CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

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Project Number

J0412

Project Title

Hydrogen Bonds: Important in Biology, but Does Antibody Care?

Abstract

Objectives/Goals

This project is a continuation of an earlier study I performed that involved the use of different substances to break the hydrogen bonds in water. The goal of my current project is to find out how different types of solutions can affect the hydrogen bonding between antibodies and the antigens they bind to. This specific binding is the biological function of all antibodies. Since nearly all biological molecules contain hydrogen (and/or electrostatic) bonds, my hypothesis predicts that disruption of these interactions would result in the loss of biological function.

Methods/Materials

A standard enzyme linked immunosorbent assay (ELISA) was used to measure the biological function of antibody binding. Various chemicals were added to test whether they would disrupt the binding of specific monoclonal antibodies to the antigen. Substances were chosen according to their different chemical properties and how they might affect hydrogen bonds. The substances tested were varying concentrations of glucose, hydrochloric acid, sodium chloride, bleach, sodium hydroxide, and SDS detergent. Binding was quantitated using a BioRad 680 Microplate Reader.

Results

The data supported the hypothesis. The substances that were tested can be arranged into three categories: substances that affect pH, detergents, and charged and noncharged substances. Initially, the substances that affected pH were the most potent, eliminating almost all the antibody binding at the lowest concentrations. The detergent was able to significantly reduce antibody binding, and finally, charged and noncharged substances had effects at low concentrations on antibody binding.

Conclusions/Discussion

The results of this study bear out the hypothesis that hydrogen bonding is important for antibody binding. On the whole, the higher the concentration of the test substances, the less antibodies were able to bind. The extent of disruption depended on the substance tested, indicating that some chemicals are more efficient at breaking hydrogen bonds than others. These experiments indicate that hydrogen bonding is critical for the function of biological macromolecules, and therefore, for maintenance of living organisms.

Summary Statement

Demonstrated the importance of hydrogen bonds on the biological function of antibodies using different chemical substances.

Help Received

Father served as advisor during experiments, Telos Pharmaceuticals provided lab space with permission from Dr. DJ Carlo, CEO.