Sciencexpress Technical Comment

Comment on "A Bacterium That Can Grow by Using Arsenic Instead of Phosphorus"

Patricia L. Foster

Indiana University, Bloomington, Indiana 47405, USA. E-mail: plfoster@indiana.edu

Wolfe-Simon *et al*. (*Science* Express Research Article, published online 2 December 2010; 10.1126/science. 1197258) reported an apparent stimulatory effect of arsenic on the growth of bacteria isolated from Mono Lake, California, which they interpreted as evidence that the cells can grow by using arsenic instead of phosphorus. Alternatively, arsenic may have stimulated the bacterium's high-affinity phosphorus assimilation pathway, which is active when phosphate levels are low.

Wolfe-Simon *et al*. (*1*) reported on a bacterium, strain GFAJ-1 of the Halomonadaceae, isolated from Mono Lake, California. The most striking biological result in their paper is the apparent stimulatory effect of arsenic (As) on the growth of these bacteria in the absence of added phosphorous (P) [see figure 1 in (*1*)]. The authors interpret this result as showing that the cells can use As instead of P for growth. However, there are alternative explanations for this stimulation.

I assume that the medium used for all three conditions shown in figure 1 in (*1*) differed only by the addition of As or P and that two P-free cultures contained about 3 μM P, as stated by the authors. Cells need about 1 to 2% phosphorous (per dry weight) (*2*), so there was sufficient P contaminating the P-free media to allow the cells to grow to a concentration of 3×10^7 to 5×10^7 per ml, about the amount of growth Wolfe-Simon *et al*. observed. However, it appears that the cells in the –As/–P medium could not use the P as did the cells in the +As/–P medium. *Escherichia coli* and many other bacteria have two systems that can assimilate phosphorous: the phosphate inorganic transport (Pit) system, which has low affinity for P but is active at all phosphate levels; and the phosphate-specific transport (Pst) system, which has high affinity for P and is active when phosphate levels are low. In 1980, Willsky and Malamy (*3*) showed that in *E. coli*, added arsenate increased uptake of P by the Pst system but poisoned P uptake by the Pit system. The authors suggested that arsenate, directly or indirectly, induces the production of the Pst carriers. By their long regime of subculturing the bacteria in +As/–P medium, Wolfe-Simon *et al*. (*1*) may have selected for mutants that lost the Pit system but increased the capacity of the Pst system in the presence of low P but high As. This would explain the apparent stimulatory effect of As.

References

1. F. Wolfe-Simon *et al*., *Science*, 2 December 2010 (10.1126/science.1197258).
2. K. M. Fagerbakke, M. Heldal, S. Norland, *Aquat. Microb. Ecol.* **10**, 15 (1996).
3. G. R. Willsky, M. H. Malamy, *J. Bacteriol.* **144**, 366 (1980).

10 December 2010; accepted 17 May 2011
Published in *Science* Express 27 May 2011;
10.1126/science.1201551