Chemo-organo-autotrophic degradation of aromatic hydrocarbons indicates a new type of bacterial metabolism

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Abstract

The sulfate-reducing culture N47 can grow with naphthalene and has a complete tricarboxylic acid cycle (TCA) and Wood-Ljungdahl pathway (WLP) while other organisms have only either of them. Here, we wanted to elucidate why N47 has two complete pathways potentially able to oxidize acetyl-CoA. Enzyme activities were measured in cell extracts indicating a fully functional rTCA and WLP. To elucidate the carbon flux through the pathways, cells were grown with ^{13}C-labeled naphthalene or ^{13}C-bicarbonate buffer. Amino acids and fatty acids were analysed for position specific ^{13}C-incorporation with GC-MS, which indicated that in catabolism, acetyl-CoA from naphthalene was fully oxidized to CO_2 via the WLP. Acetyl-CoA for anabolism of amino acids, fatty acids and carbohydrates was surprisingly not coming from the substrate naphthalene but is generated *de novo* by CO_2-fixation, making N47 a chemoorganoauto-trophic microorganism. This indicates that chemoorganoauto-trophy can also occur with complex substrates but probably requires a complete WLP and rTCA in anaerobic microorganisms.

Keywords

Central metabolism, chemo-organo-auto trophy, TCA-cycle, Wood-Ljungdahl pathway, anaerobic hydrocarbon degradation, sulfate-reduction

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Conflicts of interest

The authors have declared that no competing interests exist.