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The Effect of Chewing Apples (*Malus sylvestris mill.*) on The Plaque Index Among Elementary School Students

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ABSTRACT

Background: Oral health is an essential part of general health that influences quality of life. Dental plaque is a major factor causing caries and periodontal disease. Plaque control can be achieved mechanically, chemically, or naturally. Apples (Malus sylvestris Mill.), with their high water and fiber content, are recognized as natural tooth cleansers and may reduce plaque index. This study aimed to analyze the effect of chewing apples on plaque index among students at SDN 45 Banda Aceh. Methods: An quasi-experimental design with a pre-test and post-test control group was employed. The sample consisted of 40 students divided into treatment (chewing apples) and control (rinsing with aquadest) groups. Plaque index was measured using the PHP-M method before and after intervention. Data analysis was conducted using Paired Sample T-test and Independent Samples T-test. Results: In the treatment group, mean plaque scores decreased from 46,10 to 24,25, with most students shifting to good and very good categories. In contrast, the control group showed only a slight reduction from 44,00 to 42,65, with the majority remaining in poor and very poor categories. Statistical analysis revealed t = -9,367 with p < 0,001, confirming a significant difference between groups. Conclusion: Chewing apples proved to have a significant influence on reducing plaque index compared to rinsing with aquadest. Apples can serve as a simple, safe, and practical natural method of plaque control to support children's oral health. Further studies are recommended to expand sample size and variables for more representative results. Parents are encouraged to provide apples at home as a natural alternative for maintaining children's dental hygiene, while teachers can integrate these findings into thematic learning and school health programs (UKS) as applicable oral health education material.

INTRODUCTION

Health is a fundamental aspect of life, encompassing physical, mental, and spiritual dimensions. Dental and oral health is an essential part of general health because it directly affects the quality of life (Mokoginta & Wowor, 2017). Quoting from the official website of the Ministry of Health, according to Republic of Indonesia Law No. 17 of 2023 concerning Health, health is a state of well-being in a person, physically, mentally, and socially, and not merely freedom from disease, enabling them to live productively (Kemenkes, 2023).

The World Health Organization reports that the predominant oral health problems in society are caries and periodontal disease. Globally, the prevalence of caries reaches 60–90% among school-aged children, while almost all adults have experienced this condition. Approximately 15–20% of individuals aged 35–44 years suffer from severe periodontal disease, which increases the risk of tooth loss as a form of oral morbidity (Handayani et al., 2018).

Dental plaque is the primary risk factor for caries and periodontal disease. Plaque is a soft, colorless layer containing microorganisms, such as *Streptococcus mutans*, that adhere to teeth. If hygiene is not maintained, plaque becomes difficult to remove and can cause more serious dental problems (Handayani et al., 2018). Dental and oral health is characterized by tooth surfaces being free from debris, plaque, and calculus. Even when toothbrushing twice daily is practiced, plaque accumulation frequently occurs due to improper brushing techniques. To objectively assess oral cleanliness, the OHI-S (Oral Hygiene Index Simplified) method is used to measure debris and calculus, while PHP-M (Personal Hygiene Performance-Modified) is utilized to evaluate the plaque index (Wilis & Keumala, 2023).

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Data from the 2018 Basic Health Research (Riskesdas) showed that 57.6% of the Indonesian population experienced dental and oral problems, yet only 10.2% received care from dental health professionals. In Aceh Province, the prevalence of dental and oral health problems reached 55.34%, with only 13.89% of the population obtaining dental health services(Nuraskin & Fazira, 2025). Data from the 2023 Indonesian Health Survey (SKI) indicated that the highest proportion of dental and oral problems among school-aged children occurred in those aged 5–9 years at 62.6% and those aged 10–14 years at 48.8%. Elementary school children (6–12 years) are in the mixed dentition period.

A previous study conducted by Wilis & Keumala (2023) on 40 fifth-grade students at SDN 50 Banda Aceh revealed that 82.6% of respondents had a plaque index in the poor category based on PHP-M examination. The potential prevention of plaque formation is known as plaque control (Agung et al., 2015). Primary prevention of dental and oral health issues can be initiated early by establishing plaque control habits. These efforts encompass mechanical cleaning (toothbrushing and flossing), chemical methods (antiseptic mouthwashes), and natural methods (solid and fibrous foods). Mechanical cleaning is crucial for preventing periodontal disease but requires support from other methods. Chemical methods have limitations when used long-term, whereas natural methods are relatively safe as they do not contain harmful substances (Handayani et al., 2018).

Chewing fibrous fruits, such as apples, can assist in mechanical tooth cleansing and reduce plaque formation (Utari, 2020). Apples are recognized as natural tooth cleansers due to their high water content and fiber that support the mechanical tooth-cleansing process (Andriyani et al., 2025). Fresh apples chewed with their skin contain various bioactive compounds, including ellagic acid, chlorogenic acid, caffeic acid, tannic acid, and flavonoids such as quercetin (a flavonol group), catechin, and epicatechin (Puspaningrum, 2018).Tannin is an important component for oral health as it can cleanse and freshen the oral cavity, thereby lowering the risk of tooth decay and gum disease caused by plaque (Nabila & Nuraskin, 2022).

Based on preliminary examination data from second-grade students at SDN 45 Banda Aceh City, all respondents had a poor plaque index. A total of 4 students (40%) were in the very poor category with a mean score of 48, while 6 students (60%) were in the poor category with a mean score of 39. No students were found in the good or very good categories. Based on these conditions, the authors conducted a study entitled "The Effect of Chewing Apples (*Malus sylvestris* Mill.) on the Plaque Index Among Students at SDN 45 Banda Aceh City". This location was selected because no similar research had been conducted there and it was supported by the school's cooperation.

METHOD

This study is a quantitative research project employing a quasi-experimental design with a one-group pretest–posttest approach. The purpose of this design was to determine the plaque index before and after treatment among students at SDN 45 Banda Aceh City.

The study population comprised all students aged 7–12 years at SDN 45 Banda Aceh City, totaling 189 students. Sample size was determined using a purposive sampling technique when an experiment required specific subject criteria for intervention, selecting 40 students who met the inclusion criteria. The sample was divided into a control group of 20 students who rinsed with 20 ml of distilled water (aquadest) to assess plaque scores before and after rinsing, and an experimental group of 20 students who chewed 100 g of apple (*Malus sylvestris* Mill.) to assess plaque scores before and after chewing.

The research was conducted at SDN 45, Lambaro Skep Village, Kuta Alam District, Banda Aceh City, in May 2026. Research instruments included diagnostic sets, Patient Status Cards (PHP-M assessment sheets), quantitative scales, 100 g apple portions, 20 ml aquadest portions, and disclosing solution for plaque index measurement. Primary data consisting of PHP-M scores were obtained through plaque index measurement using disclosing solution before and after treatment, while secondary data including name, sex, and age were obtained from the school registry book.

The procedure included measuring the baseline plaque index (pretest) using diagnostic sets, disclosing solution, and filling out the prepared Patient Status Cards prior to respondents chewing 100 g of apple or rinsing with 20 ml of aquadest. Interventions were administered: 20 students in the experimental group chewed 100 g of apple (*Malus sylvestris* Mill.) and waited 15 minutes to allow for the chemical activity of the apple compounds. Meanwhile, 20 students in the control group rinsed with 20 ml of aquadest for 30 seconds (following standard mouthwash recommendations). Subsequently, 6 index tooth segments were re-examined according to the PHP-M method for both groups, and scores were recorded on the Patient Status Cards (posttest). Measurements were evaluated by comparing changes in the plaque index.

Data processing involved editing, coding, entry, and cleaning. Univariate analysis was performed to evaluate the independent variable (chewing apple) and the dependent variable (pre- and post-treatment plaque index measurements). Bivariate analysis began with normality testing. As the data were normally

distributed, the effect of chewing apples was analyzed using the Shapiro-Wilk test with a significance level of $\alpha > 0.05$.

RESULT

The study was conducted on students aged 7–12 years at SDN 45 Banda Aceh City with a total sample size of 40 respondents. Data analysis consisted of univariate analysis to describe respondent characteristics and plaque index distribution, and bivariate analysis to determine changes in plaque index before and after treatment.

Table 1. Frequency Distribution Based on Respondent Age Among Children Aged 7–12 Years

Ages	Frequency (n)	Percentage (%)
7 years	6	15%
8 years	8	20%
9 years	8	20%
10 years	6	15%
11 years	6	15%
12 years	6	15%
Total	**40**	**100%**

Source: Primary and secondary data (2026)

Based on Table 1, respondents were predominantly in the age groups of 7 and 10–12 years (24 respondents, 60%). These ages indicate that the respondents' dentition was still in the mixed dentition stage.

Table 2. Frequency Distribution of Respondent Sex Among Students

Sex	Frequency (n)	Percentage (%)
Male	23	57.5%
Female	17	42.5%
Total	40	100%

Source: Primary and secondary data (2026)

Based on Table 2, there was a difference in numbers between males and females, where 57.5% were male (23 students) and 42.5% were female (17 students).

Table 3. Frequency Distribution of Respondents Before and After Chewing Apples Among Children Aged 7–12 Years

No	PHP-M Index Category	Before Chewing Apple		After Chewing Apple	
		F	(%)	F	(%)
1	Very good	0	0%	2	10%
2	Good	0	0%	15	75%
3	Poor	9	45%	3	15%
4	Very poor	11	55%	0	0%
	Total	**20**	**100%**	**20**	**100%**

Source: Primary and secondary data (2026)

Based on Table 3, prior to chewing apples, the highest proportion of respondents fell into the very poor category (11 students, 55%). After chewing apples, the PHP-M index scores improved significantly, with the highest proportion shifting to the good category (15 students, 75%).

Table 4. Frequency Distribution of Respondents Before and After Rinsing with Aquadest Among Children Aged 7–12 Years

No	PHP-M Index Category	Before Rinsing Aquadest		After Rinsing Aquadest	
		F	(%)	F	(%)
1	Very good	0	0%	0	0%
2	Good	0	0%	0	0%
3	Poor	13	65%	14	70%
4	Very poor	7	35%	6	30%
	Total	**20**	**100%**	**20**	**100%**

Based on Table 4, before rinsing with aquadest, the highest proportion of respondents was in the poor category (13 students, 65%). After rinsing with aquadest, the highest category remained poor (14 students, 70%).

Table 5. Shapiro-Wilk Normality Test Results in the Apple Chewing and Aquadest Rinsing Groups

	Chewing Apple		Rinsing Aquadest	
	P		P	
Before	0.111	**N**	0.411	**N**
After	0.434	**N**	0.762	**N**

The Shapiro-Wilk normality test on Table 5 results revealed p-values of 0.111 before and 0.434 after chewing apples. For rinsing with aquadest, p-values were 0.411 before and 0.762 after. Because all p-values were greater than 0.05, data were normally distributed. Therefore, bivariate analysis was conducted using the Paired Sample T-test.

Table 6. Paired Sample T-test Results on Plaque Index Differences Before and After Treatment in the Apple Chewing and Aquadest Rinsing Groups

	F	Mean			p-Value
		Before	After	Difference	
Chewing Apple	20	46.10	24.25	21.85	0.001
Rinsing Aquadest	20	44.00	42.65	1.35	0.001

Table 6 demonstrates that the apple group experienced a significant reduction in plaque index post-treatment, with a mean score decrease to 24.25 ($p = 0.001$). Meanwhile, the control group rinsing with aquadest showed a minimal reduction, reaching a mean score of 42.65 ($p = 0.001$).

Table 7. Difference Scores Before and After Intervention in Both Groups

Intervention Group	F	Mean Difference	Effect Difference	95% Confidence Interval (CI)	p-Value
Chewing Apple	20	21.85	20.5	-22.377 s.d. -14.423	0.001
Rinsing Aquadest	20	1.35		-22.378 s.d. -14.422	

Independent T-test (Table 7) results showed that the mean difference in plaque index before and after chewing apples was 21.85, whereas in the aquadest rinsing group it was only 1.35. The net effect difference between the two treatments was 20.50, demonstrating that chewing apples was far more effective in reducing plaque index than rinsing with aquadest. Statistical analysis yielded $p = 0.001$, indicating a statistically significant difference between treatments ($p < 0.05$), with a 95% confidence interval ranging from -22.377 to -14.423.

DISCUSSION

The findings demonstrate that chewing apples exerts a stronger effect on plaque index reduction compared to rinsing with aquadest among elementary school students. The Shapiro-Wilk test indicated normally distributed data post-intervention ($p = 0.434$ for apple group; $p = 0.762$ for aquadest group, $p > 0.05$). The net intervention difference was 20.50, driven by a mean plaque score reduction of 21.85 in the apple group versus 1.35 in the control group. Post-intervention, the majority of respondents in the apple group shifted to the good category, whereas most in the control group remained in the poor category.

Mechanically, when an individual chews an apple (*Malus sylvestris* Mill.), the natural plant fibers rub against tooth surfaces. This friction acts like a soft brush that scrapes off and reduces adherent plaque. Unlike processed foods, natural fiber contains no chemical additives harmful to oral health. Additionally, slow mastication of fibrous food (~32 chews per bite) stimulates salivary flow. Chewing fibrous fruits not only promotes systemic health but also provides a self-cleansing action to maintain oral hygiene.

Chemically, apples contain active compounds essential for oral health. Compounds such as catechins, tannins, flavonoids, and chlorogenic acid possess antibacterial properties that inhibit oral microorganisms. Tannins and catechins prevent plaque accumulation by inhibiting the glycosylation reaction that produces extracellular glucan—the sticky substance allowing *Streptococcus mutans* to adhere

to tooth enamel. Furthermore, these compounds disrupt bacterial cytoplasmic membranes, stopping the nutrient flow required for energy production, causing bacterial growth inhibition and eventual death.

Among the 40 students at SDN 45 Banda Aceh City, a significant reduction in plaque index occurred after chewing apples due to the combined mechanical, chemical, and physiological effects that promote self-cleansing and decrease food retention.

These findings align with Nabila et al. (2024), who reported that out of 84 subjects, 73 students who chewed apples (86.9%) achieved good oral hygiene criteria (79.8%) with no subjects categorized as poor. Similarly, Angelia (2024) observed that chewing Fuji apples decreased debris index scores, increasing good category proportions to 88.9%. Sakinah & Siahaan (2023) also found that apple consumption improved plaque index ratings to 93.3% good category, confirming that apple nutrients and organic acids effectively diminish plaque build-up.

Prior to intervention, respondents exhibited uniform baseline plaque scores. Post-treatment differences are thus directly attributable to the cleansing action of chewing apples. These findings corroborate Wilis et al. (2023) and Rahmawati et al. (2025) regarding high plaque prevalence in primary school children, while advancing the field by validating apples as a simple, safe, natural, and economical plaque control strategy suitable for integration into School Health Programs (UKS).

CONCLUSION

Before treatment, 11 students (55%) in the intervention group were in the very poor category. After chewing apples, a significant reduction in plaque index occurred, with 15 students (75%) shifting to the good category. In the control group, 13 students (65%) were in the poor category before intervention, and 14 students (70%) remained in the poor category after rinsing with aquadest, with no students reaching good or very good categories.

Statistical analysis using Paired Sample T-test and Independent Samples T-test revealed $t = -9.367$ ($p < 0.001$), confirming a statistically significant difference in mean plaque index reduction between groups. The study hypothesis was supported: chewing apples is significantly more effective at reducing plaque index than rinsing with aquadest (mean score reduction of 21.85 vs 1.35).

REFERENCES

Andriyani, D., Elina, L., & Siahaan, Y. (2025). Efektivitas Buah Apel Sebagai Pembersih Alami Terhadap Debris Indeks Dan Ph Saliva. *Jurnal Ilmiah Panmed*, *20*(2), 140.

Angelia, A. (2024). *Pengaruh Mengonsumsi Buah Apel Terhadap Debris Indeks dan Ph Saliva Pada Mahasiswa/I Tingkat 1 Jurusan Kesehatan Gigi Poltekkes Tanjung Karang*.

Handayani, M., Sukrama, I. D. M., & Rahaswanti, L. A. (2018). Perbandingan indeks plak setelah konsumsi buah apel fuji (Malus pumila) dan buah apel manalagi (Malus sylvestris mill) pada anak usia 9 dan 10 tahun di SD Negeri 1 Dalung. *Bali Dental Journal*, *2*. http://jkg-udayana.org

Kemenkes. (2023). *Survei Kesehatan Indonesia (SKI) 2023*. 317–321.

Mokoginta, Z. P., & Wowor, V. N. (2017). Pengaruh Berkumur Air Kelapa Muda Terhadap pH Saliva. *PHARMACON Jurnal Ilmiah Farmasi-UNSRAT*.

Nabila, R., & Nuraskin, A. C. (2022). Mengunyah Buah Apel dapat Menurunkan Indeks Plak Chewing Apples Can Reduce the Plaque Index. *Jurnal Kesehatan Ilmiah*, *15*(2). http://ejournal.poltekkesaceh.ac.id

Nuraskin, A. C., & Fazira, M. (2025). Efektivitas Mengunyah Buah Apel Malang dan Pepaya sebagai Self Cleansing Terhadap Status Kebersihan Gigi dan Mulut Pada Siswa Kelas V SDN 2 Lamcot. *Jurnal Kesehatan Ilmiah*, *18*(2), 2025. http://ejournal.poltekkesaceh.ac.i

Puspaningrum, L. (2018). *Karakteristik Fisikokimia Fruit Leather Apel Manalagi (Malus sylvestris mill) Dengan Substitusi Pisang Candi (Musa paradisiaca) Dan Penambahan Konsenttrasi Gum Arab*.

Sakinah, P., & Siahaan, Y. L. (2023). Description of Grade V Students' Knowledge of Chewing Fuji Apples Against Plaque Index AT Ummi Aida Integrated Islamic Elementary School, Medan Tembung District. *Dental Health Journal of Aceh*, *2*(2). https://doi.org/10.30867

Utari, P. (2020). *Perbedaan Pengaruh Mengunyah Antara Buah Apel Manalagi (malus sylvestris mill.) Dan Buah Pir Shandong (Pyrus bretschneideri) Terhadap Penurunan Plak*.

Wilis, R., & Keumala, R. C. (2023). Hubungan perilaku menyikat gigi dengan status kebersihan gigi dan mulut PHPM (Personal Hygiene Performance-Modified) pada murid sekolah dasar. *Jurnal SAGO Gizi Dan Kesehatan*, *5*(1), 107. https://doi.org/10.30867/gikes.v5i1.1255