



Coop Research Program

Novel approach to biologically control spoilage of fresh vegetables using reuterin

Pre-washed bagged salads are becoming more popular with increasing consumers' demand for healthy and convenient foods. However, fresh-cut produce is rapidly spoiled, and an efficient and safe method to control microbial contamination is still lacking. Reuterin is a promising natural antimicrobial, and this project investigated its potential as a disinfectant for fresh-cut produce. Acrolein was identified as the active antimicrobial component of reuterin, and the application of reuterin reduced microbial loads in fresh-cut lettuce but led to leaf discoloration.

Motivation

Pre-washed, fresh-cut fruits and vegetables are a fast-growing market answering consumers' demand for healthy and ready-to-use food products. A major concern with minimally-processed produce is their rapid microbial spoilage and the associated foodborne illnesses. Chlorine is often used as a disinfectant, but concerns exist about its effectiveness and risks for consumer and environmental health. A promising alternative is the use of reuterin, a broad-spectrum antimicrobial compound produced by food-grade *Lactobacillus reuteri* from glycerol. However, reuterin's applicability in the food industry still needs testing.

Objective

The overall research objective was to establish the use of natural, antimicrobial reuterin as a novel method to reduce microbial load on fresh produce. The project required investigation of the antimicrobial potential of reuterin's components and testing of effectiveness for decontaminating and preserving fresh-cut lettuce in experimental trials.

Research Highlights

As a first step, the project investigated how reuterin exerts its antimicrobial activity. Reuterin is a complex system made of four components: 3-hydroxypropionaldehyde (3-HPA), its hydrated and dimeric forms, and acrolein. In aqueous solution, this system is highly dynamic, and the components continuously convert to each other (see figure). As a result, its quantitative analysis has proven challenging. The team of researchers, therefore, developed novel multiple analytical approaches for measuring all components of the reuterin system and determined the antimicrobial properties of reuterin. This approach showed for the first time that acrolein, and not 3-HPA as previously thought, is the active antimicrobial compound of reuterin.



Dr. Anna Greppi cutting fresh lettuce for an experiment to test the effectiveness of reuterin as a disinfectant.

After understanding the reuterin system, researchers then tested how well it decontaminated and preserved minimally-processed produce. They washed fresh-cut lettuce using either reuterin solutions containing similar 3-HPA levels but different acrolein concentrations or chlorine and water. The washed lettuce was packed and stored in a protective atmosphere. After seven days, the lettuce washed with reuterin with higher concentrations of acrolein had fewer enterobacteria, yeasts, and molds than the other samples. Even though acrolein is considered toxic at certain concentrations, none remained in the lettuce after treatment, suggesting that reuterin is safe to use in the food industry. However, leaves of lettuce washed with higher concentrations of acrolein looked more discolored than other samples.

Relevance to Stakeholders

Overall, the results proved that reuterin could be safely used in the food industry to control microbial loads in fresh-cut produce. One observed drawback was the discoloration of lettuce leaves, making produce less appealing to consumers and causing food and economic losses. Nevertheless, shorter shelf-life due to discoloration, as observed in pre-cut lettuce, would be of less concern with other vegetables less sensitive to oxidative stresses, such as carrots, apples, beets, and radishes. The application of reuterin as a disinfectant is especially relevant for producers and retailers in Switzerland and other European countries where the use of chlorine in fresh-cut produce is banned.

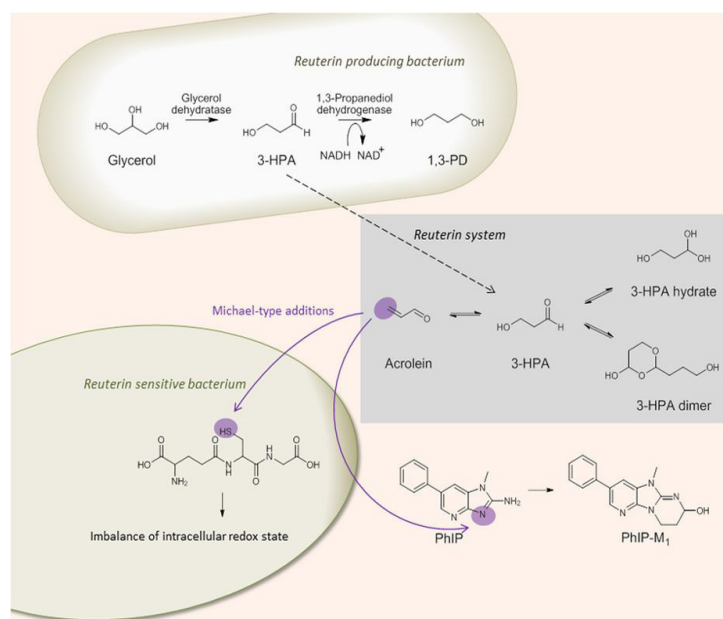


Figure: Components of the reuterin system and proposed mechanism of activity. Acrolein is the active compound causing antibacterial activity (Source: Engels, C; Schwab, C; et al. 2017. CC BY 4.0).

Selected Publications

- Asare, P.; Greppi, A.; et al. [Decontamination of minimally-processed fresh lettuce using reuterin produced by *Lactobacillus reuteri*](#). *Front. Microbiol.* **2018**, 9:1421.
- Engels, C.; Schwab, C; et al. [Acrolein contributes strongly to antimicrobial and heterocyclic amine transformation activities of reuterin](#). *Sci. Rep.* **2017**, 6: 36246.

Media

Eugster, A. Leben lassen. Es geht auch ohne Chemie. *Coopzeitung*, **January 2017**, 8-9.

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www.worldfoodsystem.ethz.ch/research/research-programs/CRP/biocontrol.html

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