# Hydrogen Peroxide Signaling Controls Fecal Indicator Bacteria Fluctuations

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Bacterial pathogen survival in the environment is dictated by their ability to grow or persist under biotic and abiotic stressors. Sunlight and competition are two significant interactions that control bacteria populations in surface waters, however there is still a significant gap in our knowledge regarding bacterial response to environmental stressors. In order to fulfill this gap, we explored the interactions between sunlight, dissolved organic matter and $H_2O_2$ on fecal indicator bacteria (FIB) in outdoor mesocosms.

Stream water (~4 - 5mg $L^{-1}$ C) was spiked with Cattle Fecal Extract (CFE) and exposed to natural sunlight for 4 h to initiate $H_2O_2$ photo-production prior to FIB co-culture inoculation (~$10^6$ CFU $mL^{-1}$) in the dark. Following inoculation, mesocosms were incubated in the dark for 20 h before the next cycle of sunlight exposure and dark incubation. We employed RT-qPCR to monitor for the expression of oxidative stress genes and glycerol metabolism genes.

For the 72 h cycle, we observed a diel pattern of day light die-off and overnight re-growth in *E. coli* populations, while *E. faecalis* showed an overnight steady state and daylight die-off in all treatments. More importantly, *E. coli* growth rate was higher in CFE spiked stream water than unspiked stream water. Further, in dark control mesocosms (no sunlight exposure), both bacteria showed a significant re-growth pattern in response to exogenous $H_2O_2$ concentrations, and oxidative stress and glycerol metabolism gene expressions.

Our results provide the first evidence for the potentially vital role $H_2O_2$ signaling may play in controlling bacterial population in surface waters.