

The Effect of Pineapple (*Ananas Comosus* L. merr) Consumption on the Potential for Dental Caries: A systematic review

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Abstract

Background: Pineapple (*Ananas comosus* L. Merr) is a fruit that is widely found in Indonesia, this fruit has many benefits because it has a high water content, as well as Potassium, Calcium, Iodine, Sulfur, and Chlorine, Phenol, and Bromelain as antibacterial. The purpose of this study is to learn more about the benefits of pineapple for dental health and in the mouth. This study uses an exploratory literature review method, namely the method of collecting and retrieving bibliographic information, textbooks, journals, scientific articles and publications related to the discussion being studied. Pineapple has several of these ingredients that can inhibit bacterial growth in the mouth by affecting protein biosynthesis. Nucleic acid metabolism and inhibition of enzymes such as glucosyltransferase. These ingredients can also prevent bacteria from producing and synthesizing exopolysaccharide acids and bacterial adhesion. Based on the results of the study, the content of pineapple fruit solution (*Ananas comosus* L. Merr) contains citric acid and phenolic compounds that are antibacterial. Consumption of pineapple can reduce plaque, *Streptococcus sp* bacteria and increase salivary pH.

Method: The procedure used in writing this systematic review is a literature search through several databases such as PubMed, ScienceDirect, Proquest, and Google Scholar.

Discussion: Pineapple (*Ananas comosus* (L.) Merr) contains flavonoid compounds. Flavonoid compounds of the flavanone type are the inhibitory effect of the growth of streptococcus mutans bacteria which occurs due to the reaction of a chemical compound. The mechanism of action of flavonoids contained in pineapple stem extract as antibacterials can be divided into three, namely inhibiting nucleic acid synthesis, inhibiting cell membrane function, and inhibiting energy metabolism.

Conclusion: The bromelain enzyme in pineapple has antibacterial properties against *Streptococcus mutans*, thereby inhibiting the occurrence of tooth decay

Keywords: Pineapple; Bromelain; Calcium; *Streptococcus sp*; pH Saliva

1. Introduction

Oral health plays a significant role in human life, as teeth have an important role in human behavior. For example, teeth are crucial when expressing oneself while speaking because they affect sound formation and the food processing process (Putu, 2010). One of the indicators of oral health is the cleanliness of the teeth and mouth, which can be seen clinically by the presence or absence of organic debris such as organic deposits, pellicle, materia alba, debris, calculus, and dental plaque. Dental caries is a progressive demineralization process on the hard tissue of the tooth surface. Dental

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caries is also defined as the chronic and continuous loss of mineral ions from the enamel surface of the crown or root, which is mostly stimulated by bacteria (Hafizah, 2021).

According to the Oral Health Problem report, 58.5% of dental health disorders occur in women, compared to only 56.8% in men. A study on M1 teeth showed that the proportion of caries in women was higher than in men, with 81.5% in women (right M1 tooth) and 82.3% (left M2 tooth), while in men it was 74.5% (right M1 tooth) and 77.6% (left M1 tooth) (Dental Health Journal, 2021). An article on Health (2013) stated that teeth and gums can stay strong and healthy by consuming fibrous fruits because the nutritional content and fiber in these fruits are very good for oral health. Many fruits are good for dental health, including apples, pears, strawberries, and pineapples, which are rich in calcium and phosphorus.

Pineapple is a fruit with a golden yellow color and a delicious taste, ranging from sour to sweet, and offers numerous benefits for dental and overall health. Rich in fiber, pineapple is known to increase saliva production, clean the teeth and mouth, and strengthen the gums (Sugeng, 2013). Pineapple is also known for its antibacterial properties. The presence of chlorine, iodine, and phenols in pineapple has a bactericidal effect. Chlorine reacts with water to form hypochlorite, which is bactericidal. Iodine is one of the strongest bactericidal agents, acting quickly to kill almost all pathogenic germs. Iodine is believed to coagulate proteins. Phenols also have antiseptic properties, acting by denaturing bacterial cell proteins.

Additionally, pineapple contains the enzyme bromelain, which can suppress the growth of plaque-forming bacteria. Bromelain shows its therapeutic effects through a complex mechanism of action, contributing to its anti-inflammatory, analgesic, anti-angiogenic, and antioxidant properties, making it a promising candidate for the treatment of various inflammation-related and oxidative stress disorders. Its diverse biological effects depend on various mechanisms of action, including proteolytic activity, anti-inflammatory and immunomodulatory effects, fibrinolytic activity, and antioxidant properties (Hikisz, P, *et al.*, 2021).

Bromelain is a protease that catalyzes the proteolytic process and is classified as a cysteine proteinase, commonly known as thiol proteinase due to its active site containing cysteine thiol. Several cysteine endopeptidases (from pineapple fruit-bromelain, pineapple stem, bromelain stem, como sain) and other components, such as phosphatase, peroxidase, carbohydrates, ribonuclease, protease inhibitors, cellulase, glycoproteins, and bound organic calcium, are present in raw bromelain. The sulfhydryl group forms its functional component (Indonesian Journal of Laboratory, 2022).

The composition of bromelain may vary depending on factors such as the extraction source and processing methods. More specifically, bromelain activity occurs between pH 3 and 7 (Feng, X *et al.*, 2018).

2. Material and methods

This type of research uses data collection through literature review. Research that is being conducted on a specific topic or question about a part of science. Data collection and analysis are carried out by searching for literature studies and observations. In this case, the theoretical basis for the research is obtained through a literature search originating from books, other journals or other trusted sources. In this study, the reference search technique was obtained from the publication year limit of articles from the last 10 years, namely 2013 - 2023. By using this method, researchers view and identify articles in a structured manner, following the steps that have been determined in each process (Triandini, Jayanatha, Indrawan, Werla Putra, & Iswara, 2019). To complete this research, researchers collected journals from Google Scholar, Research Gate, SINTA, DOAJ and Scopus. The keywords are articles that are closely related to the keywords used, namely pineapple, bromelain, calcium, *Streptococcus sp*, salivary pH. In the next step, the researchers grouped articles related to the effects of pineapple on dental caries.

3. Results and discussion

Based on the results of literature searches through publications in several academic databases, Google Scholar, Research Gate, SINTA, DOAJ and Scopus with keywords articles that are closely related to the keywords used, namely pineapple, bromelain, calcium, *Streptococcus sp*, salivary pH. So the researcher found 15 journal articles that match the keywords. Based on the results of a literature review of 15 journals, it was found that pineapple contains the enzyme bromelain which functions to break down proteins by breaking peptide bonds and simplifying proteins. The bromelain enzyme works by reducing the surface tension of bacteria through the hydrolysis of salivary proteins and glycoproteins. This enzyme also inhibits bacterial growth by breaking protein bonds in bacteria. (N. Amini, et al 2018). In addition,

pineapple fruit tubers (*Ananas comosus (L.) Merr*) contain flavonoid compounds. Flavonoid compounds of the flavanone type are the inhibitory effect of the growth of streptococcus mutans bacteria due to the reaction of a chemical compound. The mechanism of action of flavonoids contained in pineapple stem extract as antibacterial can be divided into three, namely inhibiting nucleic acid synthesis, inhibiting cell membrane function, and inhibiting energy metabolism. (R Hendra, *et al* 2011).

Bromelain enzyme isolated from ripe pineapple flesh was found to be more active than bromelain enzyme isolated from leaves and unripe pineapple fruit. The highest specific activity was found in pineapple, and the bromelain enzyme content in pineapple was 62.5 U/mg. Pineapple stem 27.3 U/mg and pineapple skin 32.2 U/mg. (Ahamed AA. 2016). Research by Bansode et al, showed that pineapple juice has antibacterial effects at a concentration of 100%. Pineapple juice at this concentration can inhibit the growth of *E. coli* (4 mm), *Shigella sonnei* (6 mm) and *Salmonella para B* (4 mm). The growth of *Salmonella para B* (1 mm) was inhibited at a concentration of 25%. A study conducted (Ashik et al, 2016) showed that the growth of *Staphylococcus aureus* bacteria can be inhibited by pineapple extract at a dose of 1000 g/ml, with an inhibition zone diameter of 23 mm. The bromelain enzyme contained in pineapple *Ananas comosus (L.) Merr* can be used as an antibacterial, antifungal, disinfectant and antiseptic for the oral cavity. (Bahtiyar, *et all* 2017).

Streptococcus mutans is a pathogenic bacteria and often causes oral infections such as tooth decay. These bacteria produce acid so they can survive and thrive at a very acidic pH. *Streptococcus mutans* produces soluble and insoluble extracellular polysaccharides such as glucan and fructan from sucrose to lower the pH of the tooth surface, which is associated with plaque formation and caries incidence (Bagg J, *et all* 2018)

The results of the study (Bahtiyar, *et all* 2015), which used the minimum inhibitory concentration test of the dilution method, showed the concentration of bromelain enzyme that was able to inhibit *Streptococcus mutans*. *Streptococcus mutans* bacteria are generally found in dental biofilms in adults, but in certain bacterial conditions this has been reported to be associated with the incidence of bacterial endocarditis. The antibacterial in the bromelain enzyme is a compound used to control bacterial growth, both gram-positive and gram-negative bacteria. The mechanism of inhibition of bacterial growth by these phytochemicals is in the form of cell wall destruction through changes in membrane permeability so that bacterial cells will undergo lysis and bacteria will die. Crude bromelain is more effective in inhibiting the growth of gram-positive bacteria compared to gram-negative bacteria. The results of the study showed a difference because bromelain inhibited all microorganisms that were specifically tested against alcohol solutions. (Ali AA, *et all* 2015).

4. Conclusion

Based on the research that has been conducted, it can be concluded that the bromelain enzyme in pineapple has antibacterial power against *Streptococcus mutans*, thereby inhibiting the occurrence of tooth decay.

Compliance with ethical standards

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