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Probiotic bacteria promote the growth of associating host(red seaweed, *Gracilaria edulis*) also synthesize antibacterial protein

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ABSTRACT

Those plant associated bacteria supporting the growth, reproduction and yield by synthesizing phytohormones, antibiotics and lytic enzymes are called plant probiotics. In this study, isolates of Gram positive *Lysinibacillus xylanilyticus* associated with red seaweed species were evaluated for antibacterial activity against plant pathogenic bacterium *X. oryzae* pv. *oryzae* which cause bacterial blight in rice using disc and well diffusion assays. The isolate HVT234 among the isolates of *L. xylanilyticus* associated with red seaweed species exhibit high antibacterial activity. The optimum level of extracellular antibacterial protein synthesize in HVT234 was recorded when cultured in 1.5% inoculum in seawater medium with lactose carbon and ammonium chloride nitrogen at pH 7.0 at 35 °C for 48 h. The antibacterial substance extracted in ethyl acetate from the culture supernatant of *L. xylanilyticus* HVT234 was isolated and separated as 66 kDs protein. The *L. xylanilyticus* synthesizing antibacterial substance elicited by some non-active co-associating bacteria promote the host *Gracilaria edulis* growth is considered as probiotic because another associated *Bacillus cereus* produce antibacterial protein did not support the host growth. This chemical elicitor protein most probably a quorum signal *N*-acyl homoserine lactone of probiotic *L. xylanilyticus* which support the host *G. edulis* growth reported for the first time from this study has immense value in the seaweed mariculture because this species is one of the major biomass feedstocks for agar production.

1. Introduction

Marine macroalgae(seaweeds) are commercially important biomass feedstock occurring along the tidal, intertidal and subtidal regions of the coastal waters exploited for industrially valuable compounds such as agar, carrageenan, alginate, fucoidan, pigments etc., that are being used for preparing several commodities like human food, medicine, fertilizers and fuel as well (Teas, 2007). The marine environment has a huge diversity of life forms and the water column of the oceans contains approximately 10^6 bacterial cells per millilitre(Hagström et al., 2002). These marine bacteria are recently being evaluated for the source of biologically active compounds (Debbab et al., 2010) because of growing demand for novel compounds of natural origin that have potential applications in pharmaceutical and other allied industries (Singh et al., 2014). As bacteria living in association with seaweeds as epibionts or endobionts which experience highly competitive environment for space and access to host nutrients (Lemos et al., 1986; Suvega and Arunkumar, 2014), they synthesize wide range of enzymes/compounds in order to absorb the nutrient from the host seaweeds. This marine algae contains unique polysaccharides and other substances that are not at all present in other marine as well as terrestrial plants and animals (Popper et al., 2011). Hence these seaweed associated bacteria can be considered as a potential source for specific enzymes and active compounds (Zheng et al., 2005; Suvega and Arunkumar, 2014; Satheesh et al., 2016).

Studies show the seaweed associated bacteria as epibionts and endobionts displaying various biological activities like antifouling, antimicrobial and cytotoxicity mainly belong to *Alphaproteobacteria, Gammaproteobacteria, Firmicutes, Actinobacteria, Bacteroidetes, Planctomycetes, Pseudomonas, Stenotrophomonas, Vibrio, Alteromonas, Shewanella, Streptomyces,* and *Bacillus* are isolated from the members of *Rhodophyceae*(red), *Chlorophyceae*(green) and *Phaeophyceae*(brown) (Armstrong et al., 2000; Egan et al., 2001; Dobretsov and Qian, 2002; Harder et al., 2004; Rajasree et al., 2012; Janaki Devi et al., 2013; Hong and Cho, 2013; Singh et al., 2014; Suvega and Arunkumar, 2014). This seaweed-bacteria association has been ascertained as beneficial, harmful or neutral and obligate to facultative (Goecke et al., 2010). And the chemical compounds exerted by the associating bacteria reported as promoting the host seaweed growth through development, morphogenesis and reproduction (Singh et al., 2011a, 2014) have been

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