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Gargling with Lemon Infused Water (*Citrus limon*) as a natural alternative to balance saliva pH in pregnant women

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ABSTRACT

Background: Pregnant women are vulnerable to decreased *salivary pH* due to hormonal changes, which can lead to oral health issues such as caries, gingivitis, and halitosis. Excessively acidic *salivary pH* may also affect maternal nutrition and fetal development. Lemon-*infused water* contains vitamin C and citric acid, which are known to stimulate *saliva* production and naturally help neutralize oral acidity. Objective: To examine changes in *salivary pH* before and after gargling lemon-*infused water* in pregnant women at the KIA Clinic, Kedaung Health Center, in 2025. Method: This study used a quasi-experimental design with a one-group pretest-posttest approach. A total of 30 pregnant women were selected using purposive sampling. *Salivary pH* was measured before and after gargling using a *pH* meter. Results: Prior to the intervention, 70% of participants had acidic *salivary pH*. After gargling, the proportion of participants with acidic *pH* decreased to 56.66%, while those with neutral *pH* increased to 43.34%. Conclusion: Lemon-*infused water* shows potential as a natural alternative to help balance *salivary pH* and support oral health in pregnant women.

INTRODUCTION

The Indonesia Health Survey (SKI) 2023 revealed that approximately 56.9% of the Indonesian population experienced dental and oral health problems. Among these, dental caries was the most commonly found issue, affecting 43.6% of the population (Kemenkes, 2023).

Dental caries is the most common oral health problem experienced by the general population (Yulita et al., 2021). Pregnant women are more likely to develop caries compared to non-pregnant women (Atqiya et al., 2021). In terms of gender, women are generally more susceptible to dental caries than men (Senawa & Vonny, 2015). Women, particularly those who are pregnant, have a higher tendency to experience dental caries. This condition can interfere with food consumption and lead to inadequate nutritional intake, which may subsequently result in low birth weight. Moreover, dental caries can trigger the release of prostaglandin hormones, increasing the risk of preterm birth or miscarriage (Aini et al., 2018).

Dental health in pregnant women is closely related to nutritional intake (Azofeifa et al., 2016). Hormonal changes during pregnancy can lead to symptoms such as nausea, vomiting, and bleeding gums, which may affect appetite and tooth brushing habits. As a result, nutritional deficiencies can increase the risk of preterm birth, stunting, and low birth weight (LBW) in infants. In addition, the common habit of neglecting to brush teeth among pregnant women can lead to bacterial growth and the development of oral health problems such as dental caries, stomatitis, halitosis, and others (Indiarto, 2022).

Dental caries can be prevented by maintaining the balance of saliva in the oral cavity. The ability of saliva to promote remineralization is strongly influenced by its *pH*. The lower the salivary *pH*, the higher the risk of developing caries (A'yun, 2021). Additionally, the buffering capacity and *pH* of saliva are closely related to its secretion rate. A decrease in salivary flow rate can lead to an increase in the number of *Streptococcus mutans* and *Lactobacillus* bacteria, which directly affects the acidity level (*pH*) in the mouth (Birkhed & Heintze, 2021).

The prevention of acid imbalance in the oral cavity can be achieved by inhibiting plaque formation. This can be done mechanically through tooth brushing or chemically through the use of mouthwash (da

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Costa et al., 2017). Although mouthwash is considered effective in maintaining oral hygiene, long-term use may cause adverse effects, such as dry mouth, due to the presence of harmful chemical substances (Nurhaeni, 2019). A study conducted by (Sadimin & Wiradona, 2016) showed that there were changes in salivary *pH* before and after gargling with lemon-infused water and strawberry-infused water, indicating that both types of solutions can affect salivary acidity levels. Another study stated that the consumption of infused water can significantly reduce salivary *pH*, and that longer infusion durations result in more acidic drinks, thereby leading to a greater decrease in salivary *pH*.

METHOD

The research design employed in this study was a pre-experimental method using a one-group pretest-posttest design. The study was conducted on pregnant women at the Maternal and Child Health (MCH) Clinic of Kedaung Health Center. The sampling technique used was purposive sampling, with a total of 30 pregnant women participating. The instruments used in this study included an information sheet, informed consent form, examination sheet, *pH* meter, and lemon-infused water. The research was carried out over a period of two days. The activities carried out were as follows:

1. The researcher provided inph
2. structions or guidance regarding the research procedure and the completion of the informed consent form.
3. The researcher gave each respondent two 25 ml small cups and instructed them to collect their saliva before gargling into one of the cups.
4. The researcher measured the salivary *pH* before gargling (pretest) by inserting the *pH* meter into the 25 ml cup containing saliva, then recorded the result on the examination sheet.
5. The researcher provided the respondent with a 20 ml bottle containing lemon-infused water.
6. The researcher instructed the respondent to gargle the lemon-infused water for 30 seconds, ensuring that the solution reached all surfaces of the teeth and oral mucosa.
7. After 5 minutes, the respondent was instructed to collect their saliva post-gargling into the second 25 ml cup. During the 5-minute waiting period, respondents were instructed not to eat or drink before saliva sample collection.
8. The researcher measured the salivary *pH* after gargling (posttest) by inserting the *pH* meter into the 25 ml cup containing saliva and then recorded the result on the examination sheet.

This study employed descriptive analysis for each variable. The research findings were processed using data analysis tools and presented in tabular form to obtain an accurate description of each variable.

RESULT

Table 1. Frequency Respondent Characteristics Based on Age

Age	Frequency	Percentage (%)
< 20 years	1	3.4
20-35 years	25	83.3
> 35 years	4	13.3
Total	**30**	**100**

Table 1 There was 1 respondent (3.4%) under the age of 20, 25 respondents (83.3%) aged between 20 and 35 years, and 4 respondents (13.3%) over the age of 35.

Table 2. Frequency Respondent Characteristics Based on Pregnancy Trimester

Pregnancy Trimester	Frequency	Percentage (%)
I	5	16.7
II	10	33.3
III	15	50
Total	**30**	**100**

Table 2 there were 5 pregnant women in the first trimester (16.7%), 10 respondents in the second trimester (33.3%), and 15 respondents in the third trimester (50%).

Table 3. Salivary *pH* Before Gargling Lemon-Infused Water (*Citrus limon*) In Pregnant Women

Salivary *pH* Category	Frequency (n)	Percentage (%)
Acidic (< 6.8)	21	70
Neutral (6.8-7.8)	8	26.66
Alkaline (7.8)	1	3.34
Total	**30**	**100**

Table 3 shows that before gargling with lemon-infused water, 21 pregnant women (70%) had acidic salivary *pH*, 8 pregnant women (26.66%) had neutral salivary *pH*, and 1 pregnant woman (3.34%) had alkaline salivary *pH*.

Table 4. Salivary *pH* After Gargling Lemon-Infused Water (*Citrus limon*) In Pregnant Women

Salivary *pH* Category	Frequency (n)	Percentage (%)
Acidic (< 6.8)	17	56.66
Neutral (6.8-7.8)	13	43.34
Alkaline (7.8)	0	0
Total	**30**	**100**

Table 4 showed that after gargling with lemon-infused water, 17 pregnant women (56.66%) had an acidic saliva pH, 13 pregnant women (43.33%) had a neutral saliva pH, and 0 pregnant women (0%) had an alkaline saliva pH.

DISCUSSION

The study conducted on pregnant women at the MCH (Maternal and Child Health) Clinic of Kedaung Public Health Center on April 22 and 26, 2025, aimed to examine the salivary *pH* levels before and after gargling with lemon-infused water. The salivary *pH* levels of the respondents were classified into three categories: acidic (*pH* < 6.8), neutral (*pH* between 6.8 and 7.8), and alkaline (*pH* > 7.8).

The results of the study showed that before gargling with lemon-infused water, the salivary *pH* of most respondents 21 respondents or 70% was in the acidic category, 8 respondents or 26.66% were in the neutral category, and 1 respondent or 3.34% was in the alkaline category. These findings indicate that the majority of pregnant women had acidic salivary *pH*. This condition may be caused by hormonal changes that affect the production and composition of saliva, leading to a more acidic environment in the oral cavity. In addition, pregnant women often experience nausea and vomiting, which leads them to consume sweet foods to relieve the discomfort. However, frequent consumption of sweet foods can increase oral acidity and thus elevate the risk of dental caries. These results are consistent with previous research (Sadimin & Wiradona, 2016), which showed that before gargling with lemon-infused water, most respondents (18 respondents or 45%) had acidic salivary *pH*.

This is in line with the theory which states that pregnant women tend to experience a *ph*ysiological decrease in salivary *pH*. This condition is caused by hormonal changes, such as increased levels of estrogen and progesterone, which can affect the composition and flow rate of saliva. Progesterone reduces the concentration of bicarbonate in saliva, which is an important component of the oral buffering system. As a result, saliva becomes more acidic during pregnancy, increasing the risk of oral health issues such as dental caries and gingivitis (Morelli et al., 2018).

In addition, the decreased salivary flow rate and the increased frequency of nausea or vomiting in pregnant women are also contributing factors to the lowered salivary *pH*. Vomiting exposes the oral cavity to gastric acid, while frequent eating patterns—especially the consumption of sweet or acidic foods—further promote an acidic oral environment (Hegde et al., 2016). Therefore, an acidic salivary *pH* condition in pregnant women can be a triggering factor for various oral health problems, such as dental caries. These problems not only have a local impact on the oral cavity but can also affect the nutritional intake of pregnant

women due to discomfort during eating. This is consistent with previous research (Indiarto, 2022), which stated that nutritional deficiencies may lead to low birth weight (LBW), stunting, and an increased risk of preterm birth. Therefore, maintaining a neutral salivary *pH* is an important step in preserving the oral and dental health of pregnant women and supporting optimal fetal growth and development.

Therefore, a natural and safe alternative is needed to help neutralize salivary *pH* and maintain oral health in pregnant women. One such alternative is gargling with lemon-infused water. Lemon contains citric acid (3.7%), limonene (70%), potassium, and vitamin C, which not only provide a refreshing taste but also have a stimulating effect on saliva production (Reca & Putri, 2021). From a *ph*ysiological perspective, lemon-infused water has the potential to stimulate an increase in salivary flow rate due to its citric acid content, which can trigger greater saliva secretion. The higher the volume of saliva, the greater its buffering capacity through the bicarbonate components it contains (Minarni, 2019). Therefore, lemon-infused water shows potential in helping to balance the salivary *pH* of pregnant women. This natural approach can be a viable option for maintaining oral health during pregnancy.

In this study, the composition of the lemon-infused water used consisted of 100 grams of sliced lemon mixed with 600 ml of water, with a gargling duration of 30 seconds. After the lemon-infused water intervention, the results showed that 17 respondents or 56.66% were in the acidic category, 13 respondents or 43.34% were in the neutral category, and 0 respondents or 0% were in the alkaline category. This indicates that lemon-infused water has potential as a natural intervention to help reduce salivary acidity in pregnant women. Although not all respondents experienced a shift to the neutral category, the results demonstrate a positive effect of gargling lemon-infused water on increasing salivary *pH*. This is supported by a decrease of 4 respondents in the acidic category after the intervention. Therefore, lemon-infused water may be considered a relatively safe natural alternative to help maintain salivary *pH* balance and oral health during pregnancy. However, its effectiveness could be improved by optimizing factors such as composition, duration, frequency of use, and other variables that influence salivary *pH*.

The results of this study are not in line with the findings of previous research (Sadimin & Wiradona, 2016) which showed that salivary *pH* actually became more acidic after gargling with lemon-infused water and strawberry-infused water. This discrepancy may be due to differences in the number of respondents, the composition of the infused water, the duration of the intervention, and the initial salivary *pH* conditions. It can be concluded that gargling with lemon-infused water has the potential to help increase salivary *pH* toward a more neutral level. Although it did not result in significant changes in all respondents, the findings indicate that lemon-infused water may serve as a safe and reasonably effective natural alternative for maintaining salivary *pH* balance and supporting oral health during pregnancy. However, its effectiveness may be influenced by factors such as the composition of the lemon-infused water, the duration of gargling, and the initial salivary *pH* condition of the respondents.

CONCLUSION

Based on the results of the study, gargling with lemon-infused water shows potential as a natural alternative to help balance salivary *pH* in pregnant women, thereby supporting oral health during pregnancy.

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