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RECENT ADVANCES AND BENEFICIAL ROLES OF *BACILLUS MEGATERIUM* IN AGRICULTURE AND OTHEIRS FIELDS

DJADOUNI FATIMA[*1] AND MADANI ZOHRA[2]

[*1]Departement of Biology, Faculty of Natural Sciences and Life, Mascara University, Mascara 29000, Algeria, Telephone: 00213781879665, **Email:** Houarisalwa@yahoo.fr

[2]Departement of Biology, Faculty of Natural Sciences and Life, Mascara University, Mascara, 29000, Algeria, Telephone: 00213559447311, **Email:** zohramadani14@gmail.com

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ABSTRACT

Bacteria spread in nature almost every where, they exist in the soil, fresh water, saltwater, deep-sea, hot springs water, and in polar snow as airborne into the upper atmosphere. It is more prevalent in places where food is available, humidity and temperature suitable for their growth and reproduction, and since this is the conditions the same in which man lives, so we find large numbers of bacteria in air, food, humans and animals skin, in the channel tract…..etc. Due to the presence of bacteria in large numbers in most natural circles, they occurs beneficial changes in the earth. Expansion bacterial activity and multi-ranging impact on soil fertilitization, biomethylation, oxidation and reduction, eutrophication, bioremidiation, mineralization, and interactions plants with soil microorganisms, so we'll show in this mini review some of the recent advances and beneficial roles of *Bacillus megaterium* in soil and agriculture and others fields.

Keywords: *Bacillus megaterium*, applications, agriculture, environment, industry, medicine, pharmacy.

INTRODUCTION

Evolution of applied bacteriology, biotechnology, genetic engenering, biochemistry and molecular biology reinforced the wides pread use of *B. megaterium*, these bacteria was found in many places including soil, water, wastes, plants, animals, insects, and in very harsh conditions. The continuous research on improving soil fertility with its multiple kinds, different climates, water shortages in many regions around the world, and try to reduce the soilborne plants pathogens and diseases, and the use of chemical fertilizers make scientists look for alternative in the use of microorganisms in agriculture specialy *Bacillus* sp.

Application of *B. megaterium* in agriculture and horticulture

Many of the world is affected by the scarcity of rain and not good for agriculture and water availability is affected as well as the bad effects produced as a result of the solubility of the salts deposited in the soil were added whenever water during irrigation. Most of the land is characterized by (high pH pH 8 and more), as well as its proximity to the very high percentage of calcium carbonate.

The high alkalinity scale in this land and the presence of a high percentage of calcium carbonate has a major negative impact on the availability and the availability of major and trace elements important and necessary to feed the plants, which also affects the fertility of the soil and thus on agricultural land efficiently and from then on the agricultural production [1-2-3]. Phosphorus component of the major elements important for the growth and plant nutrition in all its stages, and is considered the second component after the nitrogen in terms of importance. Phosphorus is added to the soil in the form of inorganic phosphate fertilizers such as single super phosphate and triple super phosphate and rock phosphorus [4-5].

In most of the agricultural land lives microorganisms beneficial bacteria and fungi and is known organisms analyst minute and dissolving phosphorus where these organisms play a very important role in the analysis and dissolving phosphorus installer and non slushy and non-available and non-absorbable by plants the image dissolved and absorbable, leading to increased availability of phosphorus dissolved element in the soil [6].

And therefore the presence of these microorganisms dissolving phosphorus increases the soil fertility and agricultural production of crops and by increasing the solubility of phosphorus. The most important types of bacteria dissolving phosphorus is that follow the genus *B. megaterium*, *B. subtilis*, *Serratia* spp., *Proteus* spp., *Arthrobacter* spp., enterobacters, *Pseudomonas* spp., and *Streptomyces* spp. and fungi such as *Aspergillus* spp., *Penicillium* spp., *Rhizopus* spp., *Fusarium* spp., and *Cunninghamella* spp. [7-8-9].

These bacteria was involved in the cycle of phosphorus and microbial mineralization of organic phosphorus (biofertilizers), necessary for the plants can use this same organic phosphorus and nitrogen fixation (*B. megaterium* var. *phosphaticum*) [10-11]. Due to its ability to produce a range of enzymes, solubilization pounded nutrients and degrade organic wastes and along with the N2-fixing ability of some strains [12-13].

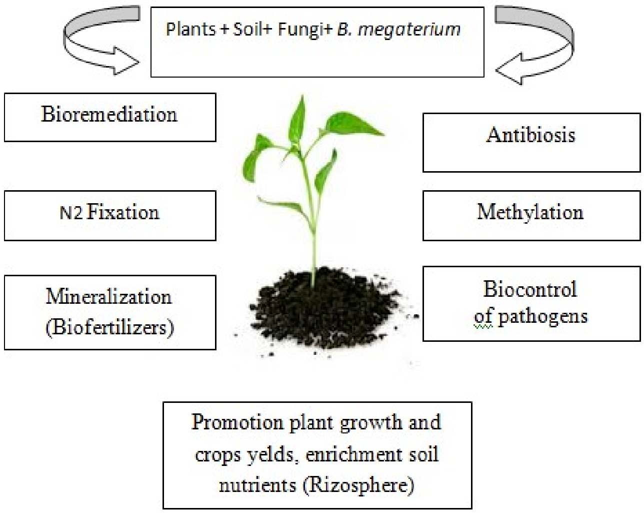

Fig. Importants roles of *B. megaterium* on soil, plants and rizosphere.

Presence of *B. megaterium* in agricultural fields reported to enhance plant growth and crop yield including sugar beet, barley, alfalfa, clover, wheatgrass, perennial ryegrass, soybean and cicer. Production of amino acids, vitamins, indole acetic acid, gibberellic acids, antibiotics induced systemic resistance to plant pathogens, production of siderophore and inhibition of plant ethylene synthesis are reported to be the possible reasons for crop yield increase in addition to nutrient solubilisation [14-15-16-17-18].

Also, it has-been reconnu as an endophyte and is a potential agent for the biocontrol of plant diseases and pathogens [19-20] such as *Aspergillus flavus* in peanut [21], *Mycosphaerella graminicola* caused foliar disease of wheat (Septoria Tritici Blotch) [22], its antagonism against select phytopathogens such as *Rhizoctonia solani*, *Macrophomina phaseolina*, *Sclerotium rolfsii* and *Fusarium oxysporum* [23], biocontrol agent of red-pepper Phytophthora blight Disease by *B. megaterium* KL39 strain [24].

B. megaterium have been advocated as effective and economical bioinoculant to use in the integrated nutrient and pest control system, suppression of bacterial and fungal, nematode pathogens by production of antibiotics, ammonia ….etc [25-26].

Environnement

Increase use of fossil fuels (industrial wastes), agricultural Activities (chemical pesticides and insecticides), trading activities, and residences are the causes of environmental pollution and ecosystems destroy. Microorganisms play a dominant role in transforming pollutants that reach the environment ; *B. megaterium* was used alone or in combination with other *Bacillus* species in eliminating odors and heavy metals from polluted areas, converting wastewater or food waste from livestock into useful resources, improving water quality, balance microbial population and reducing pathogenic bacteria in aquaculture bonds, degrading and absorbing dyes from wastewater, reducing water pollution, decolorizing of the textile dye, and bioremediation of lubricant oil pollution in water and soil ecosystems [27-28-29-30-31].

Medicine and Pharmacy

B. megaterium was considered non-pathogenic specie for humain [32-33] and its produces a large variation of proteins [34-35] including penicillin amidase [36] used for the production of penicillins that are used in the treatment of bacterial infections, mainly against Gram positive and some Gram negative bacteria, glucose dehydrogenase used in glucose blood tests in the case of diabetes mellitus or hypoglycemia, enzymes for modifying corticosteroids (steroid hormone), and amino acid dehydrogenases that catalyses the oxidation of D-amino acids into their corresponding oxoacids [37].

Antibiotics, amino acids and vitamins are olso produce by these bacteria such as penicillin G Acylase witch is one of the most relevant and widely used biocatalysts for the industrial production of β-lactam semisynthetic antibiotics [38-39-40], vitamin B12 which is essential cofactors for the human enzymes methylmalonyl CoA mutase and methionine synthase and also for normal functioning of the brain, nervous system, blood formation, and the treatment of megaloblastic anemia, pernicious anemia, diabetic neuropathy [41], pyruvate [42], lysine [43] that used in animal and human nutrition to balance diets, exotoxin [44], teichuronic acid [45], and the srain *B. megaterium* QM B1551 was used to produce the antigen for HIV Diagnostic Kits [46].

Industrial applications

The first exploitation of *B. megaterium* for use in industrial processes back to pre-1960. The reasons for intensive use in the laboratory to (1) simples cultural conditions, (2) diversity of carbon and nitrogen sources, (3) no endotoxins found in the cell wall, (4) no alkaline protease secretion, (5) Growth on various media, (6) no pathogenicity [37].

Many primary and secondary metabolites of *B. megaterium* contributed to improving the quality of foods and feeds such as α- and β-amylases used in the baking industry [47-

48], neutral proteases which are used by the leather industry [49], and probiotics used in shrimp culture industry [28]. Production of dextransucrase [50], sucrose [51], carboxy methyl cellulase from *B. megaterium* KU365409 [52].

It also produce poly-γ-glutamic acid, that has potential applications as thickener, cryoprotectant, humectant, drug carrier, biological adhesive, heavy metal absorbent, etc., with biodegradability in the fields of food, cosmetics, medicine, and water treatments [53-54].

High production of biopolymers such as poly (3-hydroxybutyrate) from a wild *B. megaterium* Bolivian strain [55-26-56], it was 100% biodegradable and are also biocompatible with a wide range of applications in medicine, pharmacy, veterinary and food packaging.

B. megaterium produces other compounds usig in the food processing industry [57] such as l-asparaginase from *B. megaterium* H-1 and its applicad in French fries, and α-amylase and glucose isomerase producing *B. megaterium* BPTK5 isolated from starch processing plant (cassava waste) [58], and tannase enzymes that used as a hydrolysing agent in cleaning up the highly polluting tannin from the effluent of leather industry [59].

Antimicrobial peptides produced by *B. megaterium* were named bacteriocins or bacteriocin -like substances including megacins [60-61-62]; it is a large proteins (430 kDa) class III, had a bactericidal effect, rapidly digested by proteases in the human digestive tract, and characterezed by nontoxicity in animals and humans and their effectiveness against spoilage and pathogenic bacteria [63-64-65-66].

Microbial biotechnology and *B. megaterium*

B. megaterium was extensively studied genetically and is amenable to genetic manipulation [67]. Progress in genetics and the availability of molecular tools such as new transposons, vectors and efficient transformation, an understanding of some of the organization and regulation of many genes and bacteriophages studies make it under investigations ; because (1) desirable cloning host and produces a large variation of enzymes, (2) good cloning host and able to house numerous plasmid vectors while remaining stable due to its unique external proteases, (3) the organism does not have alkaline proteases which allows for recombinant protein synthesis [68-69-70-71-72-73-74].

CONCLUSION

The search of a healthy eating, natural medicine, improve soil quality, reducing ecosystems pollution, and improve foods and feeds quality and bioconservation ; make *B. megaterium* under investigation to discovery of new features for applied it in others fields.

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