CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J1429

Project Title
The Effect of pH on the Bacterium E. coli

Abstract

Objectives/Goals
Many cookbooks and recipes state that adding acids such as vinegar to foods will stop harmful bacterial growth. I decided to test this idea by determining the ability of the bacterium E. coli to grow in media buffered to pH levels between 4 and 8. My hypothesis is that the bacteria will grow better at neutral pH than at acidic pH.

Methods/Materials
Five 50 ml samples of LB broth were buffered with acetic acid at pH 4 and 5, with MES at pH 6 and with HEPES at pH 7 and 8. Each sample of medium was transferred to a 250 ml flask and 0.5 ml of a saturated overnight ulture of E. coli was added to each flask. A sample was taken from each flask at times 0, 0.5, 1, 2, 3, and 4 hours. The amount of bacteria in each sample was measured using a spectrophotometer at 595 nm. The OD(595) and time data were plotted to show growth curves at each pH tested.

Results
My first experiment showed that the bacteria grew at identical rates at pH 6, 7 and 8 and did not grow at pH 4 and 5. Since I used a different buffer at pH 4 and 5 I was concerned that the failure to grow at these pH levels was due to a contaminant in the buffer. I repeated the experiment with a differnet lot of acetic acid to test this idea. My second experioment gave the saame result as the first: no growth at pH 4 and 5 and equal growth at pH 6, 7 and 8.

Conclusions/Discussion
I conclude that E. coli bacteria grow best at a near neutral pH of 6-8. They do not grow at a more acidic pH of 4 or 5. The advice to add acids to food appears to be a valid way to prevent the growth of E. coli. My experiments used a single non-pathogenic strain of E. coli and should be repeated with pathogenic strains of E. coli and other bacteia species to reach a more general conclusion on the value of low pH for preventing food contamination. It is possible that acetic acid is toxic to E. coli and therefore my experiments should be repeated using a different buffer at pH 4 and 5.

Summary Statement
I tested the ability of E. coli bacteria to grow at different pH levels and concluded that the bacteria grow well at neutral pH (6-8) and poorly at acidic pH (4-5).

Help Received
I performed all the experimental procedures myself. My father supervised me to ensure safety. The experiments were performed in my father's laboratory at Stanford University.