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# Effect of sorbitol on salivary flow rate

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## Abstract

**Aim:** The aim of the study is to investigate if the increased salivary flow rates obtained on chewing gum artificially sweetened with sorbitol is due to mastication or the active constituent of the gum i.e, sorbitol.

**Materials and Methods:** The study consisted of 30 volunteers from Coorg Institute of Dental Sciences. The materials used in the study were sorbitol sweetened gums (SSGs), liquid sorbitol (LS) 70% concentration I.P from the company Gayatri Bio Organics Limited, paraffin wax (PW), and graduated beaker for measuring the saliva. The study was conducted in the morning hours from 9 am to 10 am by collecting un-stimulated saliva (US) from the subjects and by asking each of the subject to consume all the 3 constituents after each of which saliva was collected and measured using a calibrated beaker.

**Results:** Pairwise comparison was done between US and saliva obtained after LS, SSGs, PW among the entire 30 subjects and also comparison between all the four groups using paired sample *t*-test. The pairwise comparison showed a significant difference between mean US and mean saliva obtained from SSGs and LS, but no significant difference was found between US and saliva obtained after chewing PW. The comparison between all four groups showed that there was no significant difference between LS and SSG $P = 0.346$, there was a significant difference between LS and PW $P = 0.001$ and also between SSG and paraffin $P = 0.001$.

**Conclusion:** Sorbitol the active ingredient of artificially sweetened gums seems to be responsible for the increase in salivation rather than the act of mastication.

## Introduction

Saliva is a key element that protects the oral mucosa and teeth against harmful substances, lubricates the mouth to facilitate chewing swallowing and speech and reduces tissue trauma.[1] This complex fluid is an exocrine secretion where the various constituents are alone or in the consent to perform different functions in the oral cavity.[2] Its buffer acids, helps prevent gingival mucosal erosions and aid in tooth remineralization.[3] The daily salivary secretion rates range to between 500 and 700 ml and the average volume in the mouth is 1.1 ml. At rest, secretion ranges from 0.25 to 0.35 ml/min. Sensory, electrical, or mechanical stimuli can rise the secretion rate to 1.5 ml/min. when the normal un-stimulated salivary flow rate is reduced by 40-50%, the subject experiences the sensation of dry mouth.[4]

When salivary function is diminished, there is more risk of patients developing caries, experiencing denture discomfort and having diseases like candidiasis.[3] Up to 40% of the general population is estimated to experience xerostomia or dry mouth with aging. Dry mouth can be caused by conditions such as diabetes and autoimmune disease, prescription and nonprescription drugs, and other medical problems like allergy. Chewing tobacco, mouth breathing, or using continuous positive airway pressure for apnea also causes oral dryness.[5]

Several investigators suggested the clinical use of sugar free chewing gums for the relief of patients with xerostomia/hyposalivation.[6]

Gustatory stimulation of salivary glands by mastication of sugar free chewing gums or lozenges is said to be helpful. In severe cases, saliva substitutes or salivary stimulants may be used.[7] On chewing sugar free gum, salivary production is stimulated, and an additional volume of saliva is produced, thus, beneficial for patients with dry mouth.[6] The polyols most frequently used in chewing gum are sorbitol, a hexatol derived from glucose, and xylitol, a pentatol that occur widely in nature.[8] It has been shown that on chewing flavored gum, the salivary flow rate increases

initially but declines as the flavor is lost from the gum, and as the gum softens with chewing.[6] Thus, doubt exists as to whether it is the act of chewing itself or the active constituent of chewing gum that causes the increase in salivary secretion. Thus, the aim of the study is to determine, if it is the active constituent of the sorbitol that produces the increased salivary flow rate and if so can it be used as an adjuvant to sugar free sweetened gums.

## Materials and Methods

The study consisted of 30 volunteers from Coorg Institute of Dental Sciences that included 24 females and 6 males, aged 20-30 years. Patients with any pathology were excluded from the study. The materials used in the study are graduated beaker [Figure 1] for measuring the saliva, sorbitol sweetened gums (SSGs), liquid sorbitol (LS) 70% concentration I.P from the company Gayatri Bio Organics Limited [Figure 2], paraffin wax (PW) [Figure 3]. The study was conducted in the morning hours from 9 am to 10 am.

The study was conducted in four steps.

### Step 1

Volunteers were asked to collect un-stimulated saliva (US) in their mouth for 2 min and spit into a graduated beaker, and the saliva flow rate was measured and the values were noted.

### Step 2

The subject was then asked to rinse his/her mouth with LS 70% concentration and was asked to collect the saliva in the similar manner as in Step 1.

### Step 3

The subject was then recalled the next day, and was asked to chew SSG for 1 min and was asked to collect saliva while doing so. The saliva was collected and measured as in Step 1 and Step 2. Steps 1-3 were conducted in the morning hours from 9 am to 10 am.

### Step 4

The subject was recalled the next day in the morning hours and was asked to chew PW for 1 min and saliva was collected and measured in a similar way as in the previous steps.

### Statistical analysis

Pairwise comparison was done between US and saliva obtained after LS, SSGs, PW among the entire 30 subjects and also comparison between all the four groups using paired sample *t*-test.

## Results

The mean value of US obtained was 2.25 ± 1.04, mean stimulated saliva obtained after LS was 4.38 ± 1.24, after sorbitol sweetened


**Figure 1:** Graduated beaker

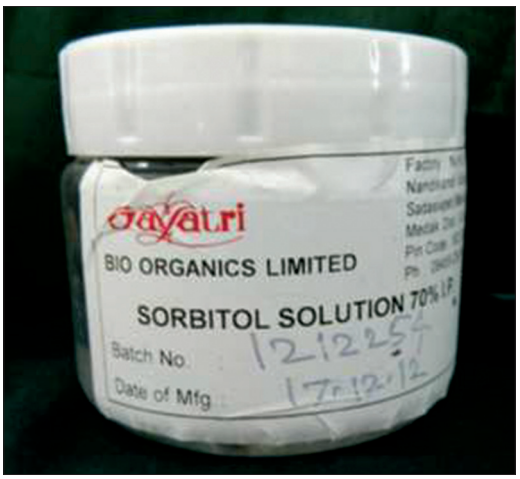


**Figure 2:** Liquid sorbitol 70% concentration I.P from the company Gayatri Bio Organics Limited

**Figure 3:** Paraffin wax

**Table 1:** Descriptive statistics-pair wise comparison using paired sample *t*-test

| Group | *N* | Mean (SD) | *t* value | *P* value (<0.05) |
|---|---|---|---|---|
| Pair 1 | | | | |
| US | 30 | 2.25 (1.04) | −9.28 | 0.001* |
| LS | 30 | 4.38 (1.24) | | |
| Pair 2 | | | | |
| US | 30 | 2.25 (1.4) | −5.416 | 0.001* |
| SSG | 30 | 4.03 (1.75) | | |
| Pair 3 | | | | |
| US | 30 | 2.25 (1.04) | −3.315 | 0.002* |
| PW | 30 | 2.95 (0.91) | | |

US: Un-stimulated saliva, LS: Liquid sorbitol, SSG: Sorbitol sweetened gum, PW: Paraffin wax, * Significance, SD: Standard deviation

**Table 2:** Paired sample statistics between all four groups

| Group | Mean (SD) | *t* value | *P* value (<0.05) |
|---|---|---|---|
| Pair 1 | | | |
| LS and SSG | 0.3500 (2.0006) | 0.958 | 0.346 |
| Pair 2 | | | |
| LS and PW | 1.4333 (1.3244) | 5.928 | 0.001* |
| Pair 3 | | | |
| SSG and PW | 1.0833 (1.5374) | 3.860 | 0.001* |

US: Un-stimulated saliva, LS: Liquid sorbitol, SSG: Sorbitol sweetened gum, PW: Paraffin wax, *Significance, SD: Standard deviation

gum was 4.03 ± 1.75 and the US obtained after chewing PW was 2.9 ± 0.91. The pairwise comparison showed a significant difference between mean US and mean saliva obtained from SSGs and LS, but no significant difference was found between US and saliva obtained after chewing PW [Table 1].

The pairwise comparison between all four groups show that there was no significant difference between LS and SSG $P = 0.346$, there was a significant difference between LS and PW $P = 0.001$ and also between SSG and paraffin $P = 0.001$ [Table 2].

## Discussion

Sugarless gums were introduced in early 1950s with Sorbitol used as a sugar substitute. The first brand to be marketed was Harvey's followed by Trident and Carefree in 1975. The main ingredients of a modern day chewing gum are the combination of powdered cane or beet sugar (50-65%) chewing gum base (18-30%) corn syrup (12-20%) color and flavoring agents (1-2%) and softeners (0.3-3%). In sugar-free gums sugar substitutes used are commonly sorbitol, mannitol or xylitol, or intense sweeteners like aspartame the other substances present are acacia, acesulfame potassium, butylated hydroxylated toluene etc.[9]

Sugar alcohols cause abdominal pains and diarrhea, aspartame lowers IQ, causes insomnia, muscle spasm etc., xylitol and acesulfame potassium present in chewing gum are carcinogens. While sorbitol, also known as glucitol, is a sugar alcohol, which the human body metabolizes slowly. Most sorbitol is made from corn syrup, but it is also found in apples, pears, peaches, and vegetables thus safe for consumption. Sorbitol is more slowly absorbed from the alimentary canal than ordinary dietary sugars and is preferentially and efficiently metabolized in the liver.[10]

The major benefits of sugar-free chewing gum are mediated through oral physiology stimulation of the salivary glands to produce a strong flow of saliva ( 10-12 fold increase over US) is elicited by a combination of masticatory and gustatory stimuli. Although saliva flow rates are the highest during the first 5 to 7 min of chewing, when the sweeteners and flavor release are maximal, a two-fold increase in flow rate (over unstimulated flow) is maintained for as long as the gum continues to be chewed.[11]

A lot of studies point out to, the masticatory process as being the reason for the increase of the salivary secretion. While it has been found in the present study, on a comparative basis that both LS and SSG have shown a significant increase in the salivary flow rate to a relatively similar extent.

Chewing of paraffin also increased the salivary flow rate but the secretion was less when compared to LS or SSG. In accordance with the results of the study, we propose that it is the sorbitol content of the gums that increases the salivary flow rate and the contribution of masticatory stimulus is secondary.

## Conclusion

Thus, using a sorbitol mouth rinse would be more beneficial than sweetened sugar free chewing gum in the treatment of hyposalivation, as it would consist of only one component, i.e. sorbitol and there is no systemic intake of the same through the gut.

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