Morphogenesis of tube network in true slime mold

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The procedure of solving a labyrinth by higher organism as mice or human is not identified in every detailed. But a chemical system like the excitable Belousov-Zhabotinsky reaction distributed in two dimensions may also be to navigate in a maze based on nonlinearity of chemical waves. A true slime mold, the plasmodium of *Physarum polycephalum*, is an amoeboid organism with sheet-like shape and is regarded as two-dimensionally distributed biochemical reactant. Cellular activities of the plasmodium is modeled by the oscillatory reaction-diffusion type equations. This implies a possibility that the plasmodium can have a computational algorithm of solving a maze. Here we show the conditions where the possibility is realized.

In the plasmodium, contraction waves, which is coupled with biochemical oscillations, propagate very rhythmically. These waves are initiated by the external stimulation including nutrient, light and temperature. The wave propagation leads to development of tubular structure from the sheet-like parts. The plasmodium has the tube-network in the sheet-like part. When the plasmodium moves, geometry of the tube network varies drastically according to the external stimulation. We focus on this relationship between the intracellular waves and of the morphogenesis of the tube. The contents of this report are: 1) fundamental characters of the tube development, 2) conditions where the plasmodium solve a maze and the solution, 3) a possible mechanism to solve a maze in terms of nonlinear dynamics of reaction-diffusion waves, 4) path-finding in multiple discrete food-sites by the plasmodium. Evidence that the amoeboid organism has an ability to solve difficult combinatorial optimization problems is shown. I had better change my stupid opinion that a unicellular organism would be stupid.