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Identification of Plant Growth-Promoting Rhizobacteria for the Development of Probiotic Consortia

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Abstract

Soil infertility is one of the major challenges in agriculture. Although chemical fertilizers provide promising solution for crop growth in infertile soil, excessive application cause negative impacts on the natural systems such as soil and water. Moreover, these fertilizers can be converted into insoluble forms soon after application which often result in increasing the application frequency and the quantity. Hence, for decades plant growth-promoting rhizobacteria (PGPR) have been considered as an environmentally friendly alternative for chemical fertilizers. In this context, the present study was focused on the identification of candidate PGPRs for the development of probiotic packages for chilli (*Capsicum annuum* L.) which is one of the most widely grown and highly demanding vegetable crops in Sri Lanka. Rhizobacteria were isolated from the roots of healthy, young chilli plants grown in Angunakolapelessa, Sri Lanka and their rhizosphere soil. In total, 75 morphologically distinct strains were isolated, and they were inoculated into different nutrient media to screen their ability to solubilize insoluble mineral nutrient sources. Those media were National-Botanical-Research-Institute's phosphate agar [NBRIP-agar] with $Ca_3(PO_4)_2$ as the P source, modified-Aleksandrov-agar containing mica as the K source and zinc-solubilizing-agar containing $ZnCO_3$ as the Zn source. Further, bacteria were screened for N fixation in the nitrogen-fixing-bacteria (NfB) medium. Sixteen P-solubilizing-bacteria (PSB), 4 K-solubilizing-bacteria (KSB), 15 Zn-solubilizing-bacteria (ZnSB) and 10 N-fixing strains were identified. We noticed that all KSB strains also have the capacity to solubilize $Ca_3(PO_4)_2$. All PSB strains, except *CSTM10*, can solubilize $ZnCO_3$. The phosphate solubilizing index (PSI) was calculated to rank the P-solubilizing efficiency (PSE) of PSB. The highest PSI was found in *CSTM40* and *CSTM6*. We further screened all mineral-solubilizing strains for the indole-3-acidic acid (IAA) production which is a PGP hormone. Cultures were induced for IAA production by supplementing the medium with 0.2% (w/v) tryptophan and IAA concentration was determined using the Salkowski's method. Nine strains were capable of producing IAA. The *CSTM6* and *CSTM21* showed the highest IAA production of 181.94 and 178.59 mg/L respectively. In conclusion, bacterial strains, *CSTM6, CSTM14, CSTM21, CSTM24, CSTM40, CMTM1, CMTM2* and *CSTM10* showed multiple PGP characteristics and they were selected as candidates for the developing probiotic consortia. They can be viewed as promising strains in sustainable agriculture since they perhaps can enhance the availability of mineral nutrients in soil and promote plant growth.

Keywords: Biofertilizer, *Capsicum annuum*, Plant growth-promoting rhizobacteria

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