The Effects of Pineapple Extract Toothpaste (*Ananas comosus L.Merr*) on Saliva Flow Rate

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Abstract. Women in the menopause period experience biological changes, decreased production of the hormones estrogen and progesterone resulting in xerostomia (dry mouth). Dry mouth treatment can be carried out using mechanical and chemical stimuli. Citric acid stimulation is one way to increase the flow rate of saliva. Pineapple contains a high amount of citric acid. The purpose of this study is to determine the effect of toothpaste with pineapple extract, which increasing salivary flow rate in women in menopause period at the Integrated Health Center (*Posyandu*) for elderly in Baso Health Center. This type of experimental research using pretest-posttest control group design and the sample selection was taken by simple random sampling with a lottery technique. The number of samples was 32 people who were divided into two groups, namely the treatment group and the control group. Saliva was collected before and after treatment into the saliva pot for 5 minutes using the spitting method. Data analysis using paired T test and unpaired T test. The results showed that there was an increase in salivary flow rate with the use of pineapple extract toothpaste 50% of 1.651 ml / minute and with fluoride toothpaste. 1,170 ml / minute. There is an effect of brushing teeth with pineapple extract toothpaste on the salivary flow rate with a significance value of p = 0.000 <0.05. Pineapple extract toothpaste can be used as an alternative treatment for xerostomia for women in menopause period.

1.Introduction

Dental and oral diseases that occur in society cannot be separated from the role of saliva in the mout [1]. The Reduced saliva in a person (hyposalivation) will result in dental and mouth problems such as difficulty of swallowing, speaking, a lot of fungus (angular cheilitis or erythematous candidiasis), other bacterial infections and dental caries. due to reduction of salivary flow rate (hyposalivation)[2]-[3]. The importance of saliva for a person's quality of life requires efforts to increase the salivary flow rate[4].

The ability of saliva to prevent the formation of dental and oral diseases depends on the amount of salivary secretion or flow rate of saliva and the composition of saliva[5]. Saliva is produced approximately 1-2 liters a day. The production of saliva not stimulated continues all the time to moisturize and moisturize the oral tissues. Biological stimulation from inside and outside the mouth will stimulate the work of the saliva-producing glands, thereby increasing saliva production. Under normal body conditions the resting salivary flow rate is 0.25 to 0.35 mL per minute and when stimulated is 1-3 mL per minute. Mechanical, gustatory or tasting, olfactory or olfactory influences and pharmacology can affect salivary secretion[6].
The stimuli that affect the flow rate of saliva are mechanical and chemical stimuli in chewing food[7]. Brushing teeth and the process of chewing hard foods and foods that contain fiber are examples of mechanical stimuli, while the tasting effect is a chemical stimulus so that both stimulations can increase salivary flow rate[8]-[9].

Chemical stimuli in the oral cavity are associated with taste and saliva secretion. Chemical substances that can give rise to taste perceptions such as citric acid, and cause a sharp sour taste. Acidic chemical stimuli are the most powerful stimuli in increasing salivary secretion[10].

Menopause is a normal physiological condition that every woman will experience. The number of women aged 60 years and over increases from 336 million in 2000 to more than 1 billion in 2050 based on estimates from the World Health Organization (WHO)[11]. The prevalence of menopausal women in Asia is 63.1% of all over the world with an age range between 40- 65 years and an average age of 51 years[12]. Indonesia's population in 2020 will reach 262.6 million, with the number of women living at menopause reaching 30.3 million according to the Indonesian Ministry of Health in 2005[13].

Menopause is a phase of a woman's life marked by changes in ovarian and hormonal function which results in the cessation of menstrual periods[14]-[15]. Menopause is characterized by not experiencing menstrual cycles in a row for at least 12 months[16]. According to 100 women in menopause period, 50% experienced dry mouth (xerostomia), 3% experienced a burning mouth sensation (burning mouth syndrome), 4% experienced decreased taste sensation. Xerostomia is a subjective complaint of dry mouth[17].

The prevalence of xerostomia ranges from 14-46% which is consistently higher in women. Xerostomia often occurs in middle age and the elderly. Women in menopause period experience biological changes and production of steroid sex hormones that affect health, especially decreased production of the hormones estrogen and progesterone which can lead to xerostomia[15]-[18]-[19]. The research that conducted on 86 subjects of women in menopause period showed that 43.5% (39 people) experiencing xerostomia[20].

Xerostomia is characterized by a hyposalivation, in which the unstimulated salivary flow rate is less than 0.1 ml / minute and the stimulated salivary flow rate is less than 0.7 ml / minute[21]-[22]-[23]. Xerostomia can be treated and treated using stimuli and saliva artificial. The stimulus consists of mechanical stimuli such as brushing teeth, chewing or rinsing and chemical stimuli such as stimulation of sour, sweet, salty, and bitter tastes[20].

Xerostomia in the elderly can affect the quality of life of the elderly themselves, because of the discomfort in the oral cavity and affect the health of teeth and oral cavity, elderly people with xerostomia can cause bad breath.

There are many development of natural ingredients as alternative materials to increase the flow rate of saliva. Wanda et al. studied the effect of pineapple consumption on salivary flow rates in elderly people with xerostomia. The results of this study indicate that the citric acid content in pineapple can stimulate the salivary glands[24]. Watanabe and Dawes in their research found that the mechanical stimulation of the mean salivary flow varied from 3.15 to 4.94 ml / min, whereas when 5% citric acid was dropped into the mouth it triggered a higher salivary flow rate of 7.07 ml / minute[6].

The way to increase the flow rate of saliva in the context of preventing oral and dental diseases can also be done by consuming foods that contain citric acid and vitamin C. Citric acid contained in pineapple is included in the high class, around 346 mg per fruit. The content of vitamin C in 100 grams is 24 grams[25]. Based on this description, it is necessary to conduct research to see the effect of pineapple extract toothpaste on increasing salivary flow rate in women in menopause period with xerostomia.

2. Methodology

This research is conducted using experimental with a cross-sectional approach. The design of this study used a pretest and posttest control group design. The research was conducted in November 2020 at Baso Health Center, Agam Regency, West Sumatra. The study population was women in menopause period who visited the Integrated Health Center for Elderly in Baso. The inclusive criteria are women in menopause period with unstimulated salivary flow rates less than 0.1mL / minute, age 40-75 years, had no systemic disease, were willing to be research subjects and signed an informed consent. The exclusion criteria are women in menopause period who do not cooperate in the study and
who are allergic to pineapple. Data were collected by measuring the flow rate of saliva without stimulation and by stimulation. The subject's saliva was collected in a saliva pot to determine whether the subject had xerostomia or not using the spitting method. Firstly, the subject was asked to swallow all the saliva in their oral cavity, then measured the saliva before it was stimulated by instructing the patient to collect saliva in the mouth in an upright back and head down and then spit every 1 minute for 5 minutes into the saliva pot. If the research subject has xerostomia, the research subject is asked to sign an informed consent, and take pieces of paper that have been available.

The subjects were divided into 2 groups, namely the treatment group and the control group. The subject treatment group was instructed to brush their teeth using pineapple extract toothpaste for ± 2 minutes with the roll technique then rinse and discard13. Meanwhile the control group brushed their teeth with toothpaste without pineapple extract. Then the volume was measured and data was recorded. This study used paired T test and unpaired T test.

3. Result and Discussion

The subjects of the study were 32 women in menopause period who experienced xerostomia, consisting of 16 people using 50% pineapple extract toothpaste and 16 people using fluoride toothpaste. Table 1 explains the distribution and subject’s frequency based on age obtained by 4 people (12.5%) at the age of  55-59 years, 24 people (75%) at the age of ≥60 years, 4 people (12.5%) at the age of 50-54 years, 0 people (0%) at the age of 45-49 years, and 0 people (0%) at the age of 40-44 years.

Table 1. Distribution dan Subject’s Frequency based on Age

| Age (year) | Total (n) | Percentage (%) |
|-----------|-----------|----------------|
| 40-22     | 0         | 0              |
| 45-49     | 0         | 0              |
| 50-54     | 4         | 12,5           |
| 55-59     | 4         | 12,5           |
| ≥60       | 24        | 75             |
| Total     | 32        | 100            |

Table 2 explains the distribution and frequency of subjects based on the length of menopause, which consist of 13 people (43.3%) for ≥10 years, 9 people (30%) for 4-6 years, 6 people (20%) for 7-9 years, and 2 people (6.7%) for 1-3 years.

Table 2. Distribution and Subject’s Frequency based on Length of Menopause Period

| Age (year) | Total (n) | Percentage (%) |
|-----------|-----------|----------------|
| 1-3       | 2         | 6,25           |
| 4-6       | 4         | 12,5           |
| 7-9       | 6         | 18,75          |
| ≥10       | 20        | 62,5           |
| Total     | 32        | 100            |

The results of the measurement of the average salivary flow rate in the treatment group and the control group indicate that there are differences in the mean of salivary flow rate of the treatment and control groups. The mean value of salivary flow rate after treatment in the pineapple extract toothpaste group is 50% greater than the mean value of the control group. Paired T test in the treatment and control groups showed a value of $p = 0.000$ ($p <0.05$). The $p$ value <0.05 indicates that
there is a significant difference between the salivary flow rates before and after the use of extract toothpaste in the treatment group and in the control group (Table 3).

Table 3. Analysis of The Results of The Measurement of The Average Salivary Flow Rate in The Treatment Group and The Control Group Using Paired T Test

| Group   | N   | Before (ml/minute) | After (ml/minute) | Difference of Mean | P Value |
|---------|-----|--------------------|-------------------|--------------------|---------|
| Treatment | 16  | 0.08               | 1.73              | 1.651              | 0.000   |
| Control  | 16  | 0.08               | 1.25              | 1.170              | 0.00    |

The difference in the average salivary flow rate in the treatment group is 1.651 ml / minute, while the control group is 1.170 ml / minute. Based on the results of the unpaired T test, it is known that p = 0.000 <0.05. to conclude, statistically there is a significant difference between the treatment group and the control group where the use of pineapple extract toothpaste is 50% better in stimulating the salivary flow rate.

Table 4. Analysis of The Result of The Measurement of difference in The Average Salivary Flow in The Treatment Group and Control Group Using Unpaired T Test

| Group   | Total (n) | Difference of mean± SD (ml/minute) | Sig |
|---------|-----------|-----------------------------------|-----|
| Treatment | 16        | 1.651 ± 0.175                      | 0.000 |
| Control  | 16        | 1.17 ± 0.125                       |      |

Xerostomia is a symptom of dry mouth that can occur in women with menopause period due to hormonal changes[26]-[27].The results of this study found that most menopausal women who experienced xerostomia were in the age group ≥ 60 years, amounting to 75%. The age of a person experiencing menopause varies widely, namely around 40-65 years because it can be influenced by several factors such as age at first menstruation, heredity, general health, and socioeconomic conditions[27]. According to Mojabi et.al, 73 years of age experience xerostomia by 50%[17]. Based on this, it can be concluded that menopause is not only influenced by hormones but also due to the aging process. The function of the organs of the body decreases where the salivary glands will atrophy, causing changes and deterioration of the function of the salivary glands.

In this study, it was seen that most subjects with menopause ≥10 years experienced xerostomia, which was 62.5%. The theory states that symptoms in most menopausal women will last for 1 or 2 years after menopause, but can continue for up to 10 years or even more. Physiological decrease in estrogen levels in menopausal women can result in changes in the condition of the oral cavity. Estrogen is a steroid hormone that has receptors in the oral cavity. The presence of estrogen receptors in the salivary glands has a very important role in the rate of salivary flow, this is because a partial or total decrease in estrogen can cause a decrease in the salivary flow rate[26]-[27].

This study involved two groups, which are the treatment group and the control group. The group who use 50% pineapple extract toothpaste obtained an average flow rate of saliva. Before use of pineapple extra was around 0.08 ± 0.479 ml/minute and after use it increased to 1.73 ± 0.417 ml / minute. These results indicate an increase in the average salivary flow rate after the 50% use of pineapple extract. The increase in salivary flow rate after the use of pineapple extract 50% can occur due to mechanical stimulation in the form of brushing and chemical stimulation[28]-[29]. Mechanical stimulation occurs through receptors found in the mastication muscles, temporomandibular joints, and oral mucosa which detects muscle movement resulting in an increase in salivary flow rate. In addition, pineapple fruit can also stimulate salivary secretion because of the acidic and sweet content in
pineapples which can affect the taste system or the perception of sour and sweet tastes received by taste buds on the tongue so that the salivary flow rate increases[28]-[29]-[30].

The fluoride toothpaste group obtained an average salivary flow rate before use which was around 0.08 ± 1 ml/minute and after use it increased to 1.25 ± 0.417 ml / minute. Brushing teeth is a mechanical stimulus that can stimulate the flow of saliva. The movements of brushing teeth and rinsing will expand the touch surface between foreign objects and the compressive receptors that are scattered in the oral cavity, thereby increasing stimulation[37]. These results are in accordance with the previous studies conducted by Pratiwi et al. gargle distilled water for 30 seconds[31]-[32].

Based on the paired T-test analysis, the measurement of salivary flow before and after using pineapple toothpaste showed an increase in salivary flow rate of about 2,800 ml / minute, while the use of fluoride toothpaste showed an increase of about 1,694 ml / minute. Based on these data, it is known that there is a significant increase in the salivary flow rate in each group. This result is in accordance with previous research conducted by Haq (2014) who states that there is a difference in the effect of chewing gum containing citric acid and non-citric acid on the flow rate of saliva with an average salivary flow rate with stimulation of gum containing citric acid. , 88 ml / minute. The results of this study are also in accordance with the research of Lewapadang et al. who states that there is an effect of consuming pineapple on the salivary flow rate in elderly people with xerostomia. The difference in this study is how to stimulate the flow rate of saliva with mechanical and chemical stimulation.

Based on the analysis of the unpaired T test on the difference in the average salivary flow rate between the control group and the treatment group, there was also a significant difference, where a difference of about 0.050 ml / minute was found. Brushing teeth with pineapple toothpaste further increases the salivary flow rate that occurs because there are two types of stimulation, which are mechanical stimulation in the form of a gargling motion and chemical stimulation in the form of sour tastes such as ascorbic acid, citric acid, malic acid, and the sweet taste contained in pineapples. with the statement of Amerongen in the research of Purwati et al. in 2016 that saliva secretion is influenced by taste stimulation, namely pineapple contains sweet and sour taste[34].

This can cause the salivary reflex when the receptors in the oral cavity, both chemoreceptors and suppressive receptors, respond to stimulation in the oral cavity. These receptors then produce impulses of afferent nerve fibers carrying information to the salivary center in the medulla of the brainstem. The salivary center then sends impulses via the extrinsic autonomic nerves to the salivary glands to increase salivary secretion[5]-[30]-[35].

Pineapple is a fruit that is rich in organic and inorganic content. The most important organic content in increasing the rate of saliva flow is the content of acids and sugars as well as the inorganic content of minerals. The high content of citric acid in pineapple acts as a stimulator of the salivary glands so that it can increase the flow rate of saliva[8]. Sugar compounds in pineapple such as fructose, glucose, and sucrose can also increase the flow rate of saliva. Other ingredients in pineapple that can increase the rate of saliva flow are high mineral content such as: potassium, sodium, calcium, magnesium, sulfate, phosphate, and others[12]-[14]-[34].

4. Conclusion
The use of 50% pineapple toothpaste has an effect on increasing the flow rate of saliva in women in menopause period at the Integrated Health Center (Posyandu) for Elderly in Baso Health Center.

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