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Starvation supports cadmium tolerance in *Enterobacter cloacae*

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The *Enterobacter cloacae* IAM 1562, cadmium-sensitive strain, showed the elevated pattern of growth in third day and sixth day after carbon and phosphate starvation in M9 medium containing abundant phosphate sources and TMS medium containing much lower level of phosphate sources. The *Enterobacter cloacae* IAM 1624, inducible strain of cadmium resistance and harboring plasmid, also showed same pattern. *E. cloacae* IAM 1624 exhibited a little higher survival for relatively high concentration of cadmium at third and sixth day after carbon starvation in TMS medium than that of M9 medium. In contrast, IAM 1562 exhibited opposite results and more over adaptive mutant was isolated. In case of phosphate starvation in TMS medium, IAM 1624 showed a higher survival for relatively high concentration of cadmium than IAM 1562. *E. cloacae* KHY4, mutant strain of cadmium resistance, exhibited relatively higher survival at the concentration of 0.75 mM cadmium than native strain and much higher concentration of MICs of cadmium.

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Inorganic polyphosphate and ppGpp affect cadmium tolerance in
Escherichia coli

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The *Escherichia coli* mutant lacking the enzyme polyphosphate kinase and exopolyphosphatase, grow at the concentration of 1.0 mM cadmium in average, but it is lower than wild type for the degree of 0.2 mM. The mutant lacking the enzyme nucleotide diphosphate kinase, grow at the concentration of 0.6 mM cadmium and it is a half compared to wild type and double mutant grows a slightly lower concentration of cadmium. Other mutants including *relA* mutant, *relA-spoT* double mutant, *relA-spoT-fis* triple mutant, and *gppA* mutant, grow at each concentration of 1.0 mM, 0.8 mM, 0.7 mM, and 1.0 mM cadmium. These data suggest that polyphosphate plays a certain role in cadmium tolerance besides on survival and other function in *Escherichia coli* and the ppGpp synthetase and nucleotide diphosphate kinase may be associated closely with *ppk* and *ppx*, playing an important role in cadmium tolerance in this strain.