1964 Effect of hydroxyapatite toothpaste on vital tooth color

C.GAO[1], H.LIU[1], and I.KATAYAMA[2], [1] Peking University, China, [2] Meikai University School of Dentistry, Japan

OBJECTIVE

Hydroxyapatite(HAP), a registered anticaries agent in Japan, is reported to remineralize areas of surface and sub-surface demineralized tooth enamel.
We set out to examine the effect of such remineralization on the structure and color of human tooth enamel, which reportedly changes up to 2 Lumin shades in color when treated with bleaches such as hydrogen peroxide.

MATERIAL and METHOD

TEST TOOTHPASTES
A commercial toothpaste containing medical grade HAP ('Apagard,' Sangi Co., Ltd., Japan) (Toothpaste A) and an identically prepared control toothpaste containing no HAP (Toothpaste B), were used in the present study. (Table 1)

CLINICAL TEST
Two groups of 6 persons each from Peking University, aged between 22 and 36 and confirmed to have healthy teeth, participated in the study. Each group brushed their teeth 5 minutes 3 times daily for about 30 days, one group using Toothpaste A (Group A) and the other Toothpaste B (Group B). The color of each subject's central incisors was recorded initially, then every 2-3 days, taking 3 measurements each at the center of the labial surface using a Photoresearch Spectra-Scan PR-650 photocolorimeter (standard light source D_{55}, brightness 1500 Lux) to obtain CIE L*a*b* readings.

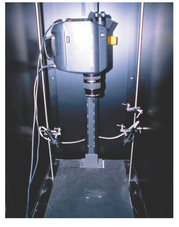
IN VITRO TEST
To evaluate results, the difference between initial and final average CIE L*a*b* values (delta E) on the VITA Lumin shade guide was calculated for each subject. This was then compared with the average delta E for reddish brown tabs (A1 through A4) and reddish yellow tabs (B1 through B4) on the VITA Lumin shade guide, calculated from measurements obtained with a MURAKAMI COLOR RESEARCH LABORATORY CMS-35FS spectrophotometer.

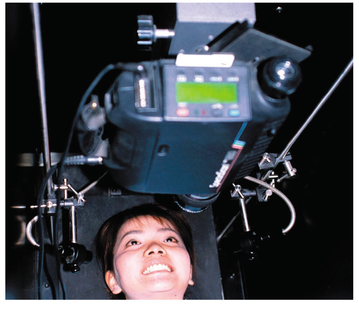
SEM OBSERVATION
Two groups of decay-free, extracted human teeth (crown portion only) were subjected to surface etching by 5 minutes immersion in a hydrochloric acid solution adjusted to pH 2.0. The teeth were then brushed 5 minutes 3 times daily for 7 days (100 strokes per mintue, brushing pressure 150g), one group with Toothpaste A and the other with Toothpaste B. Teeth were stored at 37 C, 100% relative humidity, between brushings. The teeth were then examined by field emission scanning electron microscope (FE-SEM S-4500, Hitachi), using standard observation procedures.

Table 1 INGREDIENTS OF TEST TOOTHPASTE

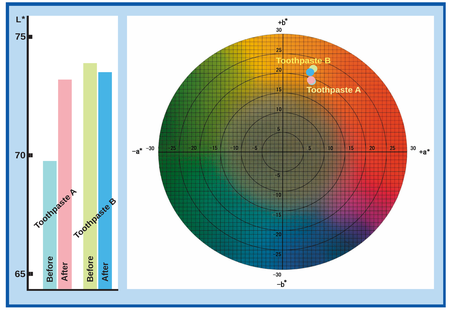
Ingredient	Toothpaste A	Toothpaste B
WATER	○	○
GLYCERIN	○	○
DICALCIUM PHOSPHATE	○	○
DICALCIUM PHOSPHATE DIHYDRATE	○	○
MEDICAL GRADE HYDROXYAPATITE	○	×
SODIUM LAURYL SULFATE	○	○
SODIUM LAURYL SARCOSINATE	○	○
FLAVOR	○	○
CARBOXYMETHYL CELLULOSE	○	○
TOCOPHEROL ACETATE	○	○
SODIUM SACCHARIN	○	○
ZEOLITE	○	○
POLYETHYLENE GLYCOL	○	○
ALKYLDIAMINOETHYLGLYCINE HYDROCHLORIDE SOLUTION	○	○

CLINICAL TEST

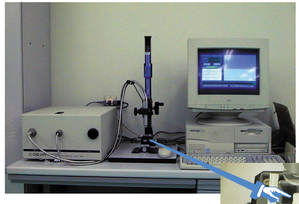


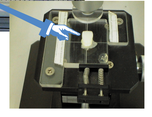


	Toothpaste A				Toothpaste B			
	L*	a*	b*		L*	a*	b*	
Control	69.74(1.03)	7.00(1.01)	18.25(1.94)	Control	73.90(3.35)	7.33(1.01)	21.49(1.54)	
2nd day	71.57(1.24)	7.26(0.65)	18.09(1.44)	3rd day	71.60(3.57)	6.77(1.23)	20.00(1.44)	
6th day	71.77(2.39)	7.43(0.68)	18.15(1.57)	7th day	71.50(2.72)	6.48(0.86)	19.91(1.57)	
9th day	72.28(2.23)	7.47(0.65)	18.41(1.17)	10th day	71.86(2.17)	6.73(1.10)	20.34(1.36)	
13th day	72.05(2.28)	7.38(0.77)	18.41(3.70)	14th day	73.67(3.10)	6.71(0.93)	20.55(1.17)	
16th day	72.39(1.86)	7.10(0.81)	18.41(3.70)	17th day	74.01(1.18)	6.81(1.09)	19.74(3.70)	
20th day	72.18(1.67)	7.14(0.96)	18.74(1.89)	21th day	72.96(3.32)	6.59(1.28)	20.09(1.96)	
23th day	72.84(2.40)	6.98(1.05)	18.59(1.59)	24th day	74.24(4.18)	6.74(1.06)	20.04(1.79)	
27th day	73.08(2.15)	6.95(0.91)	18.38(1.76)	28th day	73.52(2.37)	6.77(0.77)	20.21(1.63)	
29th day	73.21(1.38)	6.98(0.88)	18.54(1.87)					



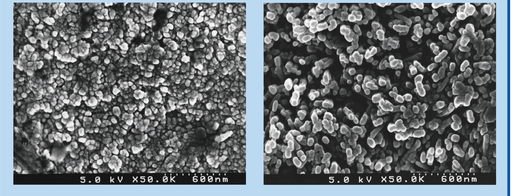
IN VITRO TEST





Shade Guide	L*	a*	b*
A1	54.09(0.01)	-1.16(0.02)	4.18(0.02)
A2	53.52(0.01)	-0.62(0.01)	6.34(0.01)
A3	51.75(0.02)	-0.28(0.01)	7.06(0.02)
A3.5	50.00(0.02)	0.49(0.04)	10.32(0.02)
A4	48.34(0.01)	1.10(0.03)	12.12(0.04)
B1	54.75(0.01)	-1.22(0.02)	2.31(0.02)
B2	53.92(0.01)	-1.35(0.03)	5.68(0.04)
B3	50.91(0.01)	-0.37(0.05)	9.39(0.03)
B4	48.91(0.01)	-0.08(0.04)	11.15(0.05)

SEM OBSERVATION



RESULTS

CLINICAL
Teeth of subjects in Group A showed a distinct increase in brightness (L*) in the first week of the study, followed by a small but steady increase thereafter. Almost no change in the other parameters recorded was seen. Teeth of subjects in Group B showed decreased brightness (L*) in the first week, but steadily returned to their initial level of brightness. No change in the other parameters recorded was seen.

Average delta E values were calculated at 3.48 for Group A, 1.45 for Group B and 2.52 for A tabs and 3.55 for B tabs on the Lumin scale. Expressed in terms of Lumin equivalent, the increase in brightness in the teeth of subjects in Group A corresponded to almost 1.4 tabs (1.38) on the reddish brown scale and almost 1 tab (0.98) on the reddish yellow scale.

IN VITRO
FE-SEM observation showed a fine particle coating on the etched surface of extracted teeth brushed with Toothpaste A, and a relatively smooth tooth surface. Teeth brushed with Toothpaste B showed an uneven surface and areas of damage to the surface crystals.

CONCLUSION

Though less powerful than bleaches, the results suggest HAP-containing toothpaste can alter tooth color by at least one shade with daily brushing, and this effect may be related to its enamel recrystallization properties.