Host-Pathogen Interactions

One of the defining characteristics of infectious disease is the specificity of host-pathogen interactions. Pathogens can be deadly to some hosts and completely harmless to other hosts. For example, *E. coli* O157:H7 is commonly found in the stomachs of cattle and does not make them sick. However, if we ingest *E. coli* O157:H7 from a rare hamburger, we have a good chance of getting sick. The same principles of host specificity apply to interactions between bacteriophage and bacteria. Bacteriophage Chi binds to the bacterial flagellum only when the bacteria are motile. A non-motile strain of *E. coli* is completely immune to the phage, while its motile relative is susceptible - but only when moving!

Scientists are still exploring the host specificity of *P. acnes* and their bacteriophage. In one experiment, 11 different bacteriophage were tested for their ability to infect 25 different *P. acnes* strains[1]. Most of the bacteriophage could infect all of the *P. acnes* strains. However, one bacteriophage was only able to infect 17 of the bacterial isolates. Two of the *P. acnes* isolates were resistant to all but one of the bacteriophage. The authors concluded that *P. acnes* bacteriophage have a broad host range overall (i.e. they can infect many different strains of *P. acnes*). They went on to suggest that the lack of host specificity indicates that bacteriophage could be developed into novel acne treatments.

How do your *P. acnes* and bacteriophage isolates compare to those isolated by the UCLA researchers?

Challenge

You have isolated *P. acnes* and bacteriophage from your faces. We know that all of the bacteriophage can infect *P. acnes* strain ATCC 6919, because you used that strain to grow your plaques. Can the phage you isolated infect other strains of *P. acnes*? How resistant is your *P. acnes* to different bacteriophage? **For the final unit of the semester, you will formulate a hypothesis and design an experiment to determine the host specificity of your phage or the susceptibility of your *P. acnes* isolate to different phages** Remember to include the appropriate controls.

[1]Laura J. Marinelli, Sorel Fitz-Gibbon, Clarmyra Hayes, et al. 2012. *Propionibacterium acnes* Bacteriophages Display Limited Genetic Diversity and Broad Killing Activity against Bacterial Skin Isolates . mBio 3(5): . doi:10.1128/mBio.00279-12.

Key Questions

The H1N1 avian flu has threatened to emerge as a global pandemic for over a decade. This strain of the flu infects birds and can be spread from bird to bird readily. However, spread from birds to humans is rare. How can the preference of H1N1 for infecting birds over humans be explained?

Bacteriophage that infect *P. acnes* are being considered as a novel treatment for acne. What properties would make a bacteriophage a good drug that could treat acne in many different patients?

Explain how the bacteriophage that isolated from a patient kill *P. acnes* ATCC 6919 very well, but are less effective at killing *P. acnes* from the patient.

You are testing two different bacteriophage to see if they could be used as drugs. The titer of the stock of phage A is 10^{11} pfu/ml and the titer of the stock of phage B is 10^{8} pfu/ml. You test the phage against *P. acnes* isolated from a patient by making serial dilutions of each phage and spotting 5 μl on plates with the patient's *P. acnes* in top agar. You find plaques at the 10^{-5} dilution using Phage A and at the 10^{-6} dilution using phage B. Which phage is more effective at killing the patient's *P. acnes* (more effective = fewer phage are needed to get a plaque)? Why?