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Rashad, A.M., Chamkha, A.J., Mallikarjuna, B., Abdou, M.M.M.

Mixed bioconvection flow of a nanofluid containing gyrotactic microorganisms past a vertical slender cylinder
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Abstract
in this paper, the steady mixed bioconvection flow of a nanofluid containing gyrotactic microorganisms past a vertical slender cylinder is studied. The passively controlled nanofluid model is applied to approximate this nano-bioconvection flow problem, which is believed to be physically more realistic than previously commonly used actively controlled nanofluid models. Using a suitable transformation, the nonlinear system of partial differential equations is converted into non-similar equations. These resulting equations are solved numerically using an accurate implicit finitedifference method. The present numerical results are compared with available data and are found in an excellent agreement. The skin friction coefficient, local Nusselt number, and the local density of the motile microorganism profiles are examined subject to various parameters of interest, namely Richardson number, thermophoresis parameter, Brownian motion parameter, bio-convection Lewis number, bio-convection Rayleigh number, and bioconvection Péclet number for various values of surface transverse curvature parameter. The results indicate that the skin friction coefficient, local Nusselt number, and the local density of the motile microorganisms enhance with a decrease in either of the bioconvection Péclet number or the thermophoresis parameter and with an increase in either of the Brownian motion parameter, bioconvection Lewis number or the Richardson number. Increasing and decreasing the buoyancy ratio parameter and bioconvection Rayleigh number respectively, lead to increase in the local skin friction coefficient and the local rate of heat transfer and reduction in the local density of motile microorganism. This type of study finds application in engineering, geothermal and industrial fields such as the design of microbial fuel cell and bio-convection nano-technological devices.

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