

Research Report

Betel leaf toothpastes inhibit dental plaque formation on fixed orthodontic patients

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ABSTRACT

Background: Brackets, archwires, ligatures, and other fixed orthodontic appliance components complicate the use of conventional oral-hygiene measures. This often results in significant plaque accumulation around the bracket bases. The addition of betel leaf extract in toothpaste is expected to inhibit the growth of dental plaque. **Purpose:** The purpose of this study was to evaluate the effect of betel leaf toothpaste in inhibiting plaque formation on the fixed orthodontic patients. **Methods:** This study was done on dental student of Airlangga University aged 18–24 years, have been wearing fixed orthodontic appliances for 1–2 years, have no systemic diseases. The samples were divided into two groups, consisting of 20 samples. First group of samples brushed their teeth with betel leaf toothpaste and the second using placebo. The subjects were instructed to brush their teeth using Scrub method until reaching zero (0) scor of orthodontic plaque index (OPI). Plaque scores were taken again 4 hours after brushing. The statistical analysis was done by using paired t test. **Results:** The average of accumulated plaque on group that use betel leaf toothpaste was 25.54 and placebo was 41.09. The result showed that there was significant difference in plaque accumulation between the group with betel leaf toothpaste and placebo 4 hours after brushing ($p = 0.001$). **Conclusion:** In conclusion, betel leaf toothpaste is effective in inhibiting the dental plaque formation on the fixed orthodontic patients.

Key words: Betel leaf toothpaste, dental plaque, fixed orthodontic appliances

ABSTRAK

Latar belakang: Bracket, kawat busur, kawat ligatur dan komponen peranti ortodonti cekat yang lain mempersulit pembersihan gigi secara konvensional. Hal ini sering menyebabkan terjadinya akumulasi plak di sekitar dasar braket. Penambahan ekstrak daun sirih yang mempunyai efek bakterisid pada pasta gigi diharapkan dapat menghambat pertumbuhan plak. **Tujuan:** Tujuan penelitian ini adalah untuk mengevaluasi efek pasta gigi mengandung ekstrak daun sirih dalam menghambat pembentukan plak pada pemakai peranti ortodonti cekat. **Metode:** Penelitian dilakukan pada mahasiswa Fakultas Kedokteran Gigi Universitas Airlangga berusia 18–24 tahun, sudah memakai peranti cekat ortodonti selama 1–2 tahun, tidak mempunyai penyakit sistemik. Sampel dibagi dalam dua kelompok, masing-masing 20 sampel. Sampel kelompok pertama menyikat gigi dengan pasta gigi yang mengandung daun sirih dan kelompok kedua dengan pasta gigi placebo memakai metode Scrub. **Pembersihan gigi dilakukan sampai didapatkan skor nol (0) orthodontic plaque index. Empat jam setelah itu skor plak diukur kembali. Data dianalisis dengan uji T berpasangan. Hasil:** Rerata pengumpulan plak pada pemakai pasta gigi mengandung daun sirih adalah 25,54 dan placebo adalah 41,09. Analisis data menunjukkan adanya perbedaan bermakna antara kedua kelompok ($p = 0,001$). **Kesimpulan:** Dapat disimpulkan bahwa pasta gigi mengandung daun sirih efektif dalam menghambat pertumbuhan plak pada pemakai peranti ortodonti cekat.

Kata kunci: Pasta gigi daun sirih, plak gigi, peranti ortodonti cekat

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part of the labial and buccal teeth with brackets except for posterior teeth which had bands. Tooth surface being examined was divided into three areas by dividing the tooth surface horizontally (Figure 1).

The plaque of every area was recorded (Figure 2). Area III (occlusal) was multiplied with 1, area I (cervical) was multiplied with 2 and area II (central) was multiplied with 3, and then the total score were found. The OPI were determined as follows:

$$\frac{\text{Total score}}{\text{Total tooth being examined} \times 6} = \text{OPI}$$

Plaque score was OPI multiplied 100. The criteria were: good: 0-25, average: 26-50, poor: >50

On the second visit, three days after the first visit, subjects were asked to brush their teeth with placebo tooth paste until got the score zero (0). Like the first visit, after four hours of fasting, plaque score was measured again. Data was collected and statistical analysis was done by using paired t test.

RESULTS

The result of this study could indicate that most of samples were in average criterion (60% of samples brushed with betel leaf toothpastes and 85% of samples brushed with placebo). Good criteria were found on 40% samples brushed with betel leaf toothpastes and only 5% samples brushed with placebo (Table 1).

Table 1. Criteria of plaque with orthodontic plaque index (OPI)

Criteria	Betel leaf toothpaste	Placebo
Good	8 (40%)	1 (5%)
Average	12 (60%)	17 (85%)
Poor	-	2 (10%)
Total	20 (100%)	20 (100%)

It was shown that the mean of plaque scores in group brushed with placebo was higher (41.09) than the group brushed with betel leaf toothpastes (25.54) (Table 2).

Before the paired t test was done to determine the significance of difference, this data needed to conduct normality test using Kolmogorov-Smirnov test. The result for group brushed with placebo was 0.978 (p > 0.05) and the group brushed with betel leaf toothpastes was p = 0.980 (p > 0.05). It means that both of the groups had normal distribution.

Table 2. Average plaque score in each group

Group	Total	Mean
Betel leaf toothpaste	20	25.54
Placebo	20	41.09

From the result of paired t test, it is known that the p value is 0.001 < 0.05 so the data was significant different. Based on this analysis it can be seen that there was significant different between the plaque score of subject who brush their teeth using betel leaf toothpaste and placebo. The plaque score in subject using placebo was higher than subject who brushed with betel leaf toothpaste.

DISCUSSION

This study was done on 20 subjects with fixed orthodontic appliances who were asked to brush their teeth until got the score zero (0) to make homogenized samples before treatment. Dental plaque can be formed within 4 hour after tooth cleaning,⁹ so in this study, samples was asked to wait for 4 hours without eating, rinsing or drinking before the second measurement of plaque scores were done.

It was shown that the mean of plaque scores in group brushed with placebo was higher (41.09) than the group brushed with betel leaf toothpastes (25.54). From the paired t test analysis, it is known that the p value = 0.001 (p < 0.05), so the results showed that the plaque formation on fixed orthodontic patients brushed with placebo was significantly higher than the subject brushed with betel leaf toothpaste. The result are consistent with previous study that says that the betel leaf extract may inhibit the formation of colonies of *Streptococcus mutans* in plaque.¹⁰ Betel leaf extract also reduced the adherence of bacteria to the biofilm contained a layer on the surface of the tooth. This reduction is possible due to alteration of protein on the cell surface of bacteria by extract of betel leaf.

Based on laboratory test results, it was found that betel leaf extract in the toothpaste had chemical components as much as 31.80% flavonoids, alkaloids as much as 17.05%, polyphenate as much as 21.41%, anthocyanin as much as 8.62%, and oil essential as much as 2.86%. One of the largest classes of naturally-occurring polyphenolic compounds are flavonoids. A number of flavonoid, shows antibacterial and antiviral activity.¹¹ They are known to be synthesized by plants in response to microbial infection and found in vitro to be effective antimicrobial substances against a wide array of microorganisms. Their activity is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell walls. More lipophilic flavonoids may also disrupt microbial membranes.^{12,13}

Alkaloids are heterocyclic nitrogen compounds.¹³ Purified alkaloids as well as their synthetic derivatives are used as medicinal agents for their various biological

effects such as analgesic, antispasmodic and bactericidal.¹² Anthocyanins and polyphenate is one kind of phenol which is both antibacterial and antioxidant.¹³ Several mechanisms of action in the growth inhibition of bacteria are involved, such as destabilization of cytoplasmic membrane, permeabilization of plasma membrane, inhibition of extracellular microbial enzymes, direct actions on microbial metabolism and deprivation of the substrates required for microbial growth.¹⁵

Essential oil of betel leaf is an effective antibacterial agent.¹⁶ Essential oil of betel leaf with phenol components include: carvacol, cineol, cariofilen, eugenol, and chavicol. Components of these phenols have a very strong antiseptic power. Bactericidal properties of carvacol efficacy has five times more powerful than other phenol component. Carvacol and cineol has the same efficacy as eugenol, which is antiseptic and topical analgesic. Cariofilen is antiseptic and local anesthetic.¹⁷ Chavicol is a major phenolic compound present in the aqueous extract of the *Piper betle* leaf. The compound is better known for its antioxidant and anticancer properties.¹⁸ Chavicol can behave as a disinfectant and antifungal. This is an influential component in inhibiting the growth of dental plaque.¹⁹ From the statement above, betel leaf has many ingredients with antibacterial, antiseptic, disinfectant, and anti fungal effect, which makes the plaque formation on fixed orthodontic patients brushed with betel leaf toothpaste was more difficult than with placebo.

Placebo also can reduce plaque accumulation in orthodontic fixed patients. This can be caused by mechanical process that occurs, ie brushing using a toothbrush. Another possibility would be caused by detergent (sodium lauryl sulfate) and abrasive (calcium carbonate) contained in placebo. Detergent makes foam and also has antibacterial effect. However, the use of placebo in reducing plaque on fixed orthodontic patients are not as effective as the betel leaf toothpaste.

In conclusion, betel leaf toothpastes can inhibit dental plaque formation on fixed orthodontic patients. Mechanical prevention of dental plaque formation on fixed orthodontic patients by tooth brushing betel leaf toothpaste is effective.

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