CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36522

Project Title

A Test of the Mutagenic and Carcinogenic Potential of Nicotine-Free Electronic Cigarette Additives

Abstract

Objectives/Goals

Electronic Cigarette use has been rapidly increasing. In 2013-2014, the National Youth Tobacco Survey reported an increase in the number of vaping middle school students from 120,000 students to 450,000 and in high schools, the growth was even more drastic, from 660,000 to 2 million. Several studies have assessed the mutagenic potential of e-cigarettes. Research seems to indicate that two principal ingredients in e-cigarettes (nicotine and Propylene Glycol) are mutagenic. The goal of our project is to assess the mutagenicity of e-cigarette additives. The results of our experiment may have implications on the use of e-cigarettes, and may inform the regulation of these products by the government. Even the nicotine free e-juices can be as harmful as ones that contain nicotine.

Methods/Materials

We altered the traditional ames test by using polypropylene sterile tubes and plates with 96 wells each instead of petri dishes. After creating serial dilutions with each of our e-juices, we split the plate in half, 1:10 and1:100 on one plate, and 1:1000 sharing with another sample. In addition, we put Salmonella Typhimurium in each tube before inserting the solution into the wells. In order to check the mutagenicity of each e-juice, we compared it with our positive control, 2-Nitrofluorene, and a negative control, water.

Results

All of the e-juices we tested proved to be mutagenic in various dilutions. 3.1% of any dilution has to change color in order for the substance to be deemed mutagenic, so some were more mutagenic than others. The nicotine-free flavorless e-juice produced the most mutagens in the 1:1000 dilution, but none in the 1:10 dilution, just like the other samples. The organic e-juice with nicotine made the most mutagens in the 1:100 dilution, and the nicotine-free ejuice with flavor produced some mutagens in the 1:1,000 dilution, but enough to deem it mutagenic.

Conclusions/Discussion

Our hypothesis was supported and our experiment demonstrated that all e-juices are mutagenic and possibly carcinogenic. Not only did the e-juice with nicotine turn mutagenic, but the nicotine free one also proved to be mutagenic. We have concluded that the acrolein in the Propylene Glycol made the nicotine free e-juice mutagenic, which is why our experiments tested positive.

Summary Statement

We tested the mutagenic property of a variety of e-juices and found out that the ingredients in these liquids are harmful since they produce several mutagens, which could lead to cancer.

Help Received

We performed the majority of the experiment on our own. Due to the harmful nature of the bacteria, our teacher, Dr. Artiss, added it. He also gave feedback and reviewed our work.