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Bacterial Chefs Secrets for Cooking Inedible Food

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Microorganisms in the environment encounter various and frequently unpalatable diet. For at least 3.5 billion years microbes have successfully developed their own strategies to survive in this erratic environment. Indeed, these abilities constitute the driving force for maintaining the steady-state concentration of environmental organic chemicals, which constitutes the cycle of carbon in nature. However, many of the organic compounds are recalcitrant or slowly biodegradable, especially when they are halogenated or have increased numbers of substituents. The slow biodegradation rate in the natural environment may be caused by unfavorable physicochemical conditions, the accessibility of the substrates, or predation of bacteria by protozoa. On the other side, the low biodegradability may also be due to properties of manmade compounds that have no structural relationship to natural products. Such compounds, which are alien to existing enzyme systems, are called xenobiotics. Nonetheless, it is known that indigenous microbial communities exposed to xenobiotic compounds could often adapt to these compounds, and microorganisms that metabolize these chemicals completely and at considerable rates have been isolated. Although not many details are known about the molecular events that lead to adaptation of microbial communities, it is generally accepted that recombination, transposition, and gene transfer can accelerate the evolution of catabolic pathways by recruiting and combining new catabolic activities (van der Meer et al., 1992. Microbiol. Rev. 56:677-694; Parke et al., 2000. J. Bacteriol. 182:257-263). This presentation covers recent developments in the evolution of bacterial catabolic pathways mainly by highlighting discoveries made by our own research group for the past five years.