Isolation, identification, and characterization of phosphate solubilizing bacteria, Paenibacillus sp., from the soil of Danum Valley Tropical Rainforest, Sabah, Malaysia

ABSTRACT

Phosphorus (P) is a vital element for plant growth. However, only 0.1% of available soil phosphate is directly utilized by plants. Consequently, P fertilizer, which is mostly sourced from unrenewable resources of phosphate rock, is practically added into croplands. Furthermore, as the demand for this fertilizer increases, its availability and impact on environmental issues raise wide concerns. The use of soil phosphate solubilizing bacteria (PSB) is a promising alternative to be further developed as a biofertilizer to increase the availability of P elements for plant growth. As such, we report here on our efforts to screen and characterize novel PSB from tropical rainforest soil. The soil samples were collected from the Danum Valley tropical rainforest, which is located in Sabah, at the northeastern region of Borneo. Phosphatase solubilizing bacteria were then screened using the NBRIP agar selective media. The result yielded five colonies, designated as PSB1, PSB2, PSB3, PSB4, and PSB5, displaying halos with an average diameter of 10mm. The 16S rRNA gene sequence analysis using BLASTn indicated that PSB1, PSB2, PSB3, PSB4, and PSB5 were mainly Bacillus sp. PSB01 (MZ675820), Pseudomonas oryzyhabitans PSB02 (MZ675821), Staphylococcus pasteuri PSB03 (MZ675822), Paenibacillus sp. PSB04 (MZ675823), and Staphylococcus pasteuri PSB05 (MZ675824), respectively. Consequently, since Paenibacillus has been reportedly used in the global agriculture industry as a promising biofertilizer, we then selected Paenibacillus sp. PSB04 for further downstream characterization using Gram staining and scanning electron microscope (SEM). The Gram staining revealed that Paenibacillus sp. PSB04 was a Gram-negative bacterium with a rod shape, which was in good agreement with the SEM data. Further analysis revealed that the specific phosphatase activity of the extracellular fraction of this bacterium was 7,378.12 U mg-1. This was the highest activity observed when compared to previous studies. The results here provide an early insight into an excellent phosphate-solubilizing bacterium obtained from a tropical rainforest which could be beneficial to the agriculture industry.