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Pineapple Fruit and Stem Chewing PreventsDental Plaque pH Drop after Meals

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***Abstract* - Eating Fruit has long believed given good benefit not only for the body but also for dental health. Any sugar contact with the teeth after meals will make a pH drop in dental plaque which can lead to enamel demineralization and tooth decay in a period of time. Pineapple has Bromelain as antibacterial agent and mostly found in the stem and at small amount in the fruit. This research conducted to assess the effect of Pineapple chewingto the dental plaque pH and to compare the effect of pineapple fruit and stem chewing on dental plaque pH. We recruited 10 subjects (aged 19-22 years) with free caries to chewed 100 grams of pineapple fruit and 2 grams of pineapple stem after eating plaque inducer meals. Dental plaque were collected at 4 consecutive time (before chewing pineapple, 25 minutes after chewing, 50 minutes after chewing and 75 minutes after chewing) followed by pH measurement of the dental plaque. Our finding showed that the Dental plaque pH drop from 6.1 to 5.7 for control while for pineapple fruit group the pH drop from 6.35 to 6.04 and for Pineapple stem group were 6.20 to 6.09. When compared the Dental plaque pH after Pineapple chewing between the 100 grams of fruit and 2 gram of stem, no significant difference were found. But when compared with control (without Pineapple chewing), significant difference were found at 25 minutes after pineapple stem (*p=0.021*) and at 75 minutes after Pineapple fruit (*p=0.005*) and Pineapple stem (*p=0.012*) chewing. Chewing fruit was effective to prevent the Dental plaque pH drop after eating meals. Chewing 2 grams of pineapple stem showed no significant difference with chewing 100 grams of pineapple fruit.**

Keywords: Pineapple fruit; pineapple stem; dental plaque, pH

I. INTRODUCTION

Dental plaque is a sticky soft layer surrounding the teeth and oral mucosa[1]. Diverse community of microorganism are living and colonized in the dental plaque[2]. Dietary sugar-fermenting bacteria were involved in dental caries pathogenesis[3]. *S. mutans* is one of the bacteria that can ferment sucrose and other sugars to produce ATP and lactic acid as a waste product[4]. Frequent exposure to fermentable carbohydrates can lead toexcessive acid production and acidification of the dental plaque environment [5], [6].The critical pH drop that needed to demineralized the dental enamel was below 5.5 [7].

The saliva act as natural buffer to protect human teeth from environmental hazard such as the acid from oral bacterial fermentation [8]. But it takes time to recover to normal pH and when the sugar contact linger on dental teeth, the dental plaque pH will still drop [7]

Eating healthy such as fruit and vegetables has been promoted to increase good oral health[9]. One of the fruit that very common in Indonesia is pineapple (Ananascomosus Linn.). As a tropical fruit that belongs to the Bromeliaceae family,pineapplehas many benefit for health [10]. It is a common fruit yet affordable for people in Indonesia and has not only been valued for its sweet taste but also has been used for centuries to treat digestion problems and inflammation[11]. Pineapple contains considerable amount of potassium, calcium, vitamin C, carbohydrate, crude fibre, water and different minerals that helps in balanced nutrition [10]. 80 % of the protein in pineapple has proteolytic activity due to a protease known as Bromelain[12].

Bromelain in penapple effectively used for achieving healthy digestion, stimulates the immune system, improves cardiovascular conditions, and accelerates wound healing[13].

The bromelain can found in any part of the pineapple, mostly found in high amount in the stem of pineapple, but in small amount can also be found in the fruit body [12], [14].

The Bromelain found in pineapple is currently being used to treat and reduce swelling, bruising, inflammation and swelling from surgeries[15].Previous study also found that bromelain extract showed sensitivity at low concentration against potent oral pathogen [16].Due to the beneficial properties for oral health, pinapple consider as a phytotherapeutic agent, herbal products that can used effectively as a therapeutic agent [17].

A study at Medan, North Sumatera in 2020 has found that pineapple chewing were effectively reducing the dental plaque amount [11] and has been proven effectively against oral pathogenic bacteria [15]. But there were no evidence in the effect on dental plaque pH.The aim of this study was to assess the effect of pineapple chewing on dental plaque pH and to compare the effect of pineapple fruit and stem chewing on dental plaque pH.

II. RESEARCH METHODOLOGY

This was a quasi-experimental study with pre and post test control group design. Subjects aged 19-22 yearswere examined

and all with dental caries and calculus free were included, while orthodontic appliance user were excluded. A total of 10 subjects were selected for the study, and informed consent was obtained from all the subjects prior understanding the study protocol that have been explained.

The experiment was conducted on 3 part. Part I was for control, part II was pineapple fruit chewing and part III was pineapple stem chewing.

This research used theripe pineapple grew at local pineapple farm at Jambi. The Pineapple were peeled, washed, divided between the fruit and the stem and weighted. 100 grams of pineapple fruit and 2 grams of pineapple stem were prepared.

Dental plaque was collected using pre-weighted dental plaque scrapper and put in pre-weighted plastic cup. The amount of the dental plaque was noted and the dental plaque pH was measured using a pH-meter.

Each subjects were asked to brush their teeth until 0 plaque score, followed by eating plaque inducer meals. The dental plaque were collected from index teeth 10 minutes later and tested for pH1control, pH1 pineapple fruit and pH1 pineapple stem.

For control, the dental plaque were collected again and measured for pH for 3 times at 25 minutes, 50 minutes and 75 minutes after the pH1 measurement.

For part II and III, after the first pH measurement, the subject asked to chew the Pineapple fruit (part II) or pineapple stem (part III) for 1.5 minutes followed by dental plaque collecting and pH testing at 25 minutes, 50 minutes and 75 minutes after the chewing.

The pH value were collected and tabulated using MS Excel sheet and statistically analysed using IBM Spss statistics version 19.0. Normality of the data were tested using Shapiro-Wilktest. Comparison of pH score within the group was obtain using Friedman test followed by Post hoc Wolcoxon test. Wilcoxon test was also used to compare the pH score between groups with a p-value <0.05 to be considered statistically significant.

III. RESULTS

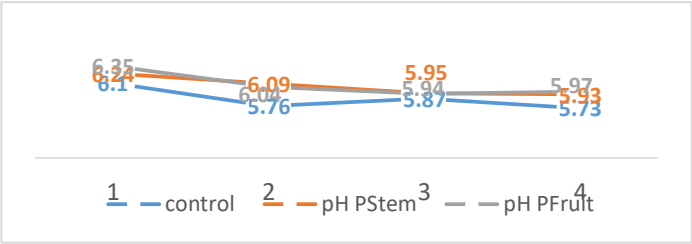
The mean score of dental plaque pH of all groups were stated in table 1.

Table 1.
Statistical analysis of pH measurement of Dental plaque within group

	N	Mean	SD (min-max)	*p-value*[*]
Control Group				
pH1 control	10	6.10	0.53 (5.6-7.2)	0.186
pH2 control	10	5.76	0.33 (5.4-6.3)	
pH3 control	10	5.87	0.19 (5.6-6.2)	
pH4 control	10	5.73	0.09 (5.6-5.9)	
Chewing Pineapple fruit Group				
pH1 PFruit	10	6.24	0.30 (6.0-7.0)	0.345
pH2 PFruit	10	6.09	0.12 (5.9-6.3)	
pH3 PFruit	10	5.95	0.15 (5.7-6.2)	
pH4 PFruit	10	5.93	0.12 (5.8-6.2)	
Chewing Pineapple Stem Group				
pH1 PStem	10	6.35	0.67 (5.5-7.3)	0.012
pH2 PStem	10	6.04	0.42 (5.6-6.5)	
pH3 PStem	10	5.94	0.15 (5.7-6.2)	
pH4 PStem	10	5.97	0.12 (5.8-6.2)	

Friedman test

The lowest pH score among all measurement were at control group from 25 minutes (pH 5.76), 75 minutes (pH 5.73) and 50 minutes (5.87) after eating plaque inducer snacks. Although there were pH drop below the pH 6 at control group, but no significant difference were found within the control group (*p value* = 0.186) and the pineapple fruit group (*p value* = 0.345). While significant difference were found within the Pineapple stem group (*p value* = 0.012).



Picture 1. The drop of pH at 1(10 minuts after eating); 2 (25 minutes later or after chewing Pineapple); 3 (50 minutes later or after chewing Pineapple); 4 (75 minutes later or after chewing Pineapple)

The graphic showed that after eating snacks, the pH of the dental plaque of all group was drop. From the graphic can be seen that the lowest drop of acidity below pH 6 in dental plaque was in control group. While the other two groups the pH measurement showed the score above pH 6.

Table 2.
Statistical analysis of pH measurement dental plaque between group

	Varieble	*p value*[*]
pH 1	Control >< P Fruit	0.514
	Control >< P Stem	0.475
	P Fruit >< P Stem	0.683
pH 2	Control >< P Fruit	0.067
	Control >< P Stem	0.021[‡]
	P Fruit >< P Stem	0.624
pH 3	Control >< P Fruit	0.348
	Control >< P Stem	0.403
	P Fruit >< P Stem	0.887
pH 4	Control >< P Fruit	0.005[‡]
	Control >< P Stem	0.012[‡]
	P Fruit >< P Stem	0.465

[*]Wilcoxon test
[‡] Significant *p value*

Statistical analysis showed in table 2 that no significant different at baseline pH measurement. After Chewing Pineapple, even there was a pH drop, but no significant different was found between the pineapple fruit and pineapple stem at 25 minutes (*p value* = 0.624), 50 minutes (*p value* = 0.887) and 75 minutes (*p value* = 0.465) after chewing the pineapple.

At 25 minutes after chewing pineapple, significant difference was found between pineapple stem and control group (*p value* = 0.021). While pineapple fruit has no significant difference compared to control. At 75 minutes after chewing pineapple, both pineapple fruit and stem showed significant difference compared to control with *p value* = 0.005 and *p value* = 0.012 respectively.

IV. DISCUSSION

Based on the result, there was a significant difference between chewing Pineapple fruit and control and between pineapple stem with control. Pineapple known for the Bromelain properties which is a proteolytic enzyme that effective in defeating the oral microbes [18]. Antibacterial activity of the Bromelain was effective against both anaerobic and aerobic microorganism such as *E coli, Porphyromonasgingivalis* and *Aggregatibacteractinomycetemcomitans*[14].

From graphic at picture 1, it showed that for all groups there were pH drops from time to time. After meals, the bacteria in dental plaque will fermenting the sugar and produce lactic acid as the waste product. Fermentable carbohydrate substrate plays the important role in dental caries pathogenesis[9]. Frequent sugar intake leads to pH drop of the dental plaque and a longer period of acid attack of the enamel can caused demineralization of the tooth structure[19]. This acidity can make the dental plaque drop and when it reach below critical pH of 5,5 it will start to dissolve the dental structure [3], [7].

The drop of the pH at Table 1 showed that the control group was the lowest compared to the Pineapple chewing group. The proteolytic enzyme of Bromelain in pineapple is proven as an antibacterial agent, antifungal agent. The antibacterial properties of the bromelain had effectively against cariogenic microorganism such as S.mutans and S.sanguinis[15].

Previous study were compared between Apple, guava and pineapple found that pineapple even has the strongest antimicrobial agent against pathogenic bacteria such as S.aureus, Klebsiella and E. faecaliscompared to the other fruits [20].

Pineapple extracted Bromelain has widely used as a terapeutic agent. In vivo and in vitro studies showed the anti-inflamatory effect by modulating the cell surface molecules and has been used to treat patient with bone fracture to reduce pain and swelling in a clinical trial[21].

Our study showed that 25 minutes after chewing pineapple, the pH drops were higher and significantliy different compared with the control group. Previous study found that Bromelain extracted from pineapple stem can break the bond of bacterial protein that can inhibit the growth of bacteria [14]. Bacteria is the main reason of pH drop in dental plaque as the waste product of sugar fermenting bacteria [22]. A previous study on a Karen population with low caries experience suggest that the population has low intake of sucrosesince the village located very remotely and only having natural growth food [4].

The highly valuable Bromelain has used in many ways for oral health. A study showed that a dentifrice containing Papain, Bromelain, Miswak and Neem has anti-plaque and anti-gingivitis effect compared to control dentifrice [23]. Another study also showed that Bromelain Enzyme from pineapple peel waste that used as a mouthwash with different concentration was effective in restricting the growth of *Streptococcus mutans* compared to clorhexidine 0.1% as positive control [24]. The proteolytic enzyme, catalase and polyphenol peroxidase of the Pineapple even used as boosting the result of the standard dental bleaching agent even with lower bleaching agent concentration [25].

The effect of chewing 2 grams of pineapple stem has no significant difference compared to chewing 100 grams of pineapple fruit. This can be answered by the amount of bromelain in pineapple stem was much higher than in the fruit. The stem bromelain is more alkaline and be the most abundant protease in pineapple tissue, while the fruit bromelain is an acidic protein [12].

V. CONCLUSION

The present study suggest that the pineapple chewing can prevent dental plaque pH dropafter eating snacks. No significant difference were found between chewing 2 grams of pineapple stem and 100 grams of pineapple fruit.

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