Kuhns et al (2016) provide evidence that the gastric pathogen *Helicobacter pylori* can use molecular hydrogen as an energy source. Increased growth yields and inorganic carbon incorporation both support the ability of *H. pylori* to gain metabolically useful energy from hydrogen. However, the use of the term *chemolithoautotrophic* to describe these findings is not correct.

The term *chemolithoautotrophy* is accurately defined as a metabolic mode that derives energy from chemical compounds (*chemo*-; as opposed to light or *photo*-), electrons from inorganic sources (-*litho*-) and carries out *net* fixation of inorganic carbon (-*autotrophy*; (2)). While the -*litho*- portion of this term has been used to describe heterotrophic organisms that oxidize inorganic compounds to supplement their metabolism (3), the -*autotroph* portion of this term can only be applied where carbon dioxide can serve as the predominant source of carbon for biosynthesis.

Since abundant organic carbon was present in the growth medium, it is unclear if CO_2 accounted for the main source of carbon for *H. pylori*. In addition, although the authors do observe CO_2 uptake into biomass this does not prove that autotrophic carbon fixation occurred. *Anaplerotic* carbon fixation occurs as a series of carboxylation reactions that replenish intermediates in the citric acid cycle (4) or during fatty acid synthesis (5). As a normal process during heterotrophic growth, it explains the observed incorporation of CO_2 in the absence of hydrogen. While such carboxylating enzymes do indeed incorporate inorganic carbon into biomass, the growth mode of an organism can only be considered autotrophic if they have complete pathways for using inorganic carbon as the main source for cellular biosynthesis (6).

This point is illustrated considering the importance of the higher activity and abundance of the acetyl-CoA carboxylase enzyme in the presence of hydrogen observed by Kuhns et al (2016). While this enzyme is indeed responsible for the carboxylation of acetyl-CoA to malonyl-CoA, the CO_2 thus

incorporated is lost during the condensation of malonyl-CoA subunits during lipid synthesis (5). Its higher activity may therefore simply be the result of higher levels of lipid synthesis associated with increased growth in the presence of hydrogen.

It should be simple to clarify whether autotrophic carbon fixation likely occurred during these experiments. The authors could estimate how much carbon was needed to support the observed increase in cell density, and compare this estimate with the amount of inorganic carbon incorporated into biomass. Unless the amount of inorganic carbon fixed represents a dominant fraction of *H. pylori*'s cell carbon, *chemolithoheterotrophic* would be a more accurate term for the results observed by Kuhns et al (2016). Indeed, such *chemolithoheterotrophic* growth with hydrogen has been previously observed in other organisms (7).

A final point is worth mentioning. True autotrophs are well-known among the Epsilonproteobacteria (6,8), which employ the reverse tricarboxylic acid (rTCA) cycle for carbon fixation (9). Therefore, the absence of RuBisCO reported by Kuhns et al (2016) is not surprising given that autotrophic Epsilonproteobacteria do not use this enzyme for carbon fixation. The key enzyme that allows the rTCA cycle to run in a reductive direction is ATP-citrate lyase (6); however, the genes encoding this enzyme are absent in *H. pylori* strain 26695 (10). Since it lacks this enzyme and is thought to have a complete (albeit non-canonical) oxidative citric acid cycle (11), the current genomic evidence also argues against the possibility of autotrophic carbon fixation in *H. pylori*.

Jesse McNichol, Postdoctoral Scholar, Chinese University of Hong Kong
Simon F. S. Li Marine Science Laboratory, Shatin, Hong Kong
mcnichol at alum dot mit dot edu
Stefan Sievert, Biology Department, Woods Hole Oceanographic Institution

266 Woods Hole Rd MS#52, Woods Hole, MA, 02543, USA

ssievert at whoi dot edu

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