

EFFECT OF AN ESSENTIAL OIL-CONTAINING DENTIFRICE ON ESTABLISHED PLAQUE AND GINGIVITIS

P Kraivaphan¹ and C Amornchat²

¹Department of Pharmacology, ²Department of Oral Microbiology,
Faculty of Dentistry, Mahidol University, Thailand

Abstract. A six-months, double-blind, parallel, clinical study was conducted to evaluate the efficacy of an essential oil containing dentifrice on established plaque and gingivitis compared with a placebo dentifrice. A total of 104 subjects were stratified into two groups according to baseline Quigley-Hein Plaque Index scores and Loe-Silness Gingival Index scores. Each group was randomly assigned to use either an essential oil dentifrice or placebo dentifrice. The subjects were instructed to brush their teeth in the customary manner for 1 minute, twice daily, with the provided dentifrice using a soft-bristle toothbrush. After six months, the essential oil containing dentifrice gave a 25.4% reduction ($p < 0.001$) in supragingival plaque accumulation and a 19.5% reduction ($p < 0.001$) in gingivitis compared to the placebo dentifrice.

Keywords: essential oil, dentifrice, established plaque, gingivitis

INTRODUCTION

Dental plaque is a microbial biofilm formed by microorganisms tightly bound to each other and to tooth surfaces by means of an extracellular matrix consisting of polymers of both host and microbial origin (Marsh, 2004). Dental bacterial plaque plays an important role in the etiology of gingivitis and periodontitis (Page, 1986; Kornman and Loe, 1993; Madianos *et al*, 2005). A number of approaches to preventing dental plaque and reducing gingivitis and periodontitis have been introduced, most have focused on antiplaque and antimicrobial agents. The most

extensively used antiplaque agent in oral care products is triclosan. Dentifrices and mouthrinses containing triclosan have been shown to provide a clinically significant benefit in reducing plaque and gingival inflammation (Tiratana *et al*, 1993, 1994, 1995; Panagakos *et al*, 2005; Muller *et al*, 2006). The use of plants and herbs has for centuries been thought beneficial in the prevention and treatment of oral diseases. The therapeutic action of these plant ingredients could be due to chemical constituents such as alkaloids, tannins and essential oils (Elvin, 1980).

Our previous *in vitro* studies of plant extracts have shown a strong potential for use in inhibiting oral bacteria (Amornchat *et al*, 1991a,b; Kraivaphan *et al*, 1992, 1994). There have been several studies regarding the efficacy of essential oils on oral bacteria (Yousef and Tanil, 1980; Meeker and Linke, 1988; Saeki *et al*, 1989). The

Correspondence: Assoc Prof Petcharat Kraivaphan, Department of Pharmacology, Faculty of Dentistry, Mahidol University, Yothee Road, Bangkok 10400, Thailand.
Tel: 66 (0) 2203 6555 ext 6481
E-mail: dtpvp@mahidol.ac.th

concept of utilizing natural products to replace synthetic agents has heightened the public's interest in the field of oral health, increasing the selling of oral hygiene products that contain herbal ingredients worldwide. Many clinical studies have demonstrated the efficacy of mouthrinse containing essential oils in reducing plaque and gingival inflammation (Charles *et al*, 2004; Sharma *et al*, 2004; Albert-Kiszely *et al*, 2007; Fine *et al*, 2007; Cortelli *et al*, 2009). However, to date, very little information is available concerning dentifrice containing essential oils against plaque and gingivitis.

The purpose of this clinical study was to evaluate the efficacy of a dentifrice containing essential oils against plaque and gingivitis compared to a placebo dentifrice.

MATERIALS AND METHODS

Healthy adult male and female subjects aged 20 and 60 years were selected for the study. Selection criteria were to have at least 20 uncrowned natural teeth (excluding third molars) with no advanced periodontal disease. Subjects were excluded if they had orthodontic appliances, partial removable dentures, severe dental caries, oral pathology or if they had undergone antibiotic or anti-inflammatory therapy any time during the one month prior to the study. Female subjects were neither pregnant nor breast feeding. Prior to participating, all volunteer subjects gave written informed consent.

Each subject was examined for the presence of supragingival plaque and gingivitis on the facial and lingual surfaces of the teeth. The clinical scoring procedure used to measure plaque formation was the Turesky *et al* (1970) modification of the Quigley-Hein Plaque Index (Quigley and

Hein, 1962). This index uses erythrosine disclosing solution and scores plaque formation on a numerical scale ranging from 0 to 5 according to the following criteria: 0 = no plaque present; 1 = separate flecks of plaque at the cervical margin; 2 = a thin, continuous band of plaque (up to 1 mm) at the cervical margin; 3 = a band of plaque wider than 1 mm but covering less than one-third of the surface; 4 = plaque covering at least one-third but less than two-thirds of the surface; 5 = plaque covering more than two-thirds of the surface. The scoring was done on 6 areas per tooth: mesio-facial, mid-facial, disto-facial, mesio-lingual, mid-lingual and disto-lingual. A modified Quigley-Hein Plaque Index for each subject was determined by adding the individual plaque scores and dividing this sum by the total number of areas scored. A Plaque Severity Index was used to record the sites of a tooth surface with high Plaque Index scores (3, 4 or 5). A Plaque Severity Index was calculated for each subject by dividing the total number of tooth sites with a high score (3, 4 or 5) by the total number of tooth sites scored in the entire mouth.

The clinical scoring procedure used to measure gingivitis was the Talbott *et al* (1977) modification of the Loe-Silness Gingival Index (Loe and Silness, 1963). This index scores gingivitis on a numerical scale ranging from 0 to 3 according to the following criteria: 0 = absence of inflammation; 1 = mild inflammation, slight change in color and texture but no bleeding on probing; 2 = moderate inflammation, moderate glazing, redness, edema and hypertrophy with bleeding on probing; 3 = severe inflammation, marked redness and hypertrophy, ulceration and a tendency to spontaneously bleed. The scoring was done on 6 areas of each tooth: mesio-facial, mid-facial, disto-facial,

Table 1

Baseline characteristics and scores for plaque, plaque severity, gingivitis and gingivitis severity indexes in subjects completing the 6 month study.

Dentifrice group	Number of subjects			Age		Plaque index (mean±SD)	Plaque severity index (mean±SD)	Gingivitis index (mean±SD)	Gingivitis severity index (mean±SD)
	M	F	Total	Mean	Range				
Placebo	25	27	52	37.03	(23-55)	3.01±0.42	0.65±0.13	1.76±0.55	0.53±0.24
Essential oil	25	27	52	37.57	(21-55)	2.93±0.52	0.66±0.14	1.80±0.36	0.54±0.17

mesio-lingual, mid-lingual and disto-lingual. A Loe-Silness Gingival Index for each subject was determined by adding all the individual scores and dividing this sum by the total number of areas scored. A Gingivitis Severity Index was calculated for each subject by counting the number of sites with a high score (2 or 3), then dividing this total by the total number of sites scored in the entire mouth.

A total of 104 subjects with Plaque Index scores of 1.5 or greater and a Gingival Index score of 1.0 or greater on initial examination were entered into this clinical study. The subjects were divided into two equal groups according to their baseline Plaque Index and Gingival Index scores. One group was randomly assigned to use an essential oil dentifrice, the second group was assigned to use a placebo dentifrice. The two dentifrices were given to the subjects in identical plain white tubes labeled only with a code number. The study was a double blind study.

All subjects were instructed to brush their teeth in their usual manner for 1 minute twice daily in the morning and evening. They were instructed to use only their assigned dentifrice and soft-bristle toothbrush for the entire 6 month duration of the study. The dentifrices and

toothbrushes were given to the subjects on a regular basis during the study. After 6 months use, the subjects were again evaluated for plaque formation and gingivitis by the same dental examiner using the same clinical scoring system.

RESULTS

All 104 subjects completed the 6 month study. Table 1 shows the baseline characteristics of subjects. There were 25 males and 27 females in each dentifrice group. The mean age was 37.0 years for the placebo dentifrice group and 37.6 years for the essential oil dentifrice group. The baseline mean scores for plaque, plaque severity, gingivitis and gingivitis severity index in the placebo group were 3.01, 0.65, 1.76 and 0.53, respectively, and in the essential oil group were 2.93, 0.66, 1.80 and 0.54, respectively. There were no significant differences between the two groups in age, sex, baseline plaque, plaque severity, gingivitis and gingivitis severity index scores ($p>0.05$, ANOVA).

Comparisons between the mean plaque, plaque severity, gingivitis and gingivitis severity index scores for the two dentifrice groups after 6 months use of their assigned dentifrices are presented in Tables 2 and 3. The placebo group had

Table 2
Comparison of mean plaque and plaque severity indexes for the two dentifrice groups after 6 months.

Dentifrice group	Plaque index		Plaque severity index	
	Mean±SD	Percent reduction	Mean±SD	Percent reduction
Placebo	2.76±0.42		0.53±0.13	
Essential oil	2.06±0.49	25.4	0.29±0.14	45.3

Table 3
Comparisons of mean gingivitis and gingivitis severity indexes for the two dentifrice groups after 6 months.

Dentifrice group	Gingivitis index		Gingivitis severity index	
	Mean±SD	Percent reduction	Mean±SD	Percent reduction
Placebo	1.59±0.46		0.48±0.22	
Essential oil	1.28±0.18	19.5	0.30±0.13	37.5

mean plaque, plaque severity, gingivitis and gingivitis severity index scores of 2.76, 0.53, 1.59 and 0.48, respectively, and the essential oil group had 2.06, 0.29, 1.28 and 0.30, respectively; the essential oil dentifrice caused 25.4, 45.3, 19.5 and 37.5% reductions in mean plaque, plaque severity, gingivitis and gingivitis severity scores, respectively, compared to placebo dentifrice ($p < 0.001$, ANOVA).

DISCUSSION

This double blind, six month, clinical study evaluated a dentifrice containing essential oils compared to a placebo dentifrice, for their effect on existing supragingival plaque and gingivitis. The results of the present study indicate twice daily use of the essential oil dentifrice had a clinically beneficial effect by providing a

25.4% reduction in supragingival plaque formation, a 45.3% reduction in plaque on tooth surfaces with higher plaque formation, a 19.5% reduction in gingivitis and 37.5% fewer sites with severe gingival disease, compared to placebo. No side effects were observed on oral soft or hard tissue. This difference in efficacy is likely due to the essential oils used in this dentifrice formulation.

Essential oils are volatile odorous mixtures of hydrocarbons, alcohols, acids, esters, aldehydes, ketones, phenols, phenol ethers and various nitrogen products. They usually constitute the savory and odorous components of the plant in which they exist. They are obtained from plant material or may be produced synthetically. The essential oils in this test consisted of thymol, eugenol and eucalyptus oils. Thymol is a phenolic an-

tiseptic with antibacterial and antifungal activity (Garg and Dengre, 1988; Didry *et al*, 1994). It is used chiefly as a deodorant in mouthwashes and gargles and has been used topically in the treatment of skins disorders. Eugenol, an antiseptic and anodyne, is the essential chemical in clove oil. It is used in protective packs after excision of gingival tissue and is found in some temporary cements. It has been used as an antiseptic in root canal fillings and for temporary relief of toothache (Meeker and Linke, 1988; Shapiro *et al*, 1994). Antibacterial and antifungal activities of essential oils, including eucalyptus oil, have been reported (Yousef and Tanil, 1980; Patnaik *et al*, 1995). Eucalyptus oil has been used as a flavoring agent, an expectorant in respiratory disorders and an ingredient in many preparations of oral hygiene products. Since natural products have captured the attention of the public, the number of oral hygiene products containing herbal ingredients has increased worldwide.

In regard to the clinical effect of dentifrice containing a combination of essential oils, the results of this study are consistent with those of other studies of dentifrices and mouthrinses containing essential oils as active ingredients (Coelho *et al*, 2000; Fischman and Coelho, 2001; Stoeken *et al*, 2007). Further investigations are needed for the potency of formulations and the interaction of the different ingredients. Further studies should be undertaken to gain more information about the mechanisms of plaque and gingivitis control using essential oil containing oral care products.

In conclusion, this study provides additional evidence that essential oil containing dentifrice has significant benefit in reducing of plaque and gingivitis after using for 6 months.

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