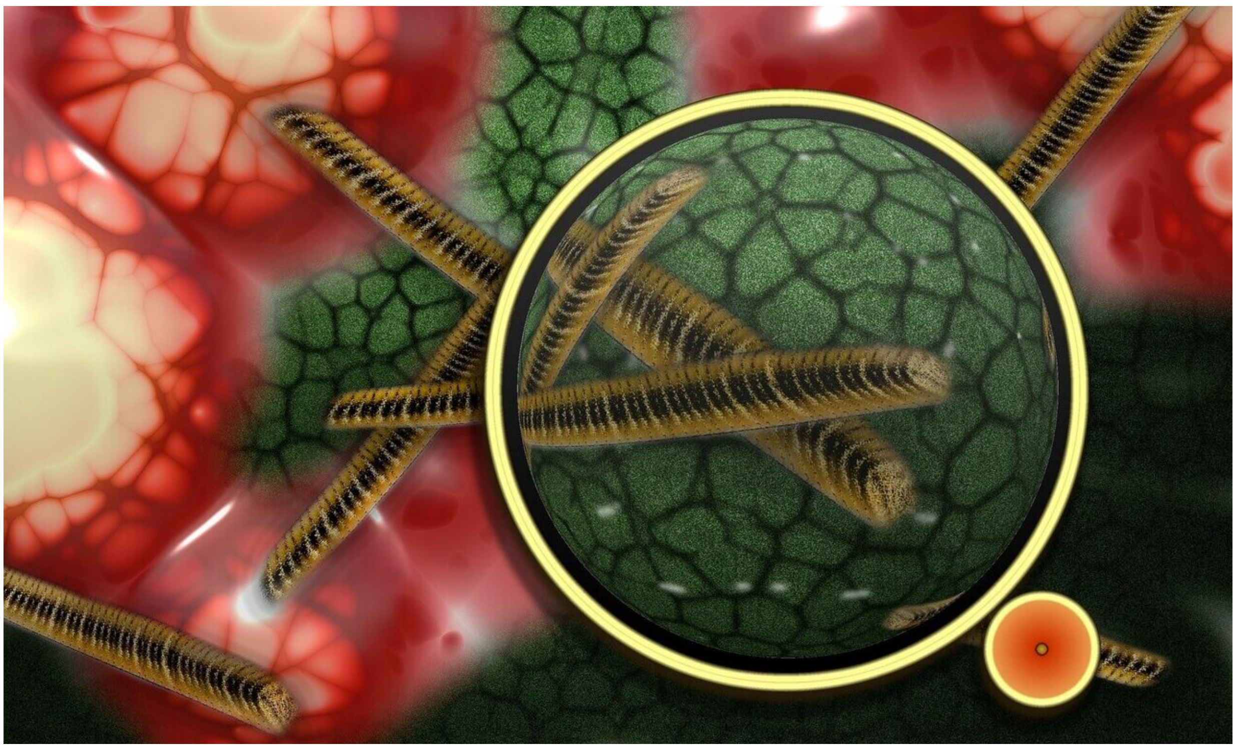
Two bacteria allow spittlebugs to thrive on low-nutrient meals

May 29 2020



Credit: CC0 Public Domain

A new study examines the symbiotic relationship between two types of bacteria and spittlebugs that helps the insect live on very low-nutrient food. The bacteria use a metabolic "trick" also employed by cancer cells to create the right conditions for converting the poor food into the necessary building blocks for survival.

The study, "Syntrophic Splitting of Central Carbon Metabolism in Host Cells Bearing Functionally Different Symbiotic Bacteria," published April 29 in the journal of the *International Society for Microbial Ecology*.

Spittlebugs get their name from the bubbly spit they create in plant branches. The clusters of spit keeps them from drying out and allow them to hide from predators. There they feed on xylem plant sap, a very low-value food; xylem transports water and minerals from the plant's roots to its leaves.

"No animal should be able to subsist on xylem alone—it's really just water and a few nutrients," said lead author Nana Ankrah, a postdoctoral researcher in the lab of Angela Douglas, the Daljit S. and Elaine Sarkaria Professor of Insect Physiology and Toxicology in the Department of Entomology in the College of Agriculture and Life Sciences.

The answers to how these bugs survive lie in two types of bacteria that live in separate spittlebug organs, called bacteriomes; one is red, the other orange. Other similar insects that feed on plant sap have just one bacterial partner to help produce high-quality amino acids, the building blocks of proteins.

"We wanted to understand if there were any advantages to having two bacterial symbionts on this very poor diet," Ankrah said.

The researchers collected local spittlebugs, removed their red and orange bacteriomes, incubated the bacteria separately in glucose, and ran metabolic experiments and computer model simulations.

They discovered that the red bacteriome uses a process known as aerobic glycolysis to process glucose, from which the bacteria synthesize seven essential amino acids. Two byproducts of this process, pyruvate and lactate, are assimilated by the orange bacteriome to create ATP molecules, which make energy for cells. The energy boost from ATP allows the bacteria in the orange bacteriome to produce three additional essential amino acids that require a great deal of energy to produce.

Having two bacterial partners instead of one works because they have this method for exchanging products from one bacterium to the other to increase the overall energy available to them, Ankrah said.

The researchers were surprised to find aerobic glycolysis occurring in these bacteria, as cancer cells employ the same process to survive, with a subset of cancer cells undergoing glycolysis and producing pyruvate and lactate, which another subset of cancer cells consumes to create energy.

"To our knowledge," Ankrah said, "our article is the first demonstration of aerobic glycolysis as a strategy to facilitate amino acid production in symbioses."

Future studies will investigate glycolysis in other insect and bacteria partnerships, he said.

More information: Nana Y. D. Ankrah et al, Syntrophic splitting of central carbon metabolism in host cells bearing functionally different symbiotic bacteria, *The ISME Journal* (2020). DOI: 10.1038/s41396-020-0661-z

Provided by Cornell University