

The effect of chewing gum on salivary pH and volume

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ABSTRACT

Objective: to assess the hydrogenic potential and salivary volume before and after using menthol chewing gum in healthy volunteers. **Method:** this is a quantitative, quasi-experimental, pre-test and post-test study, carried out with 45 healthy volunteers between 18 and 60 years old. The saliva sample was collected in a non-stimulated manner, following the spitting method. Volunteers were asked to accumulate saliva in their mouths and spit it out into a millimeter flask, every minute, before and after receiving the menthol chewing gum, for ten minutes at each step. **Results:** in the first stage of collection, the mean hydrogenic potential was 7.06, increasing to 7.42 ($p < 0.001$) after the second stage. Salivary volume increased from 5.95 mL to 23.13 mL ($p < 0.001$). **Conclusion:** chewing gum after eight hours of fasting caused an increase in the hydrogenic potential and salivary volume. This increase in salivary volume has no clinical relevance for bronchoaspiration.

Descriptors: Saliva; Salivary Glands; Alkalinization; Chewing Gum; Menthol; Thirst.

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INTRODUCTION

Thirst is reported by patients as one of the five main stressful symptoms⁽¹⁾, which affects both patients with chronic diseases and those who need surgical procedures^(2,3,4). Among surgical patients, the prevalence of thirst can be up to 85.4%⁽⁵⁾. Thirst, perceived as dryness of the oral cavity, is mostly reported by these patients, due to reduction in salivary production due to using anticholinergic medications, opioids and prolonged intubation⁽⁴⁾.

Studies show that the thirst regulating center, in the lamina terminalis, receives stimuli, not only from changes in osmolarity and blood flow volume, but also from those coming from the oral cavity^(6,7). Thirst satiety, therefore, cannot be obtained only by correcting blood osmolarity, through intravenous infusions, it also requires care and attention to oral mucosa hydration⁽⁸⁾.

In order to re-establish oral mucosa hydration and thus alleviate individuals' perception of thirst, research has assessed strategies whose mechanism of action is the stimulation of both production and increase in salivary flow. These strategies can be divided into salivary substitutes, such as

artificial saliva, and salivary stimulants, such as ice popsicle, ice popsicle associated with menthol, and menthol chewing gum^(9, 10).

It is noteworthy that menthol chewing gum can influence gastric content in several ways, including increased saliva and swallowing, increased gastric secretions, while altering gastric emptying. These actions can be observed through mechanical and chemical stimulation, which promote a 15% and 85% increase in salivary flow, respectively^(4,11,12).

Healthy adults normally produce 500 and 1,500 mL/day of saliva, with a basal flow of about 0.5 mL/min. The normal pH range is between 6 and 7 for unstimulated saliva, while it can extend from 5.3 to 7.8, when the flow rate changes. The relevance of assessing gastric juice pH lies in the potential for damage to the lung parenchyma, in case of bronchoaspiration, if it is too acidic^(13,14,15,16,17).

A meta-analysis study assessed the effects of chewing gum preoperatively, considering that the volume required to cause a serious risk is 0.8 mL/kg for healthy individuals. If a volunteer remains fasting, they may have a gastric juice volume of up

to 500 mL/kg/h. In healthy volunteers, the total stimulated rate of saliva is 6.6 mL/min⁻¹ for the first minute of chewing, decreasing to 1.5 mL/min⁻¹ within 15 minutes. Thus, chewing gum for 15 minutes would generate an increase in gastric volume of a maximum of 23 mL. These data indicate the benefit of chewing gum and show a low risk of the strategy to cause bronchoaspiration^(14,18).

Nevertheless, it is observed that, in clinical practice, chewing gum is contraindicated, reinforcing the need for absolute fasting for patients in the preoperative period. Thus, fasting periods are much longer than those recommended in evidence guidelines. As a consequence, the prolonged fasting time can lead to a change in the hydrogenic potential (pH), making it more acidic, and salivary flow, influencing oral cavity hydration and, consequently, the occurrence of dry mouth and thirst^(13,14).

Chewing gum is presented as an alternative to reduce patients' thirst, by rehydrating the mucosa of the oral cavity. At the same time, it increases saliva production and gastric volume, increasing the pH^(19,20,21,22). This factor, however, causes

the fear of adverse effects, such as bronchoaspiration, leading to calling off or postponing surgical procedures, if patients have received a chewing gum. Thus, this study aimed to measure pH and salivary volume before and after menthol chewing gum use by healthy volunteers, which will allow us to assess whether this strategy can be considered to safely reduce patients' thirst in clinical practice.

METHOD

This is a quantitative, quasi-experimental, pre-test and post-test study. It was carried out in the clinical analysis department of a tertiary-level public hospital in the state of Paraná, from March to May 2019. Students or/and employees of the study public hospital between 18 and 60 years old who do not have salivary dysfunctions (Sjögren's syndrome, chronic xerostomia, salivary gland hypofunction due to cystic fibrosis) were included⁽²³⁾.

Volunteers who reported an allergy to menthol or another component of the gum were excluded. The sampling technique was

non-probabilistic for convenience. The number of participants was all the volunteers who were present during the collection period. The final sample consisted of 45 volunteers.

Those who, upon being invited, accepted to participate in the research, received a folder with guidelines for carrying out the study, such as remaining in absolute fasting for eight hours before the test, not smoking, not consuming alcoholic beverages and not using products for oral hygiene on the day of the exam, as they are considered factors that influence salivary composition and stimulation, inhibiting or increasing secretion⁽¹⁹⁾.

The guidelines regarding salivary flow collection were delivered in a folder to the study participants, such as fasting from solids and liquids for 8 hours, not exercising on the day of collection, not brushing teeth, not drinking alcohol for up to 24 hours before collection.

A pilot test was carried out with seven volunteers with the aim of refining and testing aspects related to data collection procedures, and these data did not make up the final sample.

The material used for the

intervention was 14 grams of Trident menthol chewing gum, commercially available, composed of sweeteners, gum base, bulking agent, flavors, wetting agent, thickener, emulsifiers (sunflower lecithin), coloring agents, coating agent and antioxidant.

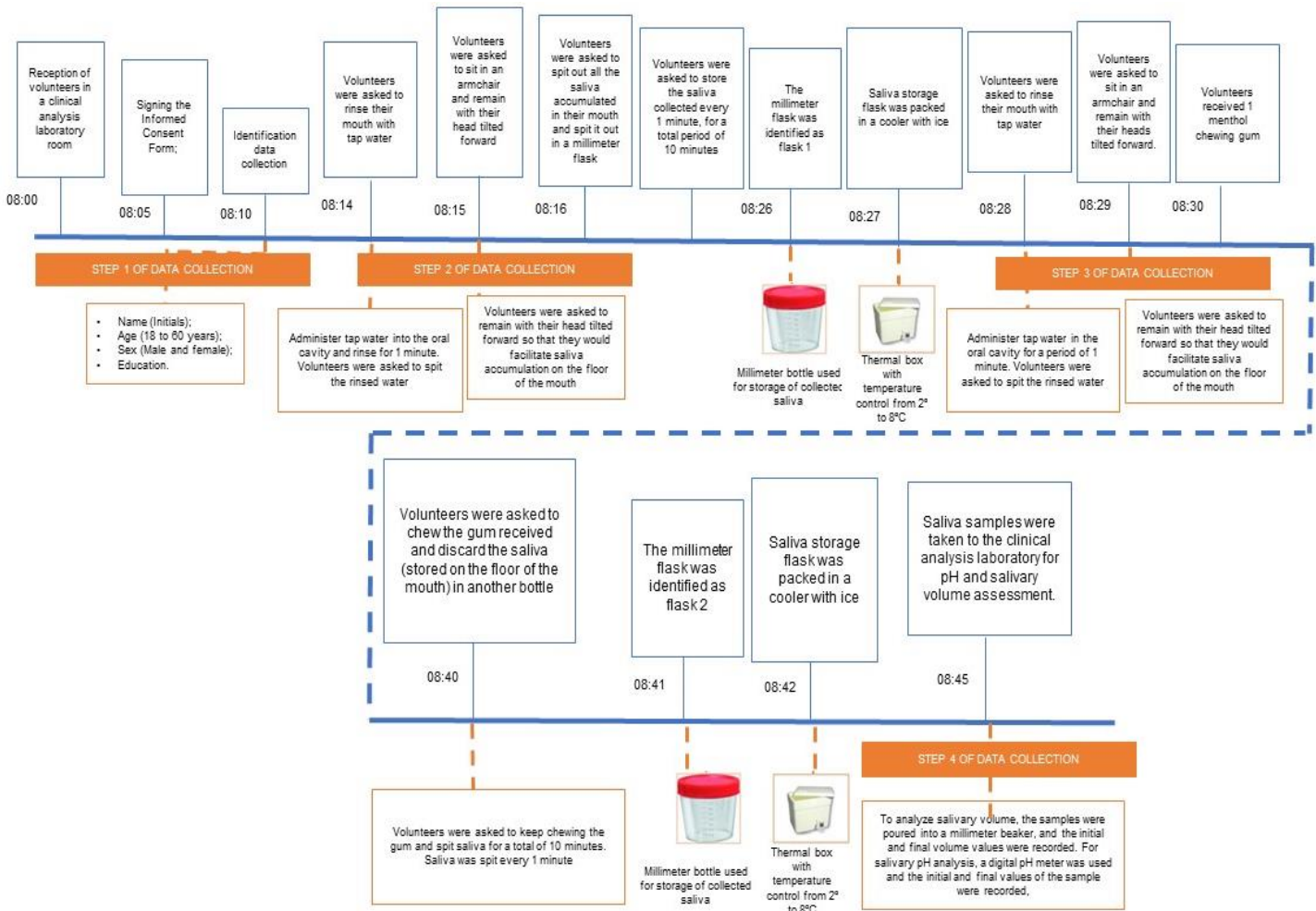
Salivary volume was collected using the spitting technique⁽²⁴⁾. This method is known as the unstimulated saliva collection method, which minimizes saliva evaporation in cases of long-term collections and can be used when the flow rate is very low^(19, 23). Volunteers were asked to accumulate saliva on the floor of the mouth and then spit it out into a millimeter container before and after the intervention, for a period of 10 minutes. Thus, 50 milliliters (mL) glass test tubes and digital pH meter were used to analyze salivary pH.

Data collection was divided into four stages, according to the flowchart below:

Once the collection was completed, flasks 1 and 2, with their respective samples, were taken to the laboratory, where pH analysis was performed using a pH meter. To obtain real pH values, the instrument was first calibrated with two solutions of standardized pH values (4.0 and 7.0). The pH

meter is a laboratory instrument that combines the possibility of measuring pH, which varies in the range from -2.0 to 20.0. The Ph meter was calibrated with a

KCl solution and, afterwards, the device's electrode was immersed to assess salivary pH(25).



Source: the authors, 2019.

Figure 1 – Data collection flowchart. Paraná, Brazil, 2019

Data were double-typed and tabulated in Microsoft Excel®. Statistical analysis was performed using R version

3.5.3. Analysis of central measurements (mean and standard deviation) for age (years), pH and salivary

volume (milliliters) was performed. The sex variable (male and female) was described in absolute and relative frequencies. Normality compliance was verified by the Lilliefors test. The pH variable was normally distributed, but the salivary volume variable was not normal. For the hypothesis test, Student's t test was used for the pH variable, and the Wilcoxon test for the salivary volume variable, with a 99% confidence level for paired samples.

The research was approved by the Research Ethics Committee, under Opinion 1.770.051 and Certificado de Apresentação para Apreciação Ética - Certificate of Presentation for Ethical Consideration (CAAE) 59936316.5.0000.5231.

RESULTS

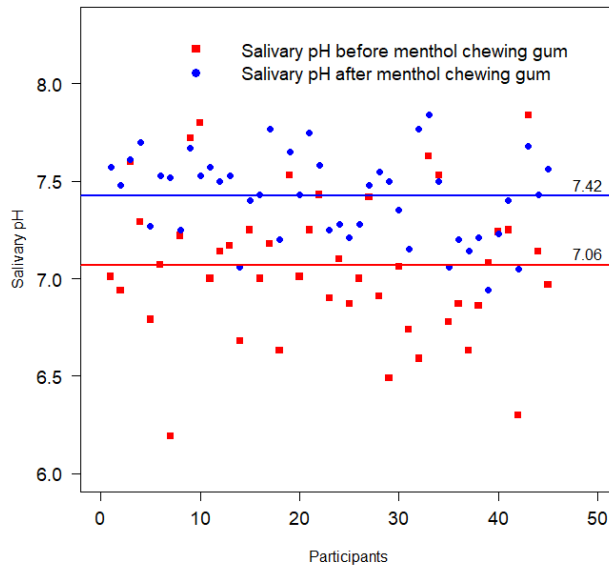
The sample consisted of 45 healthy volunteers, being 84.4% (n=38) female and 15.6% being (n=7) male. The mean age of all subjects was 23 years (SD=4.2).

In Figure 2, pH values are observed before and after volunteers received a

menthol chewing gum. The initial mean salivary pH was 7.06 (SD=0.36). The mean salivary pH found after using a menthol chewing gum was 7.42.

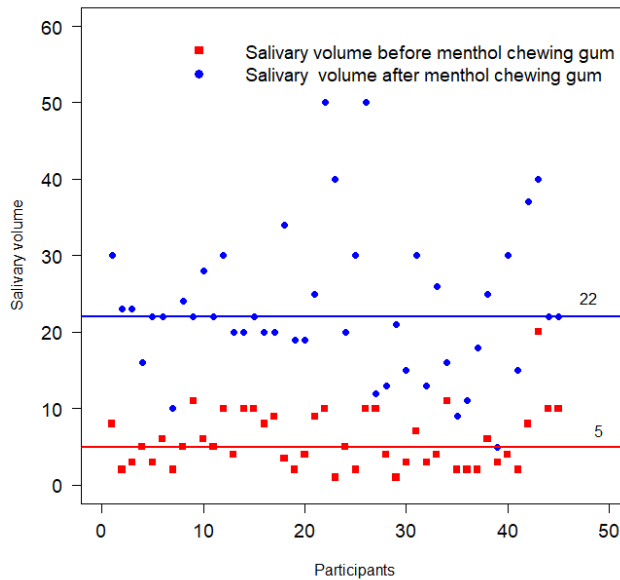
Figure 3 shows the distribution of salivary volume values before and after the intervention with menthol chewing gum. It is also possible to observe a significant difference between the salivary flow samples. During the first stage of collection, the median of the samples was 5.95 mL (SD=3.86). In the second stage, the mean increased to 23.13 mL (SD=9.69). Salivary flow increase was statistically significant ($p<0.005$) after menthol chewing gum use.

Table 1 presents the distribution of pH and salivary volume before and after the intervention with menthol chewing gum. It is verified that pH and salivary volume increase was significant after menthol chewing gum use ($p<0.01$).



Source: the authors, 2019.

Figure 2 - Distribution of hydrogen ion potential values before and after intervention with menthol chewing gum in healthy volunteers (n=45). Paraná, Brazil, 2019



Source: the authors, 2019.

Figure 3 - Distribution of salivary volume values in mL before and after the intervention with menthol chewing gum in healthy volunteers (n=45). Paraná, Brazil, 2019

Tabela 1 - Análise do pH e volume salivar antes e depois em voluntários saudáveis. Paraná, Brasil, 2019

Variable	Mean	SD	P
pH before	7.06	0.36	<0.01
pH after	7.42	0.22	
Variable	Median	IQR***	P
Salivary volume before	5	3.86	<0.01*
Salivary volume after	22	10	

* Student's t test, 99% confidence level, paired samples; **Wilcoxon test, 99% confidence level, paired samples; ***Interquartile range.

Source: authors data, 2019.

DISCUSSION

The relevance of this study consists in proving salivary flow increase and saliva alkalization after using menthol chewing gum, a strategy that has been shown to be effective in increasing oral cavity humidity.

In the present study, it is observed that the mean pH after menthol chewing gum administration showed significant alkalization, when compared to the initial pH of the samples in flask 1. The same occurred with salivary volume. This demonstrates that, statistically, there is a significant

relationship between pH and salivary volume, especially as a result of increased masticatory stimulation.

A similar result was found by a study carried out with 100 students aged 10 and 12 years, which aimed to know the effectiveness of commercially available chewing gum (sugar-free) on salivary flow rate and pH in children with active decay and without decay. In both groups, the flow rate and salivary pH increased. It is argued that when salivary flow increases, there is improvement in swallowing and oral humidification, there is a reduction in antidiuretic hormone (ADH),

dilution of gastric juice and, consequently, alkalization of salivary pH. Alkalinization of salivary pH leads to an increase in the concentration of protein, sodium, chloride, bicarbonate and a reduction in magnesium and some types of phosphates. These substances are important for the digestion process. Salivary flow rate increase is an important factor in increasing salivary pH⁽²⁶⁾.

In a study with 60 dialysis patients undergoing hemodialysis, chewing gum was used to assess the effects on dry mouth (xerostomia) and low salivary flow during the treatment period. After using the chewing gum for only ten minutes, the results showed a decrease in xerostomia, a progressive increase in salivary flow and an apparent decrease in thirst throughout sessions⁽²⁷⁾. These results show the standardization of salivary flow collection time and the effectiveness of chewing gum in significantly increasing salivary flow, supporting the results found in the present study.

In another study, whose method used was the randomized clinical trial with 102 patients, the effectiveness of menthol chewing gum as a strategy to reduce thirst

intensity and discomfort during preoperative fasting was identified. This occurred through gum masticatory and chemical stimulation, in addition to the activity of menthol on oropharyngeal receptors⁽²⁹⁾.

During the perioperative period, the surgical patient may experience several discomforts, such as anxiety, fear and stress. These symptoms can lead to dryness of the oral cavity. The dry mouth symptom is one of the uncomfortable attributes identified in perioperative thirst, and may be due to prolonged fasting period^(28,29). Strategies that act on pre-absorptive satiety of thirst are presented as viable alternatives for patients who need to undergo water restriction. Among these strategies is menthol chewing gum. Symptoms of lack of saliva or oral dryness may be precipitated by oral mucosa dehydration, which occurs when the major and/or minor salivary gland production decreases and the layer of saliva covering the oral mucosa is reduced^(4,5,7,10,29).

The myth that chewing gum is contraindicated during the traditional preoperative fasting period still has a strong presence in clinical practice. In addition to

this, few studies have assessed its use and benefits for improving the oral cavity's condition in the preoperative period.⁽²⁹⁾

It is observed in clinical practice that many anesthesiologists believe that chewing gum should be prohibited during this period, due to the fear of increased stomach content due to greater production of gastric juice during the cephalic masticatory phase⁽³⁰⁾. Another reason is gastric content increase due to the greater salivary flow, increasing the amount of saliva swallowed, assuming that this is a risk for bronchoaspiration. However, the fact that, although a specific volume above which bronchoaspiration risk increases, has not been determined, gastric volumes of up to 1.5 mL/kg (about 100 mL for the average adult) are common in fasting individuals⁽¹⁸⁾.

In a study that assessed gastric content through ultrasound, 80 volunteers fasted overnight. At the end of the period, exams were performed two hours after the ingestion of 200 mL of isotonic solution. The next day, the procedure was repeated with the ingestion of 500 mL of isotonic solution, exposure to two hours of fasting. The ingestion of 200 ml or 500 ml showed no

difference in residual gastric volume after the two-hour fasting compared with the eight-hour fasting⁽²⁸⁾.

Another study carried out with 55 healthy volunteers aimed to determine whether a chewing gum used for 1 hour was capable of altering gastric volume. Volunteers were instructed to fast for 1, 2 and 3 hours and then underwent an ultrasound examination. No solid or thick fluid content was observed. The proportion of subjects who had an empty stomach was high (approximately 80% of the sample), remaining practically unchanged throughout the study period⁽²⁹⁾.

These results reinforce the findings of this study, indicating that chewing gum before surgery with at least 10 minutes of use, 2 hours before a surgical procedure, should not be a reason for postponing or calling off a surgery, as chewing gum for 1 hour does not significantly affect gastric volume in healthy fasting subjects⁽²⁹⁾. Also, the gum acts by alkalinizing salivary pH, reducing bronchoaspiration risk, because the more acidic the pH, the greater the risk of occurrence⁽¹³⁾.

One of the initial limitations of this research was the sample size, composed of a

relatively small number of participants, 45 volunteers, which influences the possibility of data generalization, and our results can be applied only to groups similar to those used in this study. It is also worth mentioning participants' difficulty to remain fasting. Some volunteers dropped out, because they did not observe the water and food restriction guidelines for data collection, as some reported water intake habits during the night.

Despite the limitations identified, it is considered that the study carried out made it possible to identify menthol chewing gum use to safely increase salivary pH and volume.

CONCLUSION

It was observed that the mean pH and salivary volume increased significantly after using menthol chewing gum, with a statistically significant difference. However, this increase does not represent bronchoaspiration risk. Therefore, the results of this study show that chewing gum can be considered an alternative to improve oral cavity humidification in patients with water restriction, without a significant

bronchoaspiration risk increase.

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