CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
J1104

Project Title
Garbage to Gas: Fermenting Common Household Wastes into Ethanol to be Used as an Alternative Fuel Source

Abstract

Objectives/Goals
My objective was to discover which common household waste most efficiently ferments into ethanol to be used as an alternative fuel source.

Methods/Materials
I started my experiment by first breaking down fruit peels, flowers, newspapers, t-shirts, and saw dust using sulfuric acid. I then neutralized the acidity of each resulting solution with sodium hydroxide. I used pH tester strips to determine the pH as I adjusted it to a level suitable for the growth of yeast. By filtering out the solids, I obtained a liquid solution that I poured into a beer/wine alcohol hydrometer, to measure the starting specific gravity. By measuring the difference in specific gravity before and after fermentation, I will later determine the relative amount of ethanol produced. I added the yeast and then put each liquid in a sealed jar with an airlock in each top. This prevents the ethanol from evaporating but allows the carbon dioxide to be released. I then again used the hydrometer to measure the resulting specific gravity and used the amount of change to calculate my results.

Results
The resulting net change in specific gravities were as follows (in order of most ethanol produced):
Fruit Peels: 0
Flowers: +.002
Newspapers: +.005
Cotton Shirt: +.005
Saw Dust: +.006
A higher ethanol concentration results in a lower specific gravity, yet the salt produced from the acid and base reaction caused an increased specific gravity. Therefore to determine the most ethanol produced, I looked for the lowest increase in specific gravity to determine which material was the most efficient producer which was fruit peels.

Conclusions/Discussion
I found that fruit peels were the most efficient producers of ethanol, followed by the flower bouquet. Newspaper and the cotton shirt had the same results, both producing less than the flowers. The saw dust ended up with the least ethanol production. These results are due to the high concentration of cellulose in the fruit peels. The yeast feasted on the cellulose of the fruit peels, producing the most ethanol. With fewer sugars in the other materials, the yeast did not consume as much, therefore producing less ethanol.

Summary Statement
In my experiment, I explored which common household waste most efficiently ferments into ethanol to be used as an alternative fuel source.

Help Received
I received help from my parents when ordering supplies such as the necessary chemicals and tools. I then required parental supervision and some aid when dealing with the sulfuric acid, sodium hydroxide, and other harmful substances used in my experiment.