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Chemostat based *Escherichia coli* sensor for the detection of carcinogenic compounds in surface water

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The drinking water quality is extremely important to our society. Daily, people consume tap water made from natural water sources. In the Netherlands, approximately 70% of the tap water is produced from groundwater. The other 30% is produced from surface water out of rivers, canals and lakes. Unpredictable impurities may be present in groundwater, e.g. due to accidental spills of herbicides/insecticides from agricultural activities, or unnoticed leakages of chemicals from industrial sites. Water companies are responsible to safeguard the water quality they deliver to consumers. However, analytical methods using e.g. HPLC/GC only detect compounds previously identified as relevant. Unknown impurities remain undetected. We developed a biosensor, able to continuously sense low concentrations of impurities in water distribution systems. Previously, *E.coli* was transformed with a plasmid containing the *luxCDABE* operon from *Aliivibrio fischeri* and put under control of the recA promoter of the SOS-DNA repair system (1). Encountering carcinogenic compounds in its environment will lead to DNA damage in *E. coli*. The products of DNA damage will induce the *lux* operon and *E.coli* emits light. This sensor is based on growth in batch cultures (2), requiring daily attention to prepare new starting cultures. We investigated, if cultivation of *E.coli* DPD2794 grown in chemostats under carbon and nitrogen limitations results in light production upon pulse-wise addition of carcinogenic compounds to the fermentation broth. To ensure long unattended performance of the sensor the fermenter was kept as small as possible to reduce consumption of fermentation broth and to increase the sensitivity of the sensor (less dilution of the water to be analyzed). The fermenter was manufactured using a 3D-printer with UV-lithography and equipped with a small pH sensor based upon conductivity measurements. In our experimental setup, the light detecting flow cell was separated from the fermenter, but can be integrated into the reactor.

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