CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
Dhruba Banerjee

Project Number
S1101

Project Title
An Analysis on How Potassium Affects Hypertension

Abstract

Objectives/Goals
Inside the circulatory system, sodium prompts the kidney to reabsorb water into the capillaries, increasing blood pressure. Although scientists are not sure why, ingesting potassium has been shown to moderately reduce hypertension. The purpose of this experiment is to test a theory that may answer the question, "How does potassium affect high blood pressure?" by focusing on and modeling the water reabsorption process of the kidneys.

Methods/Materials
The collecting duct (of the kidney) lined with epithelium cells, the capillary, and the interstitial fluid in-between, are simulated using three dialysis tubes filled with condition-specific sucrose solutions submerged in a beaker. Sucrose is used, in place of sodium or potassium ions, because its molecules are large enough to not diffuse out-of the dialysis tubes. The water, as in the collecting duct, can passively diffuse out-of the dialysis tube. The volume of the water in the thistle tube is initially measured, and then re-measured after 30 minutes. A concentration of 0.3 M solution for all the tubes, serves as the control.

Results
As hypothesized, when the sucrose concentration of the second dialysis tube is increased, the volume of water in the thistle tube increases 2.17 mL less than if the concentration of the second tube is not increased. This indicates that an increase of intracellular potassium in the transport epithelium can decrease the rate of osmosis. The data from the five trials are analyzed using standard deviation, to determine the precision, and T-tests, to determine whether the differences among averages of each condition are statistically significant.

Conclusions/Discussion
In conclusion, this experiment proves, by chemical means, that the increased concentration of potassium in epithelium cells can inhibit the reabsorption process in the collecting duct. Such a process explains why potassium may reduce hypertension. In the future, a physiological model would be useful to re-examine this theory under a biological context. This experiment, however, is a critical building block that must precede the complications of biological testing. It is important to continue research into this subject, because a complete understanding of the functions and effects of potassium is necessary for making educated decisions when dealing with high blood pressure.

Summary Statement
This experiment demonstrates, via a chemical model, that an increase in the potassium concentration of epithelium cells (in the kidney's collecting duct) may be the reason potassium decreases high blood pressure.

Help Received
I would like to acknowledge my mentors, Ms. Moilanen, Ms. Alonzo, and Ms. Loia, for all their input into this project. I would also like to thank my parents for their undeniable support and encouragement.