CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

J1119

Project Title

Nanoparticle Pollution: A Growing Problem. The Effect of TiO(2) Nanoparticles on E. coli Growth in the Presence of Light

Abstract

Objectives/Goals

The objective is to determine whether TiO2 nanoparticle (n-TiO2) contamination in the growth medium adversely impacts E. coli growth or viability when exposed to light.

Methods/Materials

E. coli from a common source culture were grown in LB broth in three groups of nine test tubes in an incubator at 37 degrees Celsius for 48 hours. The first group was uncontaminated, the second group had 200 ppm of n-TiO2, and the third had 500 ppm.

The groups were sub-divided into three sets. One set from each group was kept in the dark, a second was subjected to indoor lighting, and a third was exposed to bright fluorescent light measuring 2400 lux. The sets were allowed to grow for another 24 hours. The optical density of each culture was then measured in 600 nm wavelength light using a spectrophotometer. Optical density was used to estimate total cell concentration.

Cell viability was measured for each of the nine combinations of contamination and illumination by plating on agar plates and incubating for 48 hours. Serial dilutions of the cultures were used for plating, and the plates that had cell colonies in the range of 30 to 300 were counted. Cell counts were used to estimate viable cell concentration.

Results

In the presence of bright light and TiO2 contamination, total E. coli concentration was reduced by 54% compared to the control group. Viable cell concentration was reduced by 8X. The difference in the total cell and viable cell concentrations can be accounted for by the cells damaged or killed by the effect of n-TiO2. Diffused lighting had a smaller effect. In the absence of light, n-TiO2 did not have a measurable effect. There was no significant difference between the 200 ppm and 500 ppm levels of contamination.

Conclusions/Discussion

The results confirm the hypothesis that n-TiO2 contamination has an adverse impact on the growth and viability of E.coli. They also clearly demonstrate the role of light in activating n-TiO2.

TiO2 nanoparticles are used in many applications ranging from industrial to household uses. Studies have shown that nanoparticles escape through waste water treatment facilities and end up in the aquatic system. This experiment clearly demonstrates that TiO2 nanoparticles can be harmful to microorganisms, and need to taken seriously as a source of pollution.

Summary Statement

This project demonstrates that man-made TiO2 nanoparticles can adversely impact E. coli growth and viability in the presence of light, and must be taken seriously as a potential source of environmental pollution.

Help Received

Used lab equipment at Harker Middle School under the supervision of project mentors Ms. Kristen Morgensen and Mr. Akhil Mehta.