in Applied Microbiology and Biotechnology Journal (Impact factor-4.69). The title of article is "Biotechnology for propagation and secondary metabolite production in *Bacopa monnieri*" Appl Microbiol Biotechnol. 2022 Feb 26. doi: 10.1007/s00253-022-11820-6. PMID: 35218388.

The Abstract of article is Bacopa monnieri (L.) Wettst. or water hyssop commonly known as "Brahmi" is a small, creeping, succulent herb from the Plantaginaceae family. It is popularly employed in Ayurvedic medicine as a nerve tonic to improve memory and cognition. Of late, this plant has been reported extensively for its pharmacologically active phyto-constituents. The main phytochemicals are brahmine, alkaloids, herpestine, and saponins. The saponins include bacoside A, bacoside B, and betulic acid. Investigation into the pharmacological effect of this plant has thrived lately, encouraging its neuroprotective and memory supporting capacity among others. Besides, it possesses many other therapeutic activities like antimicrobial, antioxidant, anti-inflammatory, gastroprotective properties, etc. Because of its multipurpose therapeutic potential, it is overexploited owing to the prioritization of natural remedies over conventional ones, which compels us to conserve them. B. monnieri is confronting the danger of extinction from its natural habitat as it is a major cultivated medico-botanical and seed propagation is restricted due to less seed availability and viability. The ever-increasing demand for the plant can be dealt with mass propagation through plant tissue culture strategy. Micropropagation utilizing axillary meristems as well as de novo organogenesis have been widely investigated in this plant which has also been explored for its conservation and production of different types of secondary metabolites. Diverse in vitro methods such as organogenesis, cell suspension, and callus cultures have been accounted for with the aim of production and/or enhancement of bacosides. Direct shoot-organogenesis was initiated in excised leaf and internodal explants without any exogenous plant growth regulator(s) (PGRs), and the induction rate was improved when exogenous cytokinins and

other supplements were used. Moreover, biotechnological toolkits like Agrobacterium-mediated transformation and the use of mutagens have been reported. Besides, the molecular marker-based studies demonstrated the clonal fidelity among the natural and in vitro generated plantlets also elucidating the inherent diversity among the natural populations. Agrobacterium-mediated transformation system was mostly employed to optimize bacoside biosynthesis and heterologous expression of other genes. The present review aims at depicting the recent research outcomes of in vitro studies performed on B. monnieri which include root and shoot organogenesis, callus induction, somatic embryogenesis, production of secondary metabolites by in vitro propagation, acclimatization of the in vitro raised plantlets, genetic transformation, and molecular marker-based studies of clonal fidelity.



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Applied Microbiology and Biotechnology
https://doi.org/10.1007/s00253-022-11820-6

MINI-REVIEW

Biotechnology for propagation and secondary metabolite production in *Bacopa monnieri*

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Received: 22 December 2021 / Revised: 3 February 2022 / Accepted: 4 February 2022

Abstract

Bacopa monnieri (L.) Wettst. or water hyssop commonly known as "Brahmi" is a small, creeping, succulent herb from the *Plantaginaceae* family. It is popularly employed in Ayurvedic medicine as a nerve tonic to improve memory and cognition. Of late, this plant has been reported extensively for its pharmacologically active phyto-constituents. The main phytochemicals are brahmine, alkaloids, herpestine, and saponins. The saponins include bacoside A, bacoside B, and betulic acid. Investigation into the pharmacological effect of this plant has thrived lately, encouraging its neuroprotective and memory supporting capacity among others. Besides, it possesses many other therapeutic activities like antimicrobial, antioxidant, anti-inflammatory, gastroprotective properties, etc. Because of its multipurpose therapeutic potential, it is overexploited owing to the prioritization of natural remedies over conventional ones, which compels us to conserve them. *B. monnieri* is confronting the danger of extinction from its natural habitat as it is a major cultivated medico-botanical and seed propagation is restricted due to less seed availability and viability. The ever-increasing demand for the plant can be dealt with mass propagation through plant tissue culture strategy. Micropropagation utilizing axillary meristems as well as de novo organogenesis have been widely investigated in this plant which has also been explored for its conservation and production of different types of secondary metabolites. Diverse in vitro methods such as organogenesis, cell suspension, and callus cultures have been accounted for with the aim of production and/or enhancement of bacosides. Direct shoot-organogenesis was initiated in excised leaf and internodal explants without any exogenous plant growth regulator(s) (PGRs), and the induction rate was improved when exogenous cytokinins and other supplements were used. Moreover, biotechnological toolkits like *Agrobacterium*-mediated transformation and the use of mutagens have been reported. Besides, the molecular marker-based studies demonstrated the clonal fidelity among the natural and in vitro generated plantlets also elucidating the inherent diversity among the natural populations. *Agrobacterium*-mediated transformation system was mostly employed to optimize bacoside biosynthesis and heterologous expression of other genes. The present review aims at depicting the recent research outcomes of in vitro studies performed on *B. monnieri* which include root and shoot organogenesis, callus induction, somatic embryogenesis, production of secondary metabolites by in vitro propagation, acclimatization of the in vitro raised plantlets, genetic transformation, and molecular marker-based studies of clonal fidelity.

Key points

- *Critical and up to date records on in vitro propagation of Bacopa monnieri*
- *In vitro propagation and elicitation of secondary metabolites from B. monnieri*
- *Molecular markers and transgenic studies in B. monnieri*

Keywords Micropropagation · Biotechnology · Cell suspension cultures · Elicitation · Saponins · Bacosides · In vitro propagation · Pharmacological activity

Introduction

Bacopa monnieri (L.) Wettst. from the *Plantaginaceae* family is an amphibian plant of the tropical regions that usually grow on the banks of rivers and lakes (Binita et al. 2005). It

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Springer

Journal : Large 253 | Article No : 11820 | Pages : 18 | MS Code : 11820 | Dispatch : 16-2-2022

is found in the tropical and subtropical regions worldwide which include India, Sri Lanka, Nepal, Taiwan, China, Pakistan, and Vietnam. It is also reported from Florida, Hawaii, southern states of the USA, and the Mediterranean Basin. plant possesses neuroprotective, anti-neuro-inflammatory, pro-cognitive, neuropsychiatric, antinociceptive, analgesic, anticancer, antioxidant, antipyretic, and anticonvulsant properties (Nemetchek et al. 2017; Ranjan et al. 2018; Abdul