MICROBIAL FERMENTATION TO IMPROVE ELEMENTS AVAILABILITY OF SOME ROCKS FOR AGRICULTURAL APPLICATION

By

ZAHRA HABIB MOHAMED TAYEB

B.Sc.Agric.Sc. (Agric. Microbiology), Ain Shams University, 2010

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ABSTRACT

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Inorganic phosphate (P) and potassium (K) are more essential macronutrient for the growth and development of plants. Only a small amount of the applied soluble P fertilizer is used by plants and the remainder fraction is hold in soil as insoluble forms. The integration of microbial inoculation with P and K solubilizing microorganisms, and rock P and K materials amendent can improve crop mineral nutrients in nutrient-deficient soils. Therefore, the investigation was designed to study the production fermented solutions of soluble P by local microbial strains in order to use in some agriculture applications.

In the present study, a number of 108 phosphate solubilizing isolates and 20 potassium solubilizing isolates were isolated from different soil samples. Only four isolates were selected as the most efficient phosphate solubilizing isolates on both solid and liquid cultures. Some nutritional and environmental factors affecting the RP solubilization by selected isolates using shake flasks as batch cultures. In a series of experiments on phosphate solubilization, the ingredients of basal med.3 were modified to give the highest phosphate solubilization after 10 or 12 days at 30°C by bacterial and fungal isolates, respectively.

Different treatments of bagasse, corn cobs, black sugar cane molasses, olive cake wastes, rice straw, sugar beet waste and whey were used as a sole carbon source at different treatments for highest phosphate solubilization by tested isolates. The maximum RPs activity was obtained by bacterial and fungal isolates in sugar beet waste and whey as whole media supplemented with 7.0 and 10.0 gL^{-1} RP at pH 7.0 and 5.5 after 10 and 12 days at 30°C which increased RPs content about 1.15 and 3.29 fold comparing to med.3, respectively.

The most efficient RP solubilization isolate was identified with 18S rDNA gene sequencing to close the gene sequencing of *Aspergillus tubingensis* USMI03. The fermented solution of this strain contains the highest concentration of citric acid, indole acetic acid (IAA) and elements as well as phosphatase activity. This solution was applied as mineral source for microbial growth and a phosphate fertilized of bean plants cultivation. Using the fermented solution as mineral source (supplemented with sucrose) increased the growth of *Aspergillus* sp., *Pencillium* sp. and *Tricoderma* sp. about 1.94, 1.53 & 1.33 fold comparing with that obtained by Czapek′s Dox media after 4 day incubation period at 30°C using shake flasks as a batch culture. Foliar spray by un-filtrated fermented solution at 197.01 µgP ml^{-1} increased the plant hight, yield and P content about 2.53, 1.97 and 2.87 fold after 45 days harvest period comparing to control treatment irrigated with Hoagland solution only, suggesting its potential use a P fertilizer.

Keywords: **Phosphate solubilizing microorganisms (PSMs), potassium solubilizing microorganisms (KSMs), *Serratia* sp, *Aspergillus tubingensis*, batch culture, Rock phosphate, bean plant, growth improvement, fermented solutions.**

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