

The Influence for the Early Stage of the Gingivitis, by Use of the Dentifrice Contained with *Panax notoginseng*, Magnoliae Cortex, and Tranexamic Acid

Sun-Joo Yoon, Kyung-Hui Moon, Ji-Young Lee, Mi-Kyoung Jeong

Department of Dental Hygiene, Jinju Helth College, Jinju, Korea

Objective: This study was conducted to compare the effects of dentifrice containing dentifrice components such as *Panax notoginseng*, Magnoliae Cortex and tranexamic acid and bamboo salt on the periodontal tissues such as relief of initial gingivitis and mitigation of gingival bleeding. I would like to use it as a reference for the development of dentifrice for patients with periodontal diseases.

Methods: 20 applicants who had a slight gingivitis have participated in this study by dividing 4 groups as using the dentifrice in the *Panax notoginseng*, Magnoliae Cortex, tranexamic acid and bamboo salt, were used for four weeks. PHP (patient hygiene performance) index, GBI (gingival bleeding) index, coated tongue check, oral moisture check were performed on before the experiment, a week later, 2 weeks and 4 weeks later. The data were analyse in order to compare the results for the gingival subsidence effect.

Results: GBI index, and coated tongue index were significantly different in all experimental groups ($p < 0.05$), and there was a significant difference in PHP index between the control and experimental 3 groups after one week ($p < 0.01$). oral moisture index was significantly different between the control group and the experimental 3 group ($p < 0.05$). There was no significant difference between two weeks ($p > 0.05$). Halitosis index was not significantly different in all groups ($p > 0.05$).

Conclusion: Using dentifrice containing *Panax notoginseng*, Magnoliae Cortex, tranexamic acid and bamboo salt were recommended to relieve slight gingivitis.

Keywords: dentifrice, gingival bleeding

Corresponding author **Sun-Joo Yoon**

Department of Dental Hygiene, Jinju Helth College, 51 Uibyeong-ro, Jinju 52655, Korea. Tel: +82-55-740-1840, Fax: +82-030300081840, E-mail: wavelove2000@naver.com

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Introduction

Dentifrice is supplemented with various ingredients for antibacterial and anti-inflammatory protection along with a mechanical property for oral hygiene and teeth cleaning, which is the main purpose of using dentifrice [1]. However, because some ingredients in dentifrice have high levels of antibacterial potency on their own but lose their effectiveness and have safety issues when used for long durations [2], studies on mixed herbal medicines that can be used long term without side effects are

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being carried out continuously as a countermeasure against such problems [3,4]. As for dentifrice development trends in recent years, its role has evolved, from just a dentifrice and foreign body remover to a remedy with a preventive effect, and growing interest is paid regarding antibacterial substances extracted from natural products, thus the necessity for the development of periodontal disease prevention agents and remedies using such substances being highlighted [5].

Panax notoginseng refers to the root and root stock of *Panax notoginseng* (Burk) F. H. Chen (Araliaceae) [6] and is effective for stopping pain and various hemorrhaging, removing extravasated blood and reducing swelling [7]. *Panax notoginseng* is mainly composed of more than 60 types of saponins, polyacetylene, compounds of the sesquiterpene family, cerebroside, phenolic acid, sterol, amino acids and polysaccharides [8], and, among them, saponins and sterol glycoside suppress the activity of macrophages and have an antioxidant and anti-inflammatory effects [9,10].

Magnoliae and honokiol, substances extracted from Magnoliae cortex and used in Chinese herbal medicine, were not only proven to be effective against dental caries and dental plaque bacteria causing inflammation, and also against periodontal disease pathogens [3,11].

Tranexamic acid has an anti-inflammatory effect and rapidly shortens bleeding times by interrupting and suppressing the plasmin activator [12].

Bamboo salt reduces gingivitis by inhibiting IL-1 and IL-6, inflammatory cytokines [13], and regarding its oral anti-inflammatory effect, it has been reported by Kim et al. [14] that it is effective in reducing gingivitis.

The purpose of this study is to develop dentifrice, in which components such as *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt are added to general dentifrice components; categorized into a Control Group, Experimental Group 1, Experimental Group 2 and Experimental Group 3 according to components in the dentifrice; and compare and investigate changes in periodontal tissue, such as the alleviation of early gingivitis and gingival bleeding, by analyzing and examining the results of a 4-week study in order to use them as a reference for developing dentifrice for periodontal disease patients in the future.

Materials and Methods

1. Subjects

This 4-week study was conducted on participants aged 20 years old or older with early gingival disease who voluntarily agreed to participate after listening to an explanation of this study.

An oral examination was conducted before the experiment

and except for those diagnosed as having no gingival disease, 120 were selected as the final study subjects.

2. Methods

120 study subjects were divided into four groups, 31 in Control Group (A), 30 in Experimental Group 1 (B), 33 in Experimental Group 2 (C) and 26 in Experimental Group 3 (D), and they were asked to use dentifrice supplemented with *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt for four weeks. Then, an oral examination was conducted on them to check for changes in their periodontal tissue, such as the alleviation of early gingivitis and gingival bleeding.

1) IRB (institutional review board) acquisition

This study was conducted after being reviewed and approved by the Institutional Review Board at the College of Natural Science, Dankook University (IRB: DKU 2017-03-029).

2) The manufacture and distribution of dentifrice

Four types of dentifrice were made and put into tubes (labeled A, B, C and D) of an identical shape. They were distributed with identical toothbrushes and the subjects were asked to brush their teeth in same way for four weeks.

3) Oral examination

Patient hygiene performance (PHP) index, gingival bleeding (GB) index, oral moisture and coated tongue of the study subjects were examined four times, before the survey tests began, 1 week, 2 weeks and 4 weeks after using the dentifrice.

(1) Patient hygiene performance (PHP) index

For this experiment, a disclosing solution was applied on the tooth surface of the subjects and they were asked to rinse out their mouths with water afterwards. Then, the buccal surface of upper right 1st molar, labial surface of upper right central, buccal surface of upper left 1st molar, lingual surface of lower left 1st molar, labial surface of lower left central and lingual surface of lower right 1st molar were examined and checked to find out whether any disclosure solution was remaining on the incisal surface of the teeth and they were scored between a minimum of 0 and a maximum of 5 [15].

(2) Gingival bleeding (GB) index

The upper right 1st molar, upper right central molar, upper left 1st molar, lower right 1st molar, lower left central molar and lower right 1st molar were probed for 10 seconds using a probe and they were checked to see whether they were bleeding: 1 point was added for bleeding on each tooth surface, and the sum total of the points ranged from zero to 12 points [15].

(3) Coated tongue test

A photo of an entire surface of the tongue was taken and the

coated tongue conditions were examined after dividing the surface into a grid with nine squares. The sum total of points ranged from zero to 9 points [15].

(4) Oral moisture test (saliva hygroscopic paper test)

The tongue was lifted from the sublingual using hygroscopic paper made by Kiso Co. (Nagoya, Japanese), and the paper was kept upright near the lingual for 10 seconds to measure moisture transuding from the lower part [15].

4) Statistical analysis

The collected data was aggregated and analyzed using the IBM SPSS ver. 24.0 (IBM Co., Armonk, NY, USA).

To identify statistical significance, changes in PHP, PMA, GBI, oral moisture and coated tongue indices of the Control Group and Experimental Groups were examined using a one-way ANOVA.

Results

1. Result of PHP index by dentifrice ingredient

The PHP index before the experiment (base) was Control Group 2.83 ± 0.57 , Experimental Group 1 2.91 ± 0.55 , Experi-

Table 1. Comparison of PHP Index according to dentifrice

Group Number	Base	1 week	2 weeks	4 weeks	
A	31	2.83 ± 0.57	2.83 ± 0.52^b	2.77 ± 0.54^b	2.72 ± 0.52^b
B	30	2.91 ± 0.55	2.82 ± 0.51^b	2.82 ± 0.51^b	2.67 ± 0.53^b
C	33	2.99 ± 0.48	2.78 ± 0.52^b	2.72 ± 0.45^b	2.58 ± 0.49^b
D	26	2.83 ± 0.45	2.34 ± 0.37^a	2.29 ± 0.37^a	2.05 ± 0.35^a
p		0.547	0.001	0.001	0.001

Values are presented as mean \pm standard deviation. p-value obtained from the one-way ANOVA. PHP: patient hygiene performance, A: controlled group, B: experimental group 1, C: experimental group 2, D: experimental group 3. ^{a,b}The same characters was not significant by Turkey's multiple comparison.

Table 2. Comparison of GB Index according to dentifrice

Group Number	Base	1 week	2 weeks	4 weeks	
A	31	9.10 ± 1.40	9.03 ± 1.35^c	8.52 ± 1.18^c	8.42 ± 0.97^c
B	30	8.34 ± 1.48	8.13 ± 1.38^b	7.83 ± 1.26^{bc}	7.24 ± 1.02^b
C	33	8.38 ± 1.48	7.82 ± 1.31^b	7.24 ± 1.10^b	6.94 ± 0.87^b
D	26	8.50 ± 1.17	5.15 ± 0.92^a	5.73 ± 0.87^a	5.31 ± 0.97^a
p		0.126	0.001	0.001	0.001

Values are presented as mean \pm standard deviation. p-value obtained from the one-way ANOVA. GB: gingival bleeding, A: controlled group, B: experimental group 1, C: experimental group 2, D: experimental group 3. ^{a,b,c}The same characters was not significant by Turkey's multiple comparison.

mental Group 2 2.99 ± 0.48 and Experimental Group 3 2.83 ± 0.45 , and showed no statistically significant difference between the Groups ($p > 0.05$). After one week, the averages of the Control Group, Experimental Group 1 and Experimental Group 2 decreased, but there was no statistically significant difference ($p > 0.05$), while the Experimental Group 3 exhibited an extremely significant difference with 2.34 ± 0.37 ($p < 0.01$). After two and four weeks, the averages of the Control Group and Experimental Group 1 and 2 decreased, but did not show a significant difference ($p > 0.05$), while Experimental Group 3 displayed an extremely significant difference ($p < 0.01$), shown in Table 1.

2. Result of GB index by dentifrice ingredient

The GBI index before the experiment (base) was Control Group 9.10 ± 1.40 , Experimental Group 1 8.34 ± 1.48 , Experimental Group 2 8.38 ± 1.48 and Experimental Group 3 8.50 ± 1.17 , showed no statistically significant difference ($p > 0.05$). After one week, two weeks and four weeks, the averages of all of Control Groups and Experimental Groups decreased and exhibited an extremely significant difference ($p < 0.01$), shown in Table 2.

3. Result of tongue coating index by dentifrice ingredient

The tongue coating index before the experiment (base) was Control Group 3.71 ± 1.42 , Experimental Group 1 4.14 ± 1.57 , Experimental Group 2 3.85 ± 1.23 and Experimental Group 3 4.38 ± 1.24 , that showed no statistically significant difference ($p > 0.05$). After one week, the Control Group increased to 3.81 ± 1.40 and did not show a significant difference ($p > 0.05$), and the Experimental Group 1 decreased to 3.97 ± 1.57 , but also did not show a significant difference ($p > 0.05$). On the other hand, Experimental Groups 2 and 3 dropped to 3.47 ± 1.19 and 2.84 ± 1.12 , respectively, and demonstrated a significant differ-

Table 3. Comparison of coated tongue Index according to dentifrice

Group Number	Base	1 week	2 weeks	4 weeks	
A	31	3.71 ± 1.42	3.81 ± 1.40^b	3.65 ± 1.31^b	3.65 ± 1.45^b
B	30	4.14 ± 1.57	3.97 ± 1.57^b	3.48 ± 1.86^b	2.86 ± 1.27^b
C	33	3.85 ± 1.23	3.47 ± 1.11^a	3.00 ± 1.11^a	2.32 ± 1.07^b
D	26	4.38 ± 1.24	2.84 ± 1.12^a	2.27 ± 1.12^a	1.62 ± 0.80^a
p		0.255	0.011	0.001	0.001

Values are presented as mean \pm standard deviation. p-value obtained from the one-way ANOVA. A: controlled group, B: experimental group 1, C: experimental group 2, D: experimental group 3. ^{a,b}The same characters was not significant by Turkey's multiple comparison.

Table 4. Comparison of coated oral humidity degree according to dentifrice

Group	Number	Base	1 week	2 weeks	4 weeks
A	31	2.38±0.6	2.38±0.68	2.33±0.70	2.29±0.72 ^a
B	30	2.41±0.62	2.49±0.66	2.52±0.66	2.50±0.68 ^a b
C	33	2.55±0.74	2.53±0.75	2.58±0.77	2.68±0.79 ^a b
D	26	2.33±0.58	2.43±0.52	2.65±0.51	2.97±0.55 ^b
p		0.614	0.807	0.306	0.030

Values are presented as mean ± standard deviation. p-value obtained from the one-way ANOVA. A: controlled group, B: experimental group 1, C: experimental group 2, D: experimental group 3. ^{a,b}The same characters was not significant by Turkey's multiple comparison.

ence ($p < 0.05$). After two weeks, the Control Group and Experimental Group 1 decreased to 3.65 ± 1.31 and 3.48 ± 1.86 , respectively, but did not show a significant difference ($p > 0.05$), whereas Experimental Groups 2 and 3 fell to 3.00 ± 1.11 and 2.27 ± 1.12 , respectively, and showed a significant difference ($p < 0.01$). After four weeks, no change was observed in the Control Group with 3.65 ± 1.45 , displaying no significant difference ($p > 0.05$), Experimental Groups 1 and 2 dropped to 2.86 ± 1.27 and 2.32 ± 1.07 , showed no significant difference ($p > 0.05$), and Experimental Group 3 decreased to 1.62 ± 0.80 , showing an extremely significant difference ($p < 0.001$), shown in Table 3.

4. Results of the oral moisture index by dentifrice ingredient

The oral moisture index before the experiment (base) was Control Group 2.38 ± 0.67 , Experimental Group 1 2.41 ± 0.65 , Experimental Group 2 2.55 ± 0.74 and Experimental Group 3 2.33 ± 0.58 , that showed no statistically significant difference ($p > 0.05$). After one and two weeks no statically significant difference was found ($p > 0.05$). After four week, the Control Group recorded 60.74 ± 12.40 , Experimental Group 1 recorded 56.07 ± 10.02 , Experimental Group 2 recorded 54.18 ± 11.63 and the Experimental Group 3 recorded 57.62 ± 10.61 showing a significant difference between Control Groups and Experimental Groups ($p < 0.01$), shown in Table 4.

Discussion

The most general and effective way to control the oral environment and prevent dental disease by brushing the teeth, for it not only can suppress the formation of dental plaque, a common cause of dental caries and periodontal disease, but preventive and curative effects against such diseases can be ex-

pected depending on the components of difference used for toothbrushing. Addy et al. [16] argued that because general toothpaste is effective in controlling the growth of dental plaque on the tooth surface, but cannot stop the formation of dental plaque at marginal gingiva, various agents should supplement difference. Also, interest in difference for home use is high, encouraging the role of difference to evolve from a mere foreign body remover to a remedy with preventive effects, and due to heightened concern for antibacterial substances extracted from natural products in recent years, the necessity of developing preventive and therapeutic agents for periodontal disease using such substances is also growing.

Recently, besides preventing periodontal disease through controlling dental plaque, diverse efforts have also been made such as taking various agents or substances, applying them to the gingiva, using them when brushing teeth or adding them to dentifrice. Accordingly, the author decided to conduct this study to investigate whether general dentifrice supplemented herbal medicines, which can be used for a long time without side effects, can alleviate early gingivitis.

This study was performed for four weeks between March and April, 2017 on 120 males and females 20 years old or older with early gingivitis. A general dentifrice supplemented with dental type silica and sodium fluoride was distributed to the Control Group, the Control Group's dentifrice was supplemented with *Panax notoginseng* to Experimental Group 1, Experimental Group 1's dentifrice was supplemented with tranexamic acid and magnoliae cortex to Experimental Group 2 and Experimental Group 2's dentifrice supplemented with bamboo salt to Experimental Group 3, and they were asked to use it for four weeks.

If we compare the Control Group and Experimental Groups regarding changes in the PHP index, a significant difference ($p < 0.01$) was observed in Experimental Group 3 a week after using toothpaste. Also, an extreme significant difference was found between the Control Group and Experimental Groups ($p < 0.01$) in terms of GB indices.

Kim et al. [3] presented that dental plaque and gingival indices of an experimental group that used toothpaste containing magnoliae cortex and ginkgo biloba leaf extract improved compared to those of the control group. This result agrees with research conducted by Mankodi et al. [17] on a correlation between the formation of dental plaque and the occurrence of gingivitis.

Also, in terms of an effect against oral inflammation, Min et al. [18] proved that the gingival index of their study subjects decreased when they used a dentifrice containing bamboo salt and herbal medicine extracts for toothbrushing for two months, and Park and Choi [19] claimed that a dentifrice supplemented with

bamboo salt and herbal medicine extracts is effective in suppressing gingivitis as dental plaque and gingivitis indices of their study subjects dropped significantly when they used it for three months. Busuttill et al. [20] found that fibrinolysis and complement activation triggered by plasmin create fibrin degradation products and anaphylatoxin that aggravates inflammations by increasing the vasopermeability, and tranexamic acid can considerably shorten bleeding time by strongly suppressing the plasmin activator. Komakine et al. [8] reported that saponins and sterol glycoside in *Panax notoginseng* inhibit the activation of macrophages and have an antioxidant and anti-inflammatory effects.

As for changes in the coated tongue index, a significant difference was observed between the Control Group and Experimental Groups ($p < 0.05$): the index of Experimental Groups 1, 2, and 3, which used a dentifrice supplemented with *Panax notoginseng*, magnoliae cortex tranexamic acid and bamboo salt, was lower than that of the Control Group, which used general toothpaste, proving that supplements are effective in cleaning the tongue.

Jang et al. [21] reported that the magnoliae cortex is less effective than that of tetracycline and chlorhexidine, but more effective than Listerine in terms of its antibacterial effect, and clearly more effective than other herbal medicines, and Lee et al. [22] suggested that herbal medicines such as magnoliae cortex have an excellent antibacterial effect after assessing their antibacterial activity against *P. gingivalis*, a periodontal pathogen.

The author conducted this study to confirm the possibility of improving early gingivitis through a dentifrice supplemented with herbal medicine, and found that using a dentifrice containing *Panax notoginseng*, magnoliae cortex and bamboo salt is effective in relieving early gingivitis. Accordingly, it is thought that an expansive long-term study is necessary for observing such substances' the inhibitory effect against the progression of periodontal disease in the future.

Conclusion

To assess the effect of a dentifrice supplemented with *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt on early gingivitis, the author divided 120 people over 20 years old into Control Groups and Experimental Groups and distributed four differently made toothpaste to them. The participants were then asked to use distributed toothpaste for four weeks to measure PHP, GB indices before the survey test began, 1 week, 2 weeks and 4 weeks after using it, and the author arrived at the concluding as follows:

1. An extremely significant difference in the PHP index was observed between the Control Group and Experimental Groups

($p < 0.01$): difference containing all four ingredients, *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt, was most effective in cleaning the tooth surface as the PHP index of Experimental Group 3, which used a dentifrice containing all four of them, was lower than that of other groups.

2. An extremely significant difference in the GBI index was noted between the Control Group and Experimental Groups ($p < 0.01$): gingival bleeding in Experimental Groups 1, 2, and 3, which used difference containing *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt, lessened more than Control Group that used general difference.

3. A significant difference in the coated tongue index was seen between Control Group and Experimental Groups ($p < 0.05$), and *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt was observed to be effective in cleaning the tongue: the coat on tongue of the participants in Experimental Groups 1, 2, and 3, who used difference containing *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt, decreased more than those in the Control Group that used general difference.

4. As a result of measuring oral moisture with saliva hygroscopic paper to confirm the degree of oral dryness, a no significant difference was found between Control Group and Experimental Groups after one and two weeks ($p > 0.05$), There has been a significant difference in Experimental Groups 1, 2, and 3, who used difference containing *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt, decreased more than those in the Control Group that used general difference four weeks ($p < 0.05$).

5. Significant changes in PHP, GBI indices and coated tongue were observed in Experimental Group 3 that used (D) difference containing *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt for four weeks ($p < 0.05$).

Based on the foregoing results, it is recommended to use difference supplemented with *Panax notoginseng*, magnoliae cortex, tranexamic acid and bamboo salt to treat early gingivitis.

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