How grapevines got acne bacteria

Microbe is the first known animal pathogen to become dependent on a plant host — and could have helped in its domestication.

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As humans millennia ago began cultivating grapevines and grafting them onto one another, a common skin bacterium could have jumped into the plant.

The bane of teenagers — a common bacterium on human skin that is partly responsible for acne — has made itself at home in the grapevine. It is the first known instance of a human bacterial pathogen that has become dependent on a host from a different kingdom of life. Italian researchers report that a newly found strain of *Propionibacterium acnes* seems unable to live anywhere else than within grapevine cells, and speculate that this adaptation helped humans to domesticate the plant.

The team dubbed the new microbe *Propionibacterium acnes* type Zappae, or *P.* Zappae for short, in an homage to the late Frank Zappa, the favourite musician of one of the authors. They described their findings in a paper published last month in *Molecular Biology and Evolution*[1].

Bacteria, viruses and other microorganisms often jump between species and find new homes. But so far, events in which the guest becomes symbiotic with its new host have been mostly limited to jumps between closely related species[2–4], with only a handful of examples going between distantly related lineages[5–7]. And in these examples, the microorganisms did not become so attuned to their new hosts that they could no longer survive anywhere else.

The research team was studying the DNA of the grapevine (*Vitis vinifera*) when they found bacterial gene sequences that did not seem to belong there. “At that time, we did not know that *P.* Zappae was a new strain. We thought it was just a normal *P. acnes* that entered grape accidentally,” perhaps as samples became contaminated in the lab, says Omar Rota-Stabelli, a lead author of the study and an evolutionary biologist from the Edmund Mach Foundation in S. Michele all'Adige, Italy. But further analyses revealed that the bacterial sequences not only belonged to the grapevine's natural microbial inhabitants, but were indicative of a new lineage of bacteria — a close relative to, but still genetically different from, the type that dwells on human skin.

On the basis of bacterial DNA they obtained from multiple grapevine plants, the authors estimate that *P.* Zappae invaded the plants some 7,000 years ago. This would be consistent with the time when people first started domesticating the crop, they say. The jump

could have occurred thanks to the extensive pruning involved in cultivating grapevines, which may have enabled the bacteria to jump off the hands of ancient farmers into the vines. “It is not surprising that this bacterium has spread in the world together with its host,” says Andrea Campisano, also lead author of the report and a microbiologist at the Mach Foundation.

Aside from being genetically distinct, the newly named bacterium also has a partly de-activated DNA repair system, the researchers found. This often happens in bacteria that adopt a symbiotic lifestyle, where they take advantage of the hosts' cellular repair mechanisms.

The human cousin of *P.* Zappae regularly feeds on fats found on the skin, such as triglycerides, which may explain why this bacterium felt so cozy in the grapevine. “Grape has a lot of fatty acids in it, which makes grape a perfect host for a sebum-eating bacterium such as *P. acnes*,” says Rota-Stabelli.

“What makes this report so remarkable is the great genetic distance between the two hosts,” says Frank Jiggins, an evolutionary biologist from the University of Cambridge, UK, who was not involved in the study. “Pathogens often have a plethora of different adaptations that allow them to live inside another organism,” he adds. But these adaptations tend to go wrong in a new host species, which is why it is so unusual for a bacterium to “leap enormous distances across the tree of life”, he says.

The authors speculate that *P.* Zappae could have helped with the domestication of grapevines by providing some as-yet-unknown advantage over wild plants not carrying the symbiont. “We are currently investigating if one compound made by propionibacteria — propionic acid, from which they get their name — may have some effect on the plants,” says Campisano. It could well be that we owe wine, at least in part, to our zits.

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