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Elevated pressure of carbon dioxide affects growth of thermophilic Petrotoga sp.

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Carbon capture and storage (CCS) is considered a promising new technology which reduces carbon dioxide emissions into the atmosphere and thereby decelerates global warming. During CCS, carbon dioxide is captured from emission sources (e.g. fossil fuel power plants or other industries), pressurised, and finally stored in deep geological formations, such as former gas or oil reservoirs as well as saline aquifers. However, with CCS being a very young technology, there are a number of unknown factors that need to be investigated before declaring CCS as being safe. Our research investigates the effect of high carbon dioxide concentrations and pressures on an indigenous microorganism that colonises a potential storage site.

Growth experiments were conducted using the thermophilic thiosulphate-reducing bacterium Petrotoga sp., isolated from formation water of the gas reservoir Schneeren (Lower Saxony, Germany), situated in the Northern German Plain. Growth (OD600) was monitored over one growth cycle (10 days) at different carbon dioxide concentrations (50%, 100%, and 150% in the gas phase), and was compared to control cultures grown with 20% carbon dioxide. An additional growth experiment was performed over a period of 145 days with repeated subcultivation steps in order to detect long-term effects of carbon dioxide. Cultivation over 10 days at 50% and 100% carbon dioxide slightly reduced cell growth. In contrast, long-term cultivation at 150% carbon dioxide reduced cell growth and finally led to cell death. This suggested a more pronounced effect of carbon dioxide at prolonged cultivation and stresses the need for a closer consideration of long-term effects.

Experiments with supercritical carbon dioxide at 100 bar completely inhibited growth of freshly inoculated cultures and also caused a rapid decrease of growth of a pre-grown culture. This demonstrated that supercritical carbon dioxide had a sterilising effect on cells. This effect was not observed in control cultures with 100 bar of hydrostatic pressure.

Further experiments will examine physiological and molecular properties of the model organism allowing for prediction of its sensitivity and/or adaptability to carbon dioxide in potential future storage sites.