On the parabolic-elliptic Keller-Segel system with signal-dependent motilities: a paradigm for global boundedness and steady states

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Abstract

This paper is concerned with a parabolic-elliptic Keller-Segel system where both diffusive and chemotactic coefficients (motility functions) depend on the chemical signal density. This system was originally proposed by Keller and Segel in (missing citation) to describe the aggregation phase of {\it Dictyostelium discoideum} cells in response to the secreted chemical signal cyclic adenosine monophosphate (cAMP), but the available analytical results are very limited by far. Considering system in a bounded smooth domain with Neumann boundary conditions, we establish the global boundedness of solutions in any dimensions with suitable general conditions on the signal-dependent motility functions, which are applicable to a wide class of motility functions. The existence/nonexistence of non-constant steady states is studied and abundant stationary profiles are found. Some open questions are outlined for further pursues. Our results demonstrate that the global boundedness and profile of stationary solutions to the Keller-Segel system with signal-dependent motilities depend on the decay rates of motility functions, space dimensions and the relation between the diffusive and chemotactic motilities, which makes the dynamics immensely wealthy.

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References