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“Optimizing Innovation in Knowledge, Education and Design”

EXTENDED ABSTRACT



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Assalamualaikum warahmatullahi wabarakatuh,



First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality. I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services. By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality. I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
RECTOR
UiTM KEDAH BRANCH



WELCOME MESSAGE (i-SPIKE 2023 CHAIR)



We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPIKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPIKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPIKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail

Chair

3rd International Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPIKE 2023)

UMK-PPS3, A LOCALLY ISOLATED RHIZOBACTERIA AS A PLANT BOOSTER

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ABSTRACT

Rhizobacteria are bacteria that inhabit the plant rhizosphere and can promote plant growth by helping plants obtain essential nutrients and plant growth regulators via several mechanisms, including solubilization of insoluble phosphate in the soil, fixation of atmospheric nitrogen suitable for plant uptake, and production of phytohormone such as indole-3-acetic acid (IAA). UMK-PPS3 is our local rhizobacteria isolated from the paddy rhizosphere. This strain was identified as having the highest similarity to *Fraterulla aurantia* which is well known as potassium solubilizing and mobilizing bacteria. We carried out several tests and assays including phosphate solubilization index (PSI) test, vanadate molybdate assay, Salkowski assay, and phytase assay to determine the plant growth-promoting activity. Besides, *in vitro* seed vigour index test and pot study were carried out to study the effect of UMK-PPS3 as plant booster. We discovered that this strain is able to solubilize insoluble phosphate and surprisingly even higher than previous study on rhizobacteria. Other than that, this isolate can fix atmospheric nitrogen, and produce a substantial amount of phytohormone and phytase enzyme. The inoculation of UMK-PPS3 has demonstrated an overall improvement in plant growth and germination rates, indicating that this bacterial isolate has immense potential as a plant booster. Thus, UMK-PPS3 is suitable to be applied as a plant booster as well as an environmental friendly, and cost-effective biofertilizer.

Keywords: rhizobacteria, plant growth-promoting, biofertilizer, plant booster

INTRODUCTION

Rhizobacteria are bacteria that live in association with plant roots and can affect plant growth in various ways. They exhibit synergistic and antagonistic interactions with the soil microbiota and engage in an array of activities of ecological significance. Some rhizobacteria are plant growth-promoting rhizobacteria (PGPR), which can enhance plant growth by fixing nitrogen, solubilizing phosphorus, producing phytohormones, or suppressing plant pathogens (Das et al., 2022). Due to their growth-promoting activities, the potential of rhizobacteria as biofertilizer or plant boosters has been extensively explored. Biofertilizers are emerging as a suitable alternative to replace synthetic agrochemicals due to the adverse environmental impacts caused by the latter. In this project, we successfully isolated a plant growth-promoting rhizobacteria from paddy rhizosphere which have a good potential to be applied as a plant booster.

CONTENT

UMK-PPS3 is our local rhizobacteria isolated from the paddy rhizosphere of a paddy field in Kota Bharu, Kelantan. Based on 16S rRNA sequence analysis, UMK-PPS3 shown the highest similarity to *Frateriuria aurantia* with 99.73% of identity. Through our extensive investigation, we discovered that this bacterium is capable of effectively solubilizing inorganic phosphate, fixing atmospheric nitrogen and producing a substantial amount of phytohormone and phytase enzyme. The treatment of UMK-PPS3 on paddy seeds significantly enhances seed germination rate and Vigor index compared to untreated seeds. When applied as a foliar spray, UMK-PPS3 can promote plant growth, increase moisture content and improve chlorophyll levels. Additionally, the inoculation of UMK-PPS3 has demonstrated an overall improvement in plant growth and germination rates, indicating that this bacterial isolate has immense potential as a plant booster. Therefore, developing and marketing UMK-PPS3 as a plant booster would benefit the agricultural industries.

Capability of solubilizing insoluble phosphate

The capability of UMK-PPS3 in solubilizing insoluble phosphate was determined qualitatively by phosphate solubilization index (PSI) test. The strain was stabbed on the center of Pikovskaya medium which contains tricalcium phosphate (TCP) as insoluble phosphate source. From the test, it can be observed that UMK-PPS3 able to solubilize phosphate with SI 8.00 ± 1.00 based on the formation of clear zone around the colony on day seven incubation as shown in Figure 1(a). This supported by Halimursyadah and Rizva (2022), the ability of isolate in solubilizing phosphate was noticeable by clear zone formation around the colony. The clear zone formation indicated the phosphate solubilization process of TCP supplemented in Pikovskaya medium had occurred (Ouattara et al., 2019). The SI shown by UMK-PPS3 is even higher compared to previous study by Sudewi et al (2020) where the highest SI of PGPR isolated from local aromatic rice rhizosphere is SI 2.33, and recent study by Chawngthu et al (2020) where the highest SI of PGPR isolated from paddy rhizosphere is SI 3.6. Besides, its ability in solubilizing insoluble phosphate was also determined quantitatively by vanadate molybdate assay as method mentioned in Kamaruzaman et al., 2020. UMK-PPS3 having 0.657 ± 0.079 mg/mL significantly at ($P < 0.05$) compared to control as shown in Figure 1(b). There

are a lot of previous studies that highlighted *F. aurantia* as a potassium solubilizing and mobilizing bacterium, however lack of study was done on the traits of phosphate solubilization (Kour et al., 2020; Mahmud, Surovy, Gupta, & Islam, 2021; Spoorthi, Ranadev, Ashwin, & Bagyaraj, 2022). Nevertheless, in this study *F. aurantia* UMK-PPS3 was proved able to solubilize phosphate and even UMK-PPS3 even able to solubilize phosphate higher than previous study on indigenous plant growth promoting diazotrophic bacteria associated with the rice rhizosphere by Mir et al (2022) where their highest phosphate solubilizing activity are 0.3124 mg/mL.

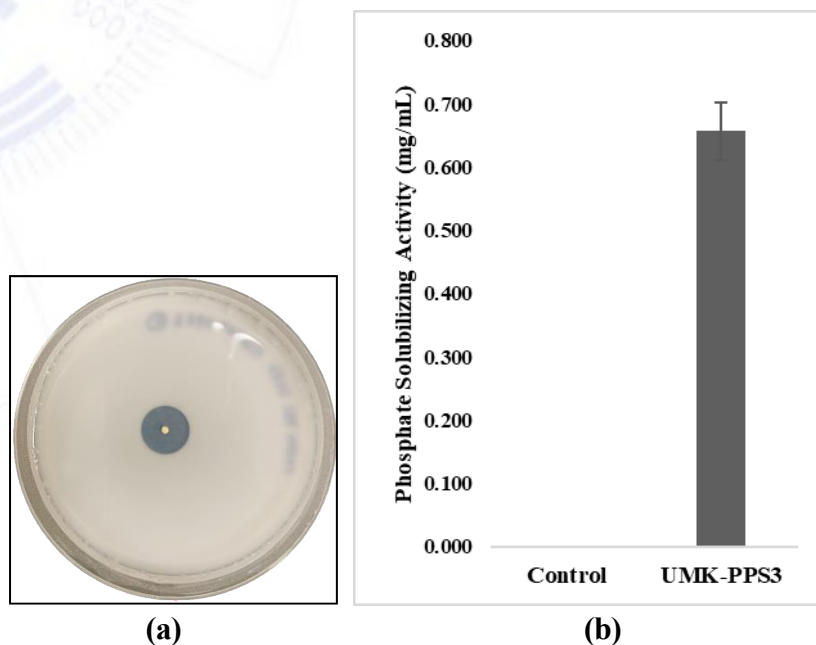


Figure 2. (a) PSI test of UMK-PPS3 on Pikovskaya agar; (b) the phosphate solubilisation activity of UMK-PPS3 compared to control

Fixing atmospheric nitrogen

The ability of UMK-PPS3 in fixing nitrogen was determined by qualitative growth on Burk's medium. Burk's medium does not contain any source of N therefore, microorganisms need to fix aerial N in the media to meet their N requirements for growth (Oo, Khai, Kyaw, Win, & Htet, 2021). Hence, the only bacteria that can fix nitrogen can grow on Burk's medium and are classified as nitrogen fixing bacteria (NFB). *Escherichia coli* was used as negative control because this strain was proved by Ryu et al (2020) neither fix N nor contain N fixation (*nif*) genes. UMK-PPS3 managed to grow on Burk's medium as shown in Figure 3 which indicated the ability to fix nitrogen, however acetylene reduction assay needs to be carried out to prove nitrogen fixing activity quantitatively.

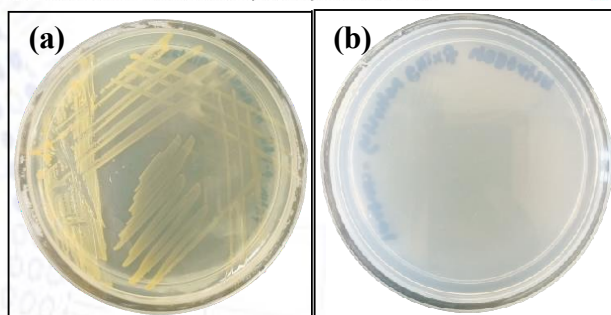


Figure 3. The growth of (a) UMK-PPS3; and (b) *E. coli* (negative control) on Burk's media.

Production of indole-3-acetic Acid (IAA) phytohormones and phytase enzyme

IAA Production was determined by using Salkowski assay. UMK-PPS3 was determined can produce IAA with $39.925 \pm 0.404 \mu\text{g/mL}$ significantly at ($P < 0.05$) compared to control as shown in Figure 4 (a). Phytase activity of UMK-PPS3 was assayed using a method by Hong, Chu, and Chung (2011) and Sanni, Jimoh, Lawal, and Bamidele (2023), and it was determined that UMK-PPS3 having $222.018 \pm 42.894 \text{ U/mL}$ phytase activity significantly at ($P < 0.05$) compared to control as shown in Figure 4 (b).

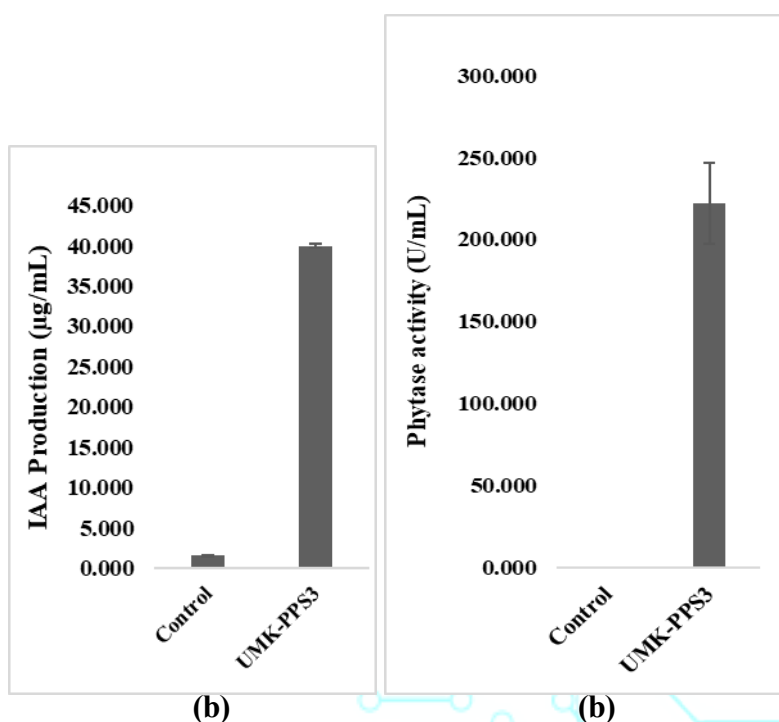


Figure 4. (a) IAA produced by UMK-PPS3 compared to control; (b) phytase activity produced by UMK-PPS3 compared to control

Validation of plant growth promoting using *in vitro* SVI test and pot study

in vitro SVI test was done on MR297 paddy seeds treated with UMK-PPS3. The treatment enhanced the germination rate of the seeds with 88.3% compared to control (75%) by improving shoot and root elongation as shown in Figure 5. Furthermore, the treated seeds showed SVI with 534.333 ± 58.101 significantly at ($P < 0.05$) compared to control (394.267 ± 55.755). Besides, a pot study was carried out to study the plant growth-promoting effect of UMK-PPS3

on chili plant by foliar spray method. The study proved that UMK-PPS3 can promote plant growth, increase moisture content and improve chlorophyll levels.



Figure 5. The development of shoot and root MR297 paddy seeds treated with UMK-PPS3(b) compared to control (a).



Figure 6. Promotion of chili plant's growth, *Capsicum frutescens* treated with (b) UMK-PPS3 foliar spray compared to (a) control.

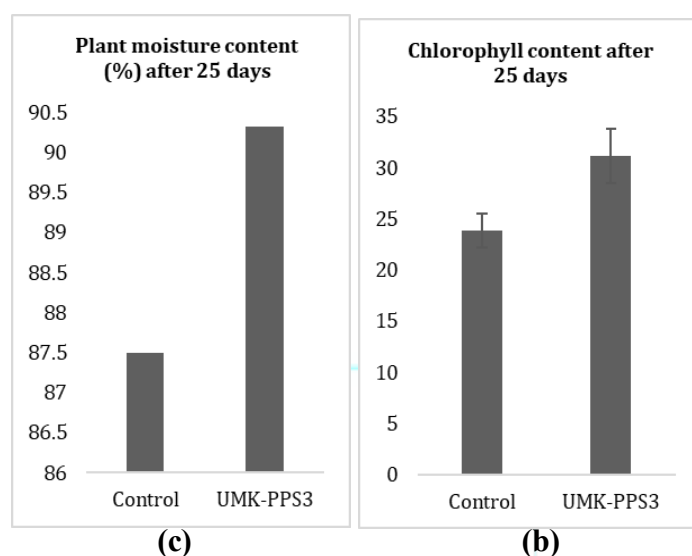


Figure 7. (a) plant moisture content of chili plant treated with UMK-PPS3 using foliar spray compared to control; (b) chlorophyll content of chili plant treated with UMK-PPS3 foliar spray compared to control

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