Dual solutions of bioconvection hybrid nanofluid flow due to gyrotactic microorganisms towards a vertical plate

ABSTRACT

The impact of gyrotactic microorganisms in the mixed convection stagnation point flow of Cu-Al2O3/water hybrid nanofluid towards an immovable plate is numerically examined. The boundary layer equation coupled with the energy, nanoparticle volume fraction and conservation equations for microorganisms are simplified into a set of ordinary differential equations by adopting similarity transformation. The validation results are in a good agreement with previous studies approximately by 0% difference relative error. The results imply that the dual solutions only exist in the opposing flow up to a critical value/turning point. Beyond this turning point, the solutions are unavailable which reflects the separation of flow. The hybrid nanofluid is essential in delaying the separation process where the results show that . Moreover, the advantage of this hybrid Cu-Al2O3/water nanofluid is in the augmentation of heat and mass transfer rates including the density of microorganisms which is higher than the Cu- and Al2O3-water nanofluids.

Keyword: Stagnation point flow; Mixed Convection; Hybrid nanofluid; Gyrotactic microorganisms; Dual solutions