CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
S1702

Project Title
Correlating Genetic Signatures with Surface Sugar Expression in Vibrio vulnificus

Abstract

Objectives/Goals

Vibrio vulnificus is a gram-negative bacterium found in warm coastal waters. Infections caused by V. vulnificus have a high mortality rate (up to 55%), and most die within 48 hours of hospital admission.

Sialic acids (Sias) are a diverse family of 9-carbon sugars found on the outermost ends of glycan chains in mammals. Some pathogenic bacteria express Sias on their cell surfaces as part of complex polysaccharide structures, such as the capsular polysaccharide (CPS). These Sia-decorated polysaccharides allow the bacteria to evade detection by the immune system. V. vulnificus has been shown to express a CPS. In the Sia biosynthetic pathway, NeuB is the gene responsible in the biosynthesis of Neu5Ac, the most common form of Sia. NeuA encodes the enzyme needed to activate Sia (Neu5Ac to CMP-Neu5Ac).

Based on available genome sequences of two different strains (CMCP6 and YJ016), I hypothesized that V. vulnificus will express Sias or closely related structures that may be directly related to virulence. There may be a correlation between the clinical or environmental status of V. vulnificus isolates and the level of Sia expression, where virulent strains have high levels and environmental strains have low levels of Sia.

Methods/Materials

Nineteen strains of V. vulnificus were selected from a larger library of isolates for which sequence data of the Sia biosynthetic genes had been characterized. These nineteen strains along with five controls were analyzed for their relative Sia content using DMB-HPLC. 2-Keto-3-deoxyoctulosonic Acid (Kdo) was used as an internal control in order to normalize Sia values. The Sia/Kdo ratio was then calculated to determine the relative Sia expression by each strain.

Results

The results show that the 7 strains that had a NeuA gene similar to CMCP6 had high Sia expression (an average of 85.59) suggesting that there is a function of the CMCP6 gene that is necessary in order to express Sias at high levels. In striking contrast (p-value < .01), the 8 strains that had YJ016-like NeuA genes expressed low levels of Sias (an average of 0.26).

Conclusions/Discussion

This project has demonstrated a direct correlation between a CMCP6-like NeuA gene, and high Sia expression. It is known that Sias play an important role in host-pathogen interactions. Thus, drugs that block the biosynthesis of Sias in Vibrio vulnificus may be an effective treatment for this highly virulent infection.

Summary Statement

I found a correlation between the presence of a certain gene in Vibrio vulnificus and the expression of Sialic Acid, which could potentially tell scientists how virulent a strain is.

Help Received

Dr. Amanda Lewis supervised my research; Used lab equpment at UCSD in Dr. VIctor Nizet's Lab.