Effects of Pollutants and Changes in pH on the Bioluminescence of Vibrio fischeri: A Novel Bioassay for Water Pollution Detection

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A major problem in today's society, specifically in developing countries, is accessing sanitary drinking water. Over 780 million people are without safe drinking water. One main cause of this is that there are very few, if any, cost effective ways to accurately and quickly detect a broad range of pollutants. In this experiment, a novel method of using the bioluminescence of the bacterium, Vibrio fischeri, to detect water pollution was investigated. The pollutants atrazine, permethrin, ammonium nitrate, and benzene, and pH levels of 5, 6, 7, 8, 9, and 10 were tested. The experiment was conducted by adding the pollutants in varying concentrations; pH was altered with levels of hydrochloric acid and sodium hydroxide with respect to the corresponding pH value. A constant amount of bacterium was inoculated into the altered solutions and incubated. The bioluminescence and optical density (OD) of each sample was measured in a luminometer/spectrophotometer. The OD was measured to ensure uniform cell density across all samples, which was successful. The bacteria bioluminesced 35 times more in pH 8 compared to pH 5, and lower concentrations of pollutants had double the bioluminescence than higher concentrations. The bioluminescence measurements show outstanding applications. Based on the development of a functional prototype, this method of detecting water pollution is more than 50 times less expensive, 5 times more precise, and 6 times faster than traditional methods of detecting water pollution. In addition, this method tests for a broad range of pollutants, rather than targeting a specific pollutant like most traditional detection methods. My experiment shows that bioluminescence can be used as a cost-effective, accurate way of detecting a broad range of water pollutants.

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