



Investigation of the diffusion regime of *Magnetospirillum gryphiswaldense*

Shima Jeddi^{1*}, Sakineh mardi¹, Farinaz Roshani¹, Seyed Fazlollah Mousavi²

1. Department of Physics, Alzahra University, Tehran, Iran

2. Department of Microbiology, Pasteur Institute, Tehran, Iran

*jeddi.shima@gmail.com

Abstract: Magnetotactic bacteria are a group of anaerobic or microaerobic gram-negative prokaryotes that align along magnetic field lines due to the paramagnetic intracellular structure called magnetosome in the size of 30 to 120 nm [1]. *Magnetospirillum gryphiswaldense* (*MSR-1*) is a group of this bacteria that can swim using two bipolarly located flagella [2]. Due to the wide application of this bacteria in many fields and the importance of most of the applications, we need to know their diffusion regime to use them correctly. In this study first, the bacteria were cultured in JCM medium and incubated at temperature of 28°C[3]. After six days samples were investigated in different external uniform magnetic fields in 2 sizes of 15 and 25 gauss and in absence of an external magnetic field. To discover the effect of the external magnetic field on the movement of bacteria and the diffusion of bacteria, films were recorded from the motion of bacteria and were analyzed in image processing toolbox of MATLAB. The trajectory of each bacteria was tracked and the coordinates of moving bacteria in each frame of the film were obtained. Time-averaged MSD of individual trajectories plotted as a function of the lag time and from a linear fit on these graphs the value diffusion exponents were reported for mentioned magnetic fields [4]. the diffusion exponents for the magnetic field of 15 G and 25 G are 1.94 and 1.96 respectively and in the absence of the external magnetic field is 1.23. all results were with 95% confidence and finally, the relation between magnetic field and diffusion exponent was acquired [5].

Keywords: *Magnetospirillum gryphiswaldense*; magnetic field; diffusion exponent; magnetotactic bacteria

References

- [1] Yan, L., et al., Magnetotactic bacteria, magnetosomes and their application. *Microbiological Research.*, 2012, 12;167(9):507-19.
- [2] Johannes Loehr, Daniel Pfeiffer, Dirk Schuler and Thomas M. Fischer, Magnetic Guidance of the magnetotactic bacterium *Magnetospirillum gryphiswaldense* *Soft Matter.*, 2016,12, 3631-3635.
- [3] U. Heyen · D. Schuler, Growth and magnetosome formation by microaerophilic *Magnetospirillum* strains in an oxygen-controlled fermentor. *Appl Microbiol Biotechnol.*, 2003, 61:536–544.
- [4] Ralf Metzler, Jae-Hyung Jeon, Andrey G. Cherstvy and Eli Barkai, Anomalous diffusion models and their properties: non-stationarity, non-ergodicity, and ageing at the centenary of single particle tracking, *Phys.Chem.Chem.Phys.*, 2014, 16, 24128
- [5] Xavier Michalet, Mean square displacement analysis of single-particle trajectories with localization error: Brownian motion in an isotropic medium, *PHYSICAL REVIEW.*, 2010, 041914.