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BRIEF REPORT

The influence of electromagnetic fields on the proliferation of *Bacillus subtilis*

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This study illustrates the fluctuations in microbial population growth when subjected to nutrient media cultivated with water exposed to a low-power electromagnetic field. We employed this field-treated water to formulate both liquid and solid culture mediums for the propagation of *Bacillus subtilis* bacteria. The electromagnetic field treatment encompassed various frequencies ranging from 30 to 230 MHz. Across all instances, a notable inhibition of bacterial vitality was observed when using water exposed to the electromagnetic field. This observed phenomenon is attributed to alterations in ion hydration sizes resulting from field exposure, subsequently affecting their involvement in membrane processes.

Keywords: Field effects, Electromagnetic field, Indirect biological effect of the HF field.

Introduction

For decades, scientific inquiry has delved into understanding how external factors influence the growth and behavior of microorganisms. Among these factors, electromagnetic fields (EMFs), generated by electrically charged particles and integral to our modern technological landscape, have garnered significant attention. This article focuses on the ramifications of EMFs on the growth of *Bacillus subtilis*, a widely studied and adaptable bacterium. The structured nature of the aqueous environment plays a pivotal role in orchestrating crucial processes that ensure bodily well-being. Considering this aqueous milieu as a rich source of information reveals its potential to skillfully address the body's safety concerns during challenging circumstances and emergencies. This perspective transforms the challenge of safeguarding the body into an opportunity for natural management, empowering the body to effectively counteract adverse factors. The distinctive matrix arrangement of water's structural components within each organism serves as the foundational information bedrock upon which all life processes intricately unfold (Hecker, M., et al., 1998).

Bacillus subtilis, a gram-positive bacterium commonly found in soil and the gastrointestinal tracts of humans and animals, possesses the adaptability to thrive in diverse environments. Its well-characterized genetics and ability to acclimate to different conditions have rendered it an ideal model organism for studying bacterial physiology and genetics. Scientists have therefore explored how external elements, including electromagnetic fields, can impact its growth and behavior (Hashem, A., et al., 2019).

Description

Electromagnetic fields encompass a wide spectrum of frequencies, spanning from Extremely Low-Frequency fields (ELF) to Radio Frequency (RF) and microwave fields. These fields originate from various sources, including power lines, electronic devices, and wireless communication technologies. The potential effects of EMFs on living organisms have been the subject of extensive debate and investigation for many years, with conflicting research findings adding complexity to our comprehension (Aguilar, C., et al., 2007).

Effects of EMFs on *Bacillus subtilis* growth

Research investigating the impact of EMFs on *Bacillus subtilis* growth has yielded intriguing yet intricate outcomes. Several key findings include:

Numerous studies have reported fluctuations in *Bacillus subtilis* growth rates when exposed to electromagnetic fields. While some experiments have demonstrated inhibitory effects, others have shown a stimulation of growth. The variability in results can be attributed to differences in EMF types, exposure durations, and experimental conditions. Exposure to specific EMFs has been linked to alterations in the cellular morphology of *Bacillus subtilis*. Researchers have observed changes in cell size, shape, and arrangement, indicating that EMFs might interfere with bacterial membrane integrity and cellular processes. EMF exposure has been shown to influence the genetic expression of *Bacillus subtilis*. Some studies have identified changes in gene expression related to stress response, metabolism, and cell division, suggesting that EMFs could affect the bacterium's regulatory pathways (Morikawa, M., 2006).

The mechanisms responsible for the effects of EMFs on *Bacillus subtilis* growth remain incompletely understood, and several hypotheses have been proposed: EMFs may influence the permeability of bacterial cell membranes, affecting nutrient uptake, waste elimination, and overall cellular homeostasis. Reactive Oxygen Species (ROS) generation: Exposure to EMFs might trigger the production of ROS within bacterial cells, leading to oxidative stress and potential damage to cellular components. EMFs could modulate ion channels and transporters in bacterial membranes, impacting crucial processes such as energy production and nutrient transport (Jeong, J.S., Kim, I.H., 2014).

The nutrient media used in the experiment underwent sterilization through autoclaving at a temperature of 115°C. One might expect that this elevated temperature would nullify the effects of field exposure. Furthermore, the inclusion of various components in both the broth and agar should contribute to nullification. Surprisingly, this expected outcome did not materialize. Therefore, the observed transformations in the characteristics of the cultivation media appear to originate from deeper underlying factors. An explanation for this phenomenon can be postulated as follows: The modulation or alteration of growth patterns in living organisms, specifically bacteria, can be attributed to shifts in the velocity of essential element transportation within them, whether across the membrane or the spore wall. This observation substantiates the capability of the RF field to induce alterations in the structural arrangement of water, along with its hydrating properties. With substantial evidence supporting the existence of water molecules exhibiting varying degrees of association in the liquid state, including individual molecules, it is plausible to propose that the equilibrium between monomolecular water and structured water is perturbed due to the influence of the RF electromagnetic field. This disruption consequently leads to a modification in the average water capacity for hydration processes, resulting in an adjustment of ion hydration radii. Consequently, the diffusion rate of ions through the channels in the membrane is impacted, which may contribute to the observed inhibition of the biological processes documented within the experiment (Yu, X., et al., 2011).

Conclusion

The interplay between electromagnetic fields (EMFs) and the growth of *Bacillus subtilis* presents a complex and captivating realm of study. While certain investigations propose that EMFs have the potential to impact bacterial growth rates, cellular structure, and genetic expression, the precise mechanisms underpinning these effects remain enigmatic. With the relentless advancement of technology and our increasing reliance on electronic devices and wireless communication, comprehending the potential repercussions of EMFs on microorganisms assumes growing significance. To gain a comprehensive understanding of how EMFs influence *Bacillus subtilis* and other microorganisms, further research is imperative. Such inquiries could extend beyond the realm of microbiology, potentially enriching our comprehension of how electromagnetic fields impinge upon broader biological systems. As scientists persist in their exploration of this field, we stand to acquire valuable insights into the intricate interplay between external influences and microbial growth, thereby illuminating the broader ramifications of electromagnetic fields on living organisms.

References

Hecker, M., Völker, U. (1998). Non-specific, general and multiple stress resistance of growth-restricted *Bacillus subtilis* cells by the expression of the σB regulon. Molecular Microbiology, 29:1129-1136.

Hashem, A., Tabassum, B., Abd_Allah, E.F. (2019). *Bacillus subtilis*: A plant-growth promoting rhizobacterium that also impacts biotic stress. Saudi Journal of Biological Sciences, 26:1291-1297.

Aguilar, C., Vlamakis, H., Losick, R., Kolter, R. (2007). Thinking about *Bacillus subtilis* as a multicellular organism. Current Opinion in Microbiology, 10:638-643.

Morikawa, M. (2006). Beneficial biofilm formation by industrial bacteria *Bacillus subtilis* and related species. Journal of Bioscience and Bioengineering, 101:1-8.

Jeong, J.S., Kim, I.H. (2014). Effect of *Bacillus subtilis* C-3102 spores as a probiotic feed supplement on growth performance, noxious gas emission, and intestinal microflora in broilers. Poultry Science, 93:3097-3103.

Yu, X., Ai, C., Xin, L., Zhou, G. (2011). The siderophore-producing bacterium, *Bacillus subtilis* CAS15, has a biocontrol effect on *Fusarium wilt* and promotes the growth of pepper. European Journal of Soil Biology, 47:138-145.

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