Microbial respiration at low oxygen concentrations

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Periode: 2016 - 2018
Bachelor: x Speciale: x Individuel Studieaktivitet: x

Molecular oxygen is the second most abundant gas in the Earth's atmosphere and a multitude of aerobic organisms require it in their metabolism as terminal electron acceptor. In many environments, oxygen is drawn down to low or even undetectable concentrations. Such environments can for example be found in aquatic sediments, in soils and in oxygen-depleted regions of the global ocean known as Oxygen Minimum Zones (OMZs). These low oxygen environments are often transition zones between oxygenated and anoxic zones and oxygen concentrations may be fluctuating in the nanomolar range. OMZs are predicted to expand as a result of global warming and climate change.

Microbes thriving in such environments have evolved to be able to effectively use such low levels of oxygen. Previously, it has been shown in our laboratory that bacteria are able to grow at oxygen concentration such low as 3 nM (Stolper *et al.* 2010). However, a lot of questions regarding the respiration kinetics and energetic efficiency remain unclear.

For example, bacteria may possess different types of oxygen reductases, the enzymes that catalyze the reduction of O_2 to water. These enzymes differ in their affinities for oxygen and in the amount of energy they provide to the cell per reduced oxygen molecule. We want to explore the competiveness of bacteria with different inventories of oxygen reductases. To address this question *E. coli* mutants that have knock-out mutations for different oxygen reductases are available.

This research project is designed for students who are interested in microbial physiology. You will get experience in the cultivation of bacteria. You will learn how to set-up and perform incubations at nanomolar levels of oxygen and you will monitor growth yields and kinetics of oxygen respiration.

If you are interested and would like to learn more about project possibilities please contact Beate Kraft (bkraft@biology.sdu.dk).

References:
Stolper, Daniel A., Niels Peter Revsbech, and Donald E. Canfield. "Aerobic growth at nanomolar oxygen concentrations." *Proceedings of the National Academy of Sciences* 107.44 (2010): 18755-18760.