

Plant Probiotic Bacterial Endophyte, *Alcaligenes faecalis*, Modulates Plant Growth and Forskolin Biosynthesis in *Coleus forskohlii*

Probiotics and Antimicrobial Proteins

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Article

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Abstract

Coleus forskohlii is an herb, well-known for its medicinal compound forskolin present in its roots, with wide range of pharmaceutical applications. Here, we report, for the first time, the role of plant–probiotic bacterial endophytes of *C. forskohlii*, CFLB1 and CFRB1, isolated from leaf and root, which regulate plant growth and *in plant* forskolin content. Native bacterial endophyte, CFRB1 (*Alcaligenes faecalis*), significantly modulates primary plant productivity and forskolin content under pot and field conditions. Under field conditions, CFRB1 endophyte application significantly enhanced photosynthetic pigments and reduced the severity of root-knot and root rot diseases. Expression analyses of functional genes involved in the forskolin biosynthesis in *C. forskohlii* plants treated with CFRB1 endophyte under field conditions revealed differential upregulation of four *C. forskohlii* diterpene synthases (*CfTPSs*), *CfTPS1*, *CfTPS2*, *CfTPS3* and *CfTPS4*, along with cytochrome P450 (*CfCYP76AH15*) and acyltransferase (*CfACT1–8*) genes. CFRB1 treatment reduced the severity of nematode infection and root rot in *C. forskohlii* plants by 81 and 78%, respectively. Overall, we demonstrate that cross-talk of plant–endophyte interaction in *C. forskohlii* is beneficial, leading to enhanced forskolin content through modulation of forskolin biosynthetic pathway genes along with increased plant

yield and reduced disease incidence. Thus, endophytic isolate, *A. faecalis* (CFRB1), could be deployed as a novel bio-stimulant for enhancing *in planta* forskolin content during cultivation of *C. forskohlii*.

Keywords

Alcaligenes faecalis Plant–probiotic bacterial endophyte *Coleus forskohlii*
Forskolin *CfTPSs* *CfCYP76AH15* *CfACT1–8*

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Notes

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Authors' Contribution

Research concept was conceived and designed by CSV. AM and DR performed the bench work, and AM, CSV, DR and SGD analyzed the data. AM, SGD and CSV wrote the manuscript.

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Compliance with Ethical Standards

Conflict of Interest

The authors declare that they have no conflict of interest.

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Supplementary material

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