

## **A difficult choice for a bacterium: *Escherichia coli*'s decision between fermentation and respiration.**

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Many microbial systems are known to actively reshape their proteome in response to changes in growth conditions induced e.g. by nutritional stress or antibiotics. Part of the re-allocation accounts for the fact that, as the growth rate is limited by targeting specific metabolic activities, cells respond by fine-tuning their proteome to invest more resources into the limiting activity (i.e. by synthesizing more proteins devoted to it). However, this is often accompanied by an overall re-organization of metabolism, aimed at improving the growth yield under limitation by re-wiring resource through different pathways. By focusing on *E. coli*'s 'acetate switch', we show that the transition from a predominantly fermentative to a predominantly respirative metabolism in carbon-limited growth results from the trade-off between maximizing the growth yield and minimizing its costs in terms of required the proteome share. In particular, *E. coli*'s metabolic phenotypes appear to be Pareto-optimal for these objective functions over a broad range of dilutions.