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ORIGINAL ARTICLE

# Differences in Chewing Convenience Chocolate and Stevia Dark Chocolate on Plaque Index of Children Aged 10-12 Years

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## ABSTRACT

**Background:** This study is based on children aged 10-12 years who chew chocolate-based snacks with high sweetener content, which can trigger dental caries. Chocolate is a type of food that contains carbohydrates, has a soft consistency, and easily sticks to the teeth. This makes residual chocolate difficult to clean, leading to dental plaque, a primary factor in caries. Stevia is an alternative sweetener with antibacterial properties.
**Objective:** This study's objective is to determine the difference in plaque index among children aged 10-12 years after chewing convenience chocolate versus dark chocolate with stevia.
**Method:** This study used a quasi-experimental quantitative research design with a non-equivalent control group design. The sample was selected using purposive sampling. Data collection involved measuring plaque indices after the research subjects were given two treatments: chewing convenience chocolate and chewing dark chocolate with stevia.
**Outcome:** The results showed that the group that chewed convenience chocolate had a higher mean plaque index (25.81) compared to the group that chewed dark chocolate with stevia, which had a lower plaque index (12.94).
**Conclusion:** This study revealed a significant difference in the mean plaque index between groups chewing convenience chocolate and dark chocolate with stevia. The mean plaque index after chewing dark chocolate with stevia was lower than after chewing convenience chocolate.

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## INTRODUCTION

In the results of the 2023 SKI (Indonesian Health Survey), a figure of 52.2% was obtained, which shows that 12-year-olds have dental caries.[1, 2] Caries are prone to arise at that age because it is a period of mixed dentition, namely the change from primary teeth to young permanent teeth in children aged 6-12 years. There is a morphological difference between primary teeth and young permanent teeth that have not grown perfectly as adequate permanent teeth.[3] In addition, the risk of developing dental caries is higher due to low levels of dental and oral hygiene and the habit of eating too many sugary foods such as candy and chocolate, which can form plaque.[4]

Dental plaque is a layer of biofilm that adheres to the surface of the teeth, gingiva, and other hard tissues in the oral cavity. Chocolate is a type of food that contains carbohydrates, especially sucrose, has a soft consistency, is easy to stick to the teeth, and is favored by many people.[5] One type of chocolate that can be processed into various types of food and is sufficient in the food industry is dark chocolate. Dark chocolate is made from pure cocoa beans and several other ingredients such as lecithin, cocoa butter, and sweeteners.[6] Pure cocoa beans contain flavonoid compounds as natural antioxidant compounds and also have the potential to inhibit the growth of bacteria. The flavonoid levels contained in cocoa have been shown to be more effective than those contained in other foods.[7]

Dark chocolate, on the other hand, has more pure cocoa beans than other chocolates. Thus, dark chocolate is rich in flavonoid compounds that give a distinctive pungent and bitter taste. Sweeteners are, therefore, usually added to the composition of dark chocolate. Sweeteners used in processed chocolate products are usually synthetic sweeteners.[6,8] Too many artificial sweeteners can cause a number of dental and oral health problems, one of which is dental caries.[9] Stevia is a natural sweetener obtained from the leaves of stevia (Stevia rebaudiana Bertoni). It is non-cariogenic and low in calories.[7, 10] Stevia's sweetness is up to 450 times that of sucrose but with fewer calories. This is due to the glycoside content, especially stevioside and rebaudioside-A.[11, 12]

Steviosides contain enzymes that can inhibit the work of cariogenic fermented bacteria that cause infections, including those that cause caries in teeth by inactivating sucrose dextran.[13] Other active substances in stevia leaves that provide antibacterial effects are used to inhibit the growth process of bacteria such as alkaloids, tannins, and flavonoids.[14, 15] Research using stevia leaves aims to understand their benefits and efficacy for human survival. Allah created a landscape with various natural riches that have their own benefits.[16]

Based on the background of the above problem, the author chose children aged 10-12 years as the object of research. This is because school-aged children enjoy sugary snacks with a sweet taste, such as chocolate, candy, bread, lollipops, sweets, and crackers. The author hopes that this study can provide knowledge and help reduce the risk of caries in children by using stevia as a natural sweetener in chocolate, which is the most popular food for children. The purpose of this study was to determine the difference between chewing convenience chocolate and stevia dark chocolate on the plaque index of children aged 10-12 years.

## RESEARCH METHOD

This study is a quasi-experimental quantitative study. It has been approved by the Health Research Ethics Committee of Dr. Moewardi General Hospital under Ethical Clearance Number 2.411/X/HREC/2024. The subjects of this study were children aged 10–12 years at SDN 5 Mojosongo, Surakarta. This study involved post-treatment sampling to observe and assess the extent of the treatment's effect on the experimental group (stevia dark chocolate) and the control group (convenience chocolate).

The primary objective of this study was to determine the effect on scores following the administration of each treatment. Each child was given 3 grams of commercial chocolate and stevia dark chocolate, both of the same weight and shape. Each child's plaque index was measured after receiving the treatment using the PHPM (Patient Hygiene Performance-Modified) method.

The sampling technique used was purposive sampling. The sample size was based on what is considered acceptable in experimental research, with between 10 and 15 subjects in each group. The research subjects had signed informed consent forms. All subjects in this study had to meet the inclusion criteria: active students of SDN 5 Mojosongo, aged 10–12 years, able to chew properly on both sides of the jaw, and having parental/guardian consent; and the exclusion criteria for research subjects: students with extensive dental caries on the index teeth causing confusion in plaque score calculation, having an allergy to chocolate, a history of systemic disease, and uncooperative students. The study will be conducted on a single sample group, and the sample size used in this study is 16 subjects for the two treatments. The plaque index results after the two treatments were analysed using an independent t-test on the mean plaque index.

## RESEARCH FINDINGS

The study, entitled "Differences in Chewing Convenience Chocolate and Dark Chocolate Stevia on Plaque Index of Children Aged 10-12 Years," was carried out in November 2024 and approved by the Health Research Ethics Commission of Dr. Moewardi General Hospital through Ethical Clearance Number 2.411/X/HREC/2024. There is a difference in the average plaque index between the two types of chocolate: the average plaque index after chewing convenience chocolate (25.81) is higher when compared to the average plaque index after chewing stevia dark chocolate (12.94). The data in this study were analyzed using the Shapiro-Wilk normality test. For both the convenience chocolate (0.813) and dark chocolate stevia (0.330) treatment groups, the data are normally distributed (p>0.05). The results for the entire group were considered to have qualified for a homogeneity test using Levene's test method.

After the homogeneity test with Levene's test method, it can be concluded that the data in this study are homogeneous with a significance value of 0.098 (0.098>0.050), thus making them eligible for a parametric test. Parametric statistical tests can be performed if they meet all of the following requirements: normally distributed data, a numerical data measurement scale, and homogeneous data. The parametric test method used in this study is the independent t-test.

**Table 1.** Parametric Test Results Differences in Convenience Chocolate Chewing and Dark Chocolate Chewing Treatment Groups Stevia Independent T-test.

| Treatment Groups | Variable (unit) | N | Average (x ± SD) | Sig. |
|---|---|---|---|---|
| Chocolate Convenience | PHPM Plaque Index | 16 | 25,81 ± 3,544 | 0.001 |
| Dark Chocolate Stevia | | 16 | 12,94 ± 2,489 | |

The independent samples t-test, a parametric test, was used to determine the significance of the difference in average plaque index values after chewing convenience chocolate and after chewing stevia dark chocolate. Based on the results, there was a significant difference in the average plaque index between the two treatment groups (convenience chocolate and stevia dark chocolate) in children aged 10-12 years, with a significance value of <0.001 (p <0.05). The group that chewed stevia dark chocolate had a lower average plaque index than the group that chewed convenience chocolate.

## DISCUSSION

This study aims to determine the difference between chewing convenience chocolate and stevia dark chocolate on the plaque index of children aged 10-12 years. The results

showed that the convenience chocolate plaque index was 25.81, and the stevia dark chocolate plaque index was 12.94. This confirms that the plaque index in children after chewing stevia dark chocolate has a lower value than after chewing convenience chocolate. The results of this study align with previous research indicating that stevia content significantly lowers the plaque index because it inhibits bacterial activity and its contents cannot be fermented or decomposed by acid hydrolysis. [17, 18]

This study aimed to compare the difference in plaque index after chewing dark chocolate stevia and convenience chocolate, with a 1-hour waiting period for plaque index measurement. The plaque index is measured 1 hour after chewing chocolate, at which time resting plaque has formed from the metabolism of residual energy sources and the accumulation of the final acid product increases. The measurement results showed that stevia dark chocolate significantly reduced plaque index scores compared to convenience chocolate. This indicates that stevia is antibacterial and non-cariogenic, which has the potential to help maintain dental health.[14]

In this study, it was found that children did not chew one piece of stevia dark chocolate at a time because they could not tolerate its bitterness. The bitterness was more pronounced than the fleeting sweet taste. This is an important consideration because children need to chew one piece of chocolate until it is finished for accurate study measurements. The bitter taste, derived from the dark chocolate content, could be improved in composition to make the product more palatable to children while maintaining the same benefits as 1% stevia dark chocolate.

When developing chocolate for children, it is crucial to consider their preferences regarding color, taste, and texture. Notably, popular chocolate snacks, foods, and drinks for children rarely use dark chocolate due to its bitter taste; milk chocolate is more commonly used. The chocolate formulation could be altered by adding milk, reducing the chocolate mass, or incorporating fruit flavors. Organoleptic tests are necessary to assess chocolate acceptability, using a hedonic scale to understand children's preferences as consumers for color, taste, aroma, and viscosity. This will enable the production of a healthy chocolate product that children enjoy and that can even serve as a substitute for convenience and mass-produced chocolate products.[19]

A waiting time of approximately one hour is challenging for children, especially ensuring they do not eat or drink anything during that period. Another method is needed to measure dental and oral hygiene, one with a relatively shorter but still effective waiting and examination time, to ensure children are more cooperative during examinations.

## CONCLUSION

Based on the results of a study that has been conducted on children aged 10-12 years at SDN 5 Mojosongo regarding the difference in chewing convenience chocolate and stevia dark chocolate on the plaque index, it can be concluded that there is a significant difference in the average value of the plaque index from the group after chewing stevia dark chocolate than the plaque index after chewing convenience chocolate, the average plaque index after chewing stevia dark chocolate is lower when compared to the average index plaque after chewing convenience chocolate.

Based on the experience in this study, several recommendations for future research can be considered. Future studies should evaluate the plaque index after chewing stevia dark chocolate across different time spans to observe its fluctuations, as well as expand the demographic scope to include different age groups. Additionally, conducting organoleptic tests is advised to determine children's preferences for chocolate products, enabling future formulations to optimize the color, taste, and texture while maintaining the same health benefits as 1% stevia dark chocolate. Finally, exploring variations in the composition of stevia dark chocolate, such as reducing the dark chocolate content to 1 gram or incorporating milk and fruit flavors, could make the product more appealing to children without compromising its efficacy in maintaining a lower average plaque index compared to convenience chocolate.

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