Mouthwash for Children That Targets *Streptococcus mutans* Biofilms

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ABSTRACT

The early stages of dental caries involve *Streptococcus mutans* adhering to teeth, forming biofilms, and producing enamel-damaging acids. The *S. mutans* enzyme sortase A (SrtA) is crucial for bacterial adhesion, making it a key target for plaque prevention. We found that polyphenolic compounds from maple extracts, including (-)-epicatechin gallate (ECG), inhibit SrtA. ECG is also abundant in green tea. Computational models showed ECG binds to the enzyme's active site, and in vitro studies confirmed it reduces SrtA activity. At 100 μM, ECG significantly impaired bacterial attachment and biofilm formation on saliva-coated hydroxyapatite, simulating tooth enamel. These findings suggest ECG as a safe, affordable option for preventing caries, particularly in children who may avoid antimicrobial based products due to safety concerns, if ingested. This natural compound offers a promising alternative for maintaining oral health and could be used in a safe to swallow oral rinse.

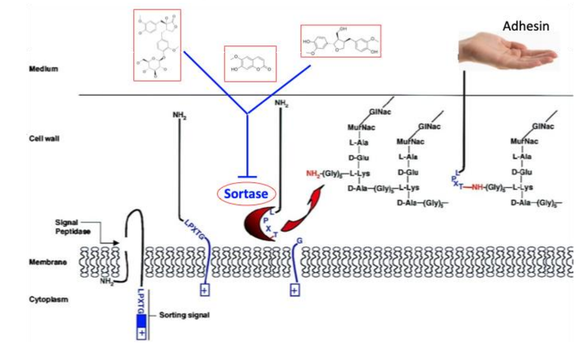
BACKGROUND AND SIGNIFICANCE

Problem

- Dental caries is one of the greatest unmet health treatment needs" (CDC). By 6-9 y.o., one half of American children have cavities.
- Therapeutic mouthwashes (oral rinses) contain toxic antimicrobial chemicals and/or fluoride. ADA does not recommend mouthwashes for children under 6 y.o. because they tend to swallow them.

Solution

- A mouthwash that is efficacious and safe to ingest.
- Active ingredients: natural GRAS compounds with antibiofilm properties against *Streptococcus mutans*.
- Sortase A inhibitors from maple sap inhibit biofilm formation in *Listeria* by blocking the anchoring of protein adhesins to the bacterial cell surface [*Front Microbiol* 2024, 15:1436476].

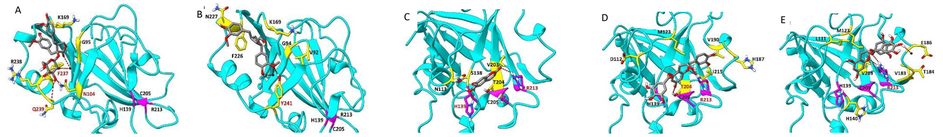


OBJECTIVE

- Test edible maple polyphenols as potential biofilm inhibitors in *S. mutans*.
- Develop an antibiofilm mouthwash.

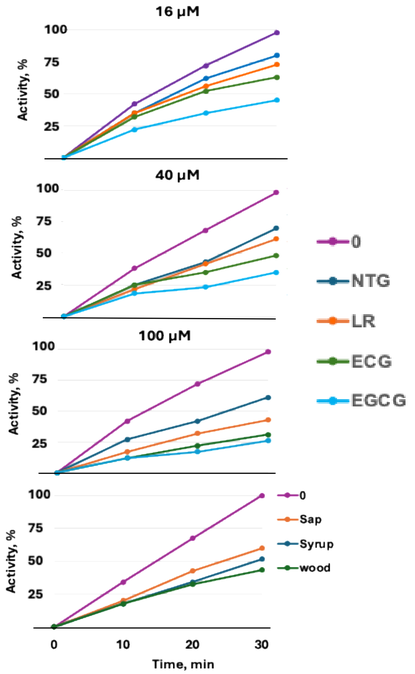
RESULTS

1. Maple polyphenols are predicted to bind inside the catalytic pocket of the *S. mutans* sortase A with favorable free energies.



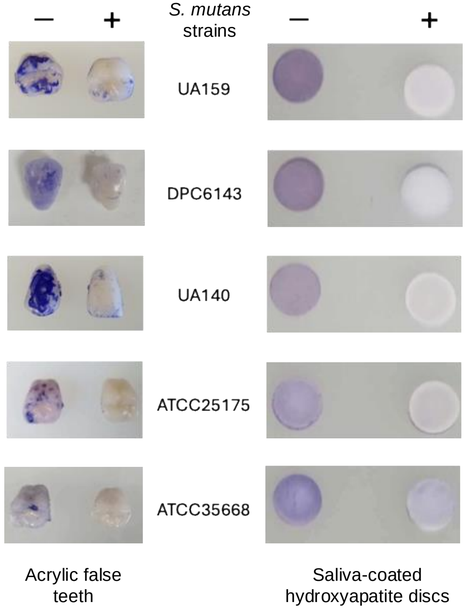
	Nortrachelogenin-8'-O-β-D-glucoside (**NTG**)	Lariciresinol (**LR**)	Isoscopoletin (**IS**)	(-)-Epicatechin gallate (**ECG**)	(-)-Epigallocatechin gallate (**EGCG**)
ΔG (kkal/mol)	-6.2	-6.6	-5.4	-8.1	-7.2

2. Maple polyphenols and maple extracts inhibit *S. mutans* sortase A *in vitro*.



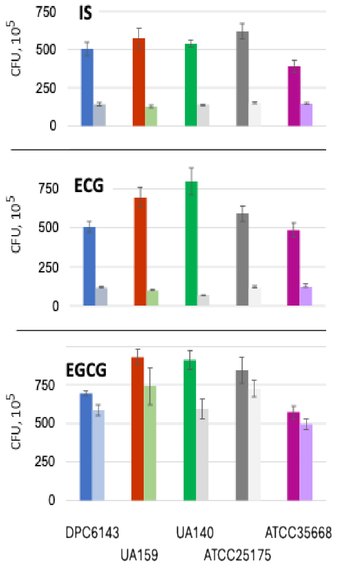
S. mutans sortase A was incubated with a fluorescent peptide substrate for 30 min @ room temperature.

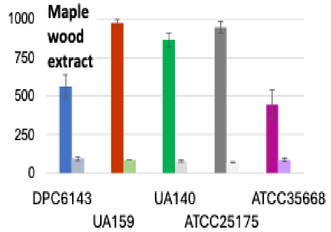
3. Biofilms formed by various *S. mutans* strains are inhibited by ECG (+).



False teeth or discs were incubated in BHI + sucrose +/- ECG, 100 μM in the presence of *S. mutans* for 48 h.

4. Quantification of polyphenol-mediated inhibition of *S. mutans* biofilms on hydroxyapatite discs.





Hydroxyapatite discs were incubated with *S. mutans* in BHI + 1% sucrose +/- polyphenols, 100 μM (or maple extracts) for 48 h; bacteria were removed by sonication and plates for enumerating CFU.

5. MayPall's antibiofilm mouthwash

- Safe for kids of all ages
- Inhibits plaques
- Safe to ingest
- Natural ingredients
- No alcohol
- No fluoride

CONCLUSIONS

- Maple polyphenols inhibit *S. mutans* sortase A *in vitro* and prevents biofilm formation by various *S. mutans* on tooth-like surfaces.
- Maple polyphenol-based antibiofilm mouthwash is safe for children of all ages.

ACKNOWLEGMENTS

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