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Scientists Discover a New Way to Fight Tooth Decay

by Stacy Kish, CSREES

Dental caries is an infectious disease that results in tooth decay and cavities if left untreated. It is one of the most common diseases around the world. >>

The USDA Cooperative State Research, Education, and Extension Service (CSREES) funded a team of scientists in New York to examine a group of compounds, called polyphenols, in grapes that could potentially fight the onset of tooth decay.

Streptococcus mutans, one of the primary microbial agents involved with tooth decay and cavity formation, produces a biofilm that covers the teeth. The biofilm allows acidic environments to form that breaks down the mineral structure of the tooth, producing points of weakness where the onset of disease can occur.

Hyun Koo and colleagues at the University of Rochester Medical Center (URMC) and the Agricultural Experimental Station at Cornell University focused their analyses on red wine grapes and wine-derived byproducts due to their rich and diverse content of polyphenols and availability of the products for research. Previous studies show that polyphenolic compounds in the extracts of grape, apple, cranberry and cocoa act as a natural biological agent against the ability of *S. mutans* to cause the disease.

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Right: Hydroxyapatite discs are used as tooth surrogates to investigate how polyphenolic extracts of grape impede *S. mutans* from forming dental biofilms at Dr. Koo's lab at the University of Rochester Medical Center, Rochester, NY.

Credit: Keith Bullis

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Their work examined the chemical composition of polyphenolic compounds obtained from whole grape and pomace, a slightly fermented grape mash consisting primarily of skins and seeds. The phenolic compounds from the different wine grape varieties were tested against *S. mutans* to determine the most effective disruptive agent.

The scientists determined that all wine grape varieties contained high levels of polyphenolic extracts. The extracts, however, did not kill *S. mutans*. Instead, the extracts were effective at disrupting the bacteria's ability to form the acidic biofilms that cause dental caries. The phenolic extracts obtained from the pomace were slightly more effective than the whole grape in inhibiting acidic bacterial biofilm production.

"We hope to isolate the key compounds within the winemaking waste that render bad bacteria harmless—perhaps in the mouth with a new kind of rinse," said Koo, an author of the current study who is an assistant professor of dentistry within the Eastman Department of Dentistry and Center for Oral Biology at URMC.

These compounds embody an emerging philosophy in the design of drugs against bacteria. It takes away the bacteria's ability to cause disease without killing beneficial bacteria or specifically selecting resistant genes when breeding. In addition to the potential medical value, the waste products of the winemaking process may have important economic implications. The pomace contains at least as many polyphenols as whole fruit, eliminating the need to use good food to make any future drugs.

All polyphenolic extracts were effective at inhibiting acidic biofilm production at concentrations as low as 63 micrograms per milliliter. The researchers obtained phenolic compounds from different varieties of *Vitis vinifera*, including Cabernet Franc, Pinot Noir and interspecific hybrid varieties, such as Baco Noir and Noiret.

Future work in this area may develop useful compounds to fight pathogenic biofilms as a form of microbial control that may be beneficial to the food safety industry.

"Overall, the phenolic extracts disrupt essential virulence traits for a widespread, destructive oral pathogen, but without killing it," said Olga I. Padilla-Zakour, Ph.D., associate professor of food processing at Cornell University's New York Agricultural Experiment Station.

CSREES funded this research project through the National Research Initiative Bioactive Components for Optimal Health program. Through federal funding and leadership for research, education and extension programs, CSREES focuses on investing in science and solving critical issues impacting people's daily lives and the nation's future. For more information, visit www.csrees.usda.gov. ■

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