Journal Highlights

The (Microbial) Caffeine Diet Explained

(l-r) Summers, Subramanian, and Yu

Some people seem to live on caffeine, but some bacteria actually *do* obtain all their carbon and nitrogen from the world's favorite stimulant. Now Mani Subramanian and colleagues of the University of Iowa, Iowa City, are elucidating the mechanics of caffeine metabolism in the bacterium *Pseudomonas putida* CBB5, which grows on several purine alkaloids, and which this team previously showed metabolizes caffeine and related methylxanthines via sequential *N*-demethylation of xanthine. "Mapping all the genes in CBB5 involved in the degradation of caffeine identified N1 (*ndmA*), N-3 (*ndmB*) and N-7 (*ndmC*) specific *N*-demethylases," says Subramanian. "Xanthine and formaldehyde liberated from caffeine via these genes are further degraded for growth and energy. NADH-dependent conversion of caffeine to xanthine by *ndmA*, *B*, and *C* is absolutely dependent on *ndmD*, a Rieske protein with three redox centers! This is the first report of N-demethylase reactions catalyzed by Rieske/non-heme iron proteins." Subramanian notes that "Coffee, tea, and cocoa waste are abundant worldwide," but that genes identified herein can remove the purine alkaloids in the wastes, so that these can be used as animal feed, a source of high-value alkylxanthines, or for ethanol production. "Scientifically, this work demonstrates for the first time how purine alkaloids are completely degraded via *N*-demethylation reactions, contributing to the carbon and nitrogen balance on our planet."

(R. M. Summers, T. M. Louie, C.-L. Yu, L. Gakhar, K. C. Louie, and M. Subramanian. 2012. Novel, highly specific *N*-demethylases enable bacteria to live on caffeine and related purine alkaloids. J. Bacteriol. 194:2041–2049.)

Ecological Succession on Sea Floor Sulfide Chimneys

Ecological succession occurs on sea floor hydrothermal sulfides, just as on ecosystems that are more familiar to humans, such as forests. Sulfide chimneys are globally distributed microbial substrates that can endure for tens of thousands of years following cessation of venting. Now Katrina J. Edwards of the University of Southern California et al. show that following cessation of hydrothermal venting the residential bacterial community shifts from one that is supported by redox energy from hydrothermal fluids to one that is supported by redox from the sulfide structures. "The presence of sequences indicative of autotrophic bacterial lineages suggests that these sulfide chimneys are a source of new organic matter and biogeochemical cycling with a potential influence on oceanic geochemistry," says Edwards. "The current study investigated what lineages are present, as identified by their 16S ribosomal RNA genes. We are currently using metagenomics to learn more about the metabolisms represented on inactive sulfides."

(J. B. Sylvan, B. M. Toner, and K. J. Edwards. 2012. Life and death of deep sea vents: bacterial diversity and ecosystem succession on inactive hydrothermal sulfides. mBio doi:10.1128/mBio.00279–11.)

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