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Title: Evolving Communication in Escherichia Coli

(The title should be more elaborate. Normally it’s a topic sentence, and then a more elaborate explaination)

Introduction: How does Bacteria evolve communication? (Should be a more thought out question. Maybe describe how bacteria has been used in other experiments and why you chose it in this experiment.) Over many generations, bacteria evolve quickly through time. (Possibly describe how quickly bacteria generations reproduce/die. More explanation and citation might be needed.) Despite being taught that evolution takes place over millions of years, one can see evolution take place through microbes that have fast generations. Previous studies, like the one that has been studying E. Coli since 1988, show particular interest in the evolution of the stringent response and how it has played a large role in phenotypic and genotypic adaptation (1). The experiments we will conduct will involve Escherichia Coli because of their ease, rapid growth, simple nutrition, and ease of propagation (2). They are known to send, receive, and process information allowing unicellular organisms to work as multicellular groups, giving them a greater chance at survival (3). Escherichia Coli live a community-based sessile life style for the normal mode of growth and survival. (I would go more id depth of the life cycle or reproduction cycle of E.Coli.) Under such conditions, cell-to-cell interactions are inevitable and ultimately lead to the establishment of dense, complex and highly structured populations encapsulated in a self-produced extracellular matrix and capable of coordinated and collective behavior (4). These organisms are known to inhabit the gastrointestinal tract of humans and other endotherms (5). (I would go through some processes of how E. coli affect endotherms and why it is an issue.) Knowing how E. Coli communicate can give humans an advantage to fixing common health issues. One for instance, is how E. Coli is responsible for >90% of UTIs (5).

E. Coli has been found to use AI-2 dependent signaling and being able to communicate through this AI-2 dependent signaling pathway is conducive to intraspecific communication (3,6). This happens by the release of extracellular vesicles (7). The AI-2 receptor is LuxP, and was found by co-crystallizing AI-2 and LuxP together (8). Various inhibitors of E. Coli’s AI-2 dependent signaling pathway have been found through its repressors LsrR and LsrK, proline residue insertion, a D*lsrK* and D*lsrR*D*luxS* mutation, and inhibiting the synthases that produce autoinducers (9-12).

Study Systems: The experiments we will conduct will involve Escherichia Coli because of their ease, rapid growth, simple nutrition, and ease of propagation. Furthermore, the experiment will manipulate how E. Coli communicate in order to see how they evolve new forms of communication. They are known to send, receive, and process information allowing unicellular organisms to work as multicellular groups, giving them a greater chance at survival (3). Escherichia Coli live a community-based sessile life style for the normal mode of growth and survival. Under such conditions, cell-to-cell interactions are inevitable and ultimately lead to the establishment of dense, complex and highly structured populations encapsulated in a self-produced extracellular matrix and capable of coordinated and collective behavior (4). (This paragraph is pretty well thought out.)

Experiment 1: When E. Coli is inhibited to use intraspecies communication, the unicellular organism shall evolve a new form of communication to work as it did prior, like a multicellular organism (5). We will test this hypothesis by inhibiting the AI-2 dependent signaling pathway with repressors LsrR and LsrK, proline residue insertion, a D*lsrK* and D*lsrR*D*luxS* mutation, and inhibiting the synthases that produce autoinducers (9-12). There will be five populations of E. Coli one will be a control, the others will be manipulated by one of the inhibitors listed above. Manipulations will proceed by system metabolic engineering (13). (I would recommend instead of just citing all the references, make an actual reference to what the experiment and the outcome was.) The experiment will continue for a maximum of ten years, or until an efficient replacement of intraspecies communication is presented. We will compare any parallel phenotypic changes, and look for convergent or divergent morphologies. This experiment is expected to force E. Coli to eventually construct an efficient form of cell-to-cell communication after their AI-2 dependent signaling pathway is inhibited. Communication shall (not sure why you are saying shall, change the tone to should) evolve in one of the organisms and spread cooperative behavior to the rest of the population, to work synergistically (14). Alternatives to the experiment may be that the E. Coli become resistant to the inhibitors and counter their effects. This would cause the continued use of the AI-2 dependent signaling pathway. Another alternative could arise from an unknown cause. One may find that the model solves the desired problem, but could underlie mechanisms of other motors that weren’t present prior (15). The experimental results will suggest how important it is for intraspecies communication, and how it can be prioritized to evolve when it is not present in a population. Plus, scientists will be given more information to help predict bacterial resistance in public health.

(Overall, I think the experiment portion is pretty thought out, but I would like more explanation. I would also like to see outcomes from other experiments and citations. My overall gripe is that there should be more explanation to why this research is so important, and why other things can arise from doing this experiment).

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