1 Social evolution in micro-organisms and a Trojan horse approach to medical intervention strategies.

Brown SP, West SA, Diggle SP, Griffin AS

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Recommendations:

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INTERESTING HYPOTHESIS

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The paper includes interesting strategies to exploit microbial competition dynamics and social behaviors as a means to suppress bacterial infections. Brown et al. used simple Lotka-Volterra-like competition models to illustrate the possibility of manipulating or sabotaging (such as by introducing Trojan-horse-like alleles or less virulent cheat strains) the cooperative social behavior of bacterial populations as medical intervention strategies.

Humans know how to protect crops from insect pests by exploiting interspecific or intraspecific relationships among insects through integrated pest management (IPM), which is based on ecological principles and emphasizes the integrated uses of various tactics including biological control, host plant resistance, and the use of pesticides as a last resort. Entering into the 21st century, Brown et al. and others cited in Brown's paper suggest ways to control bacterial diseases that seem to mirror the IPM strategy. In their paper, Brown et al. suggested that the growing understanding of bacterial population dynamics and their social behavior makes it possible to devise strategies to suppress the population growth of infectious bacteria in favor of the human hosts. Through analysis with simple Lotka-Volterra-like competition models, they suggested four manipulative strategies. The first one is to introduce selfish strains -- which do not produce exoproducts themselves but still use the products -- into a normal infectious bacterial population whose individuals produce and share such exoproducts (therefore the public goods). The selfish strain is called a cheat, and its introduction to the otherwise cooperative bacterial population should lead to the familiar tragedy of the commons. The second is the Trojan-horse strategy with which one hitchhikes the useful alleles -- such as those highly vulnerable to antibiotics -- to the Trojan horse (the strains that can invade an infectious bacteria population). When the Trojan horses are in place, and the antibiotic is applied, they will help to sabotage or suppress the bacterial growth.

An interesting question is how promising the proposed strategies will be for clinical adoption. Since at present the topic is still in a theoretic exploration stage, we suggest it should be helpful to learn from what happened with the IPM strategy in agriculture to set meaningful research agendas. We predict that the discipline of human microbial ecology might become an important foundation for medicine if the intervention strategies -- such as those proposed by Brown et al. -- are to be practiced in clinics.

Disclosures
None declared

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Abstract:

ABSTRACT

Medical science is typically pitted against the evolutionary forces acting upon infective populations of bacteria. As an alternative strategy, we could exploit our growing understanding of population dynamics of social traits in bacteria to help treat bacterial disease. In particular, population dynamics of social traits could be exploited to introduce less virulent strains of bacteria, or medically beneficial alleles into infective populations. We discuss how bacterial strains adopting different social strategies can invade a population of cooperative wild-type, considering public good cheats, cheats carrying medically beneficial alleles (Trojan horses) and cheats carrying allelopathic traits (anti-competitor chemical bacteriocins or temperate bacteriophage viruses). We suggest that exploitation of the ability of cheats to invade cooperative, wild-type populations is a potential new strategy for treating bacterial disease.

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