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Final Report
Enamel Stain Prevention Using a Novel Dental Pen Formulation

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GOAL

The goal of this study was to identify the effects of a test whitening pen (Oral Essentials) on enamel stain development during timed exposure to coffee and red wine.

MATERIAL AND METHODS

20 extracted teeth that appeared healthy to the naked eye and inspection under the light microscope (x10) were bisected. After standardized photography and colorimetry, one half of each tooth was painted with two coats of the OE whitening pen, allowing for 30 secondsdrying time after each application; the other half remained untreated. 10 of the bisected sample pairs were immersed in individual 20mL aliquots of freshly brewed Via coffee (Starbucks) according to the instructions on the packet: 1 packet per cup of coffee. The remaining 10 sample pairs were immersed in individual 20mL aliquots of red wine (Charles Chaw Cabernet Sauvignon, Trader Joes). Standardized photography and colorimetry to determine L* and b* values were repeated every 10 minutes for a total of 50 minutes. The endpoint was selected once no further color changes were recorded over the preceding 10 minute interval.

RESULTS

1. Coffee
1.1.L* values: Briefly, the teeth began to stain significantly after 30 minutes exposure to coffee when pre-coated with the OE pen, whereas the untreated teeth began to stain significantly after 20 minutes exposure to coffee. Thus using the OE pen significantly prevented enamel staining for an additional 10 minutes of coffee exposure vs the uncoated teeth. The L* value measures lightness or brightness.

Coffee exposure of non-coated and OE coated teeth caused a significant decrease in the L* value (darkening) over time starting at 20 vs. 30 minutes exposure duration. Before these time points, differences were not significant. (Non-coated teeth, L* values comparing baseline vs. 20, 30, 40, and 50 minutes respectively: $P < 0.01$, $P < 0.01$, $P < 0.001$, $P < 0.001$; OE-coated teeth comparing baseline vs. 30, 40, and 50 minutes respectively: $P < 0.05$, $P < 0.01$, $P < 0.01$, one way ANOVA followed one way ANOVA followed by Tukey post-test). The changes in L* values (darkening) were minimal and not significant at the 10 and 20 minute time points ($P>0.01$)using the OE coating teeth and these changes continued to be less than in the uncoated teeth at 30,40 and 50 minute time points (Figure 1,Table 1).
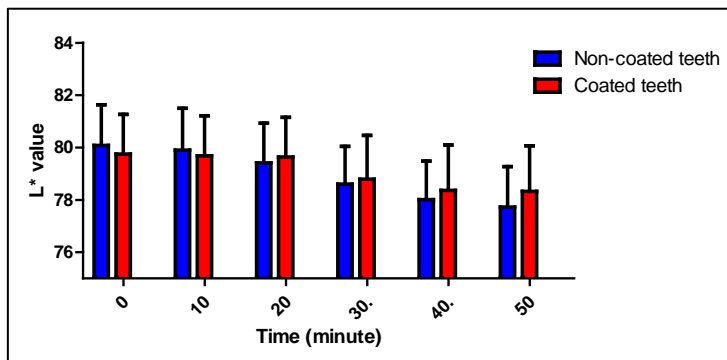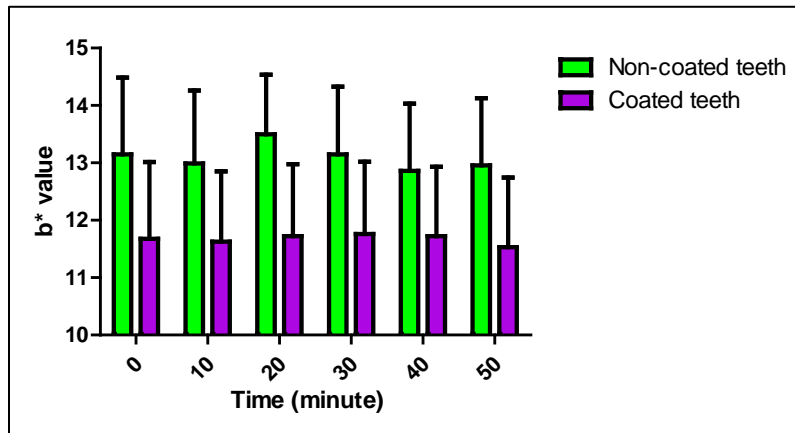

Figure 1: Effect of OE coating on L* values after coffee exposure.

Time	Baseline	10min	20min	30min	40min	50min
Non-coated teeth	80.08	79.90	79.41	78.60	78.01	77.73
OE coated teeth	79.75	79.69	79.64	78.79	78.37	78.33

Table 1: Mean L* values over time for non-coated vs OE coated teeth after coffee exposure.

1.2. b* values: Briefly, b*values did not change for either treatment group throughout the duration of the study.

Coffee exposure of non-coated and OE-coated teeth did not cause a significant decrease at any time point (treatment and time effects: $P > 0.05$ for all time points, Two way ANOVA) (Figure 2, Table 2).

Figure 2: Effect of OE coating on b* values after coffee exposure.

Time	Baseline	10min	20min	30min	40min	50min
Non-coated teeth	13.15	12.99	13.50	13.15	12.86	12.96
OE coated teeth	11.68	11.63	11.72	11.76	11.72	11.53

Table 2: Mean b* values over time for non-coated vs OE coated teeth after coffee exposure.

1.3. CONCLUSION

Applying the OE pen to the tooth surface prevents enamel staining for an additional 10 minutes of coffee exposure vs the uncoated teeth.

2. Red Wine

2.1.L* values: Briefly, the teeth began to stain significantly after 30 minutes exposure to red wine when pre-coated with the OE pen, whereas the untreated teeth began to stain significantly after 10 minutes exposure to red wine. Thus using the OE pen significantly prevented enamel staining for an additional 20 minutes of red wine exposure vs the uncoated teeth.

Red wine exposure of non-coated teeth caused a significant decrease of L* (darkening) in a time-dependent manner after the first 10 minute exposure interval, with progressive darkening at each subsequent time point (Non-coated teeth, L* at 0 minutes vs 10, 20, 30, 40, and 50 minutes respectively: $P < 0.01$, $P < 0.01$, $P < 0.01$, $P < 0.001$, $P < 0.001$. One way ANOVA followed by Tukey post-test). OE-coated teeth began to darken significantly after 30 minutes exposure to red wine, with progressive darkening at each subsequent time point (L* at 0 minutes vs 10, 20, 30, 40 and 50 minutes respectively: $P>0.01$, $P>0.01$, $P<0.01$, $P<0.01$, $P<0.01$, One way ANOVA followed by Tukey post-test) (Figure 3, Table 3).
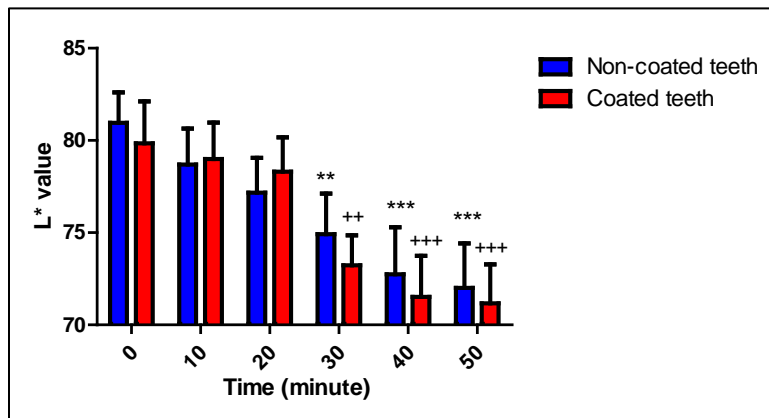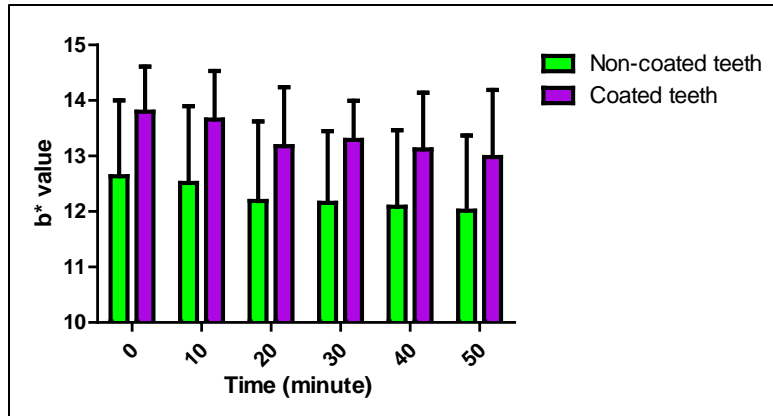

Figure 3: Effect of OE coating on L* values after red wine exposure.

Time	Baseline	10min	20min	30min	40min	50min
Non-coated teeth	80.95	78.70	77.17	74.92	72.74	72.01
OE coated teeth	79.85	79.00	78.31	73.23	71.52	71.17

Table 3: Mean L* values over time for non-coated vs OE coated teeth after red wine exposure.

2.2. b* values: Briefly, b*values did not change for either treatment group throughout the duration of the study.

Red wine exposure of non-coated and OE-coated teeth did not cause a significant decrease at any time point (treatment and time effects: $P> 0.05$ for all time points, Two way ANOVA) (Figure 4, Table 4).

Figure 4: Effect of OE coating on b* values after red wine exposure.

Time	Baseline	10min	20min	30min	40min	50min
Non-coated teeth	12.63	12.51	12.19	12.16	12.08	12.02
OE coated teeth	13.80	13.66	13.18	13.29	13.12	12.98

Table 4: Mean b* values over time for non-coated vs OE coated teeth after red wine exposure.

2.3. CONCLUSION

Applying the OE pen to the tooth surface prevents enamel staining for an additional 20 minutes of red wine exposure vs the uncoated teeth.