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Salese to Buffer Saliva in Elderly Patients with Xerostomia: a Pilot Study

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Abstract

Purpose: The objective of this study was to compare the pH of saliva from xerostomic patients before and after the use of Salese lozenges (Nuvora Inc., Santa Clara, CA).
Materials and Methods: After IRB approval, ten subjects were selected to participate in this pilot study to evaluate the efficacy of Salese. The inclusion criteria were patients on multiple medications who demonstrated xerostomia and acidic salivary pH. Saliva was collected from the patients at baseline and after the use of Salese at selected intervals up to 120 minutes. The pH of the collected saliva was measured, and the data were analyzed using an ANOVA.
Results: Use of Salese lozenges showed a shift toward a more neutral pH in the first half hour. The pH remained at the same level after the primary shift for at least 2 hours.
Conclusions: This pilot study indicates that patients suffering with xerostomia can use Salese lozenges for at least 10-30 minutes to induce a salivary pH shift to a more neutral level. More research should be performed to investigate the buffering capacity of Salese lozenges.

Xerostomia (dry mouth) is the subjective feeling of oral dryness. It is generally accompanied by salivary gland hypofunction and a reduction in the secretion of unstimulated whole saliva. The normal range is very large and includes individuals with very low flow rates who do not complain of dry mouth. Values below 0.1 ml/min are considered hyposalivation.[1] Navazesh et al described a useful diagnostic algorithm to identify a patient at risk of developing xerostomia, and asserted that a simple questionnaire is effective to assess a dry mouth.[2]

Unstimulated whole saliva is the mixture of secretions entering the mouth in the absence of exogenous stimuli such as chewing. The average value for whole saliva is about 0.3 ml/min and pH 6.[1,3–5] There is a significant difference between genders in unstimulated flow rates.[3,6,7] Men have higher flow rates than women due to the size of the salivary glands. In menopause many women suffer from xerostomia, and this condition worsens with age. Salivary flow rates are also affected by a variety of conditions such as stimulus, vomiting, smoking, gland size, gag reflex, olfaction, unilateral stimulation, and food intake.[1,3,6]

Reduced salivary flow may cause different, mostly unspecific symptoms in the patient.[8] Saliva influences caries incidence mainly by its rate of flow and its fluoride content. Salivary flow rate influences the rate of oral and salivary clearance of bacterial substrates.[1,9,10]

Saliva includes three major buffering systems that help maintain neutral pH level in whole saliva: carbonic acid/bicarbonate, phosphate, and protein. The bicarbonate concentration is strongly dependent on secretion rate. Since bicarbonate is the chief determinant of buffer capacity, there is an interrelationship between pH, secretion rate, and salivary buffering capacity, which is affected by reduced salivary flow.[1,3]

Multiple factors, including systemic diseases, prescription and nonprescription medications, head and neck radiation therapy, psychogenic factors, and decreased mastication, cause salivary hypofunction.[11] The most common cause of salivary gland hypofunction is the intake of medicaments, over 400 of which possess the ability to diminish the flow of saliva. Salivary gland changes associated with multiple medication therapy are well documented.[1,6] The feeling of dryness increases with the number of drugs taken per day. Their effect can be reversed after discontinuing the drugs, as they do not cause permanent damage to the structure of the salivary glands. Clinically, the most important classes of drugs that continuously diminish the flow of saliva are antidepressants, anticholinergics, antihistamines, diuretics, and antihypertensive agents.[6,7,12]

The mechanism of many of these medications is the competition for acetylcholine release at the parasympathetic effector junctions.[1,3,6,7,12] Furthermore, drugs that inhibit neurotransmitters from binding to salivary gland membrane receptors, or those that affect ion transport pathways in the acinar cell, contribute to the quality and quantity of salivary output.[7]

In elderly patients taking multiple medications for chronic diseases, less xerostomic effect is observed with low doses of the drug. The chronicity and longevity of the disease causes more salivary gland changes.[1,2,13]

Changes in salivary gland hypofunction contribute to dysphagia, eating difficulties, poor oral hygiene, taste alterations, and oral infections, especially those from *Candida albicans.* Bacterial substrates impacted by changes in saliva increase patients' susceptibility to infections and mucous membrane degradation, leukoplakia, and ulcerations. Seymour and Rudralingham described changes in the salivary glands with compromised glandular secretions and resultant pain.[5]

Changes in the quantity and quality of saliva are exhibited in a shift in salivary pH toward acidity. Parvinen and Larmag reported a highly significant correlation between salivary flow and salivary pH, and that a low flow rate favors the occurrence of salivary yeast and *lactobacilli.*[11]

The acid shift of saliva supports the colonization of *Candida* and increases the potential for demineralization of teeth with the consequence of caries. Long-term effects of multiple medication therapy can result in an increase in dental caries and poor use of removable prostheses due to diminished lubrication of oral mucosa.

The lubricating action of saliva facilitates the movements of the tongue and lips during swallowing and eating and is important for clearly articulated speech. The efficacy of saliva as a lubricant depends on its viscosity and changes in shear rate, content of mucins and proline-rich proteins, and is greatly influenced by pH and calcium.[14] Increased salivary viscosity due to diminished flow rate and pH may increase the risk of caries.[3,4]

The use of buffering agents to maintain a neutral salivary pH would be helpful to patients. Clinicians have in the past recommended the use of chewing gum or sodium bicarbonate powder dissolved in water as one therapeutic method of buffering acidic saliva.[15-19] Neyraud et al found that the mechanical action of chewing of salted chewing gum could increase salivary production but for a very short period of time.[17] In a study by Gil-Montoya et al, a mouthwash and an oral gel containing lactoperoxidase, lactoferrin, and lysozyme were able to reduce some aspects of xerostomia in elderly subjects.[20]

A lozenge, Salese, developed by Nuvora (Santa Clara, CA), incorporates sodium bicarbonate and may extend the saliva buffering time for these patients. The effectiveness of this lozenge in buffering-compromised saliva has not been evaluated to date in the published literature.

Objectives of pilot study

The objective of this study was to measure the oral saliva pH of ten elderly subjects receiving multiple medication therapy. In ten subjects, salivary pH was determined before the test and after the use of the Salese lozenge for a period of up to 120 minutes or until the lozenge was dissolved.

Subjects had to meet the following criteria to be eligible for this study:

1. The patient had to be a recipient of one or more of the 450 available medications known to cause dry mouth (xerostomia).
2. The patient should not have any observable damage to the major and/or minor salivary glands.
3. The patient must be 60 years of age or older.

Subjects were not eligible for this study if they had:

1. A life expectancy of less than 6 months.
2. Severe-to-moderate inflammation of the oral mucosal tissues (mucositis).
3. Dementia, Alzheimer's, Parkinson's, or related degenerative psychological or physical medical conditions that would prevent the patient from completing the study or providing informed consent.

Materials and methods

After IRB approval (HPD-DEN02259017Exp), ten subjects were recruited in the Postgraduate clinic of Nova Southeastern University College of Dental Medicine. All patients were pretested for acidic salivary pH in order to participate in this study. Ten subjects, three women and seven men with ages from 62 to 80, were recruited for this study (mean age 70.3). Six subjects were partially dentate, two were fully dentate, and two were edentulous. After the dental screening exam and dental records check, the patients signed written informed consent.

Each subject answered ten short questions for a Quality of Life (QoL) survey. A health status survey was completed. The subjects then were asked to expectorate into a medicine cup to collect their saliva. The saliva pH was measured using pH indicator strips (nonbleeding) with a range of 2.0 to 9.0 and measured against the standards assigned by the manufacturer. Patients without enough saliva to measure were given tap water

Table 1 Distribution of subjects according to age, gender, and medications

#	Gender	Age	Dentate state	Medication(s)
1	M	70	P	Atenolol, Prozac
2	F	80	P	Diavan, Symbacord, Syncroid
3	M	78	P	Glucophage, ibuprofen
4	M	72	D	Fosamax, Simvastatin
5	M	67	D	Nexium
6	M	63	P	Caletra, Metformin, Oxadron, Viramune, Crestor, Previcid, Actos, Zerit, DDI
7	M	70	E	Atenolol, Nexium
8	F	69	P	Zopenopril, Lyrica
9	F	65	E	Leflunomide, Naproxen, Medrol
10	M	69	P	Insulin, Captopril

P = Partially dentate; D = Fully Dentate; E = Edentulous.

Table 2 pH of saliva at different time intervals

Subject	Baseline pH	10 min	30 min	1 hr	2 hr
1	5.5	5.5	6.0	6.0	6.0
2	5.0	5.5	5.5	5.5	5.5
3	5.5	6.0	6.0	6.0	6.0
4	6.0	7.5	7.5	7.5	7.5
5	5.5	7.0	7.5	7.5	7.5
6	5.5	6.0	6.0	7.5	7.5
7	5.5	6.0	6.0	7.0	7.0
8	5.5	6.0	6.0	7.0	7.0
9	5.5	6.0	6.0	6.0	6.0
10	5.5	6.0	7.5	7.5	7.5

with pH 7.0 and asked to rinse the mouth and expectorate into a medicine cup. The baseline salivary pH was then determined on this sample. Thus, each patient served as his/her own control with the baseline pH.

The subjects were given the Salese lozenge, and the saliva pH was measured again at 10-, 30-, 60-, and 120-minute time intervals. All subjects were tested at least 2 hours after the morning meal to minimize variation. The pH measurements at each of the time intervals ceased once the lozenge was completely dissolved or at a maximum time of 120 minutes. The lozenge is reported by the manufacturer to take about 1 to 1.5 hours to completely dissolve.

Results

The following data were collected for ten subjects who were eligible to participate in the study (Tables 1 and 2). In all subjects, use of the lozenges improved the salivary pH from 5.5 to 6.25 (mean data) in 10 minutes and continued the pH shift to 6.75, which remained for 2 hours. In some subjects, pH increased in the next hour. In the majority of patients, pH remained at the same level after a primary shift, which occurred within 30 to 60 minutes. The pH remained at the same level for at least 2 hours.

Table 3 Statistical data

Time/ measure/value	Baseline	10 min	30 min	1 hour	2 hour
Mean	5.50	6.25	6.50	6.75	6.75
SD	0.24	0.68	0.78	0.79	0.79
Min	5.00	5.50	5.50	5.50	5.50
Max	6.00	6.75	7.50	7.50	7.50

Data were analyzed using a repeated measures ANOVA (Fig 1, Table 3). Data from this pilot study indicated that Salese lozenges can buffer the salivary pH in xerostomic patients in the first 30 minutes. The pH remained at same level for at least 2 hours. There was no difference in the pH shift in the dentate, partially dentate, or edentulous patients.

All subjects filled out the QoL questionnaire (Appendix). Seven of the ten patients admitted they could not eat certain types of food. Four of ten mentioned the feeling of dry mouth, and four of ten reported their mouth and gums were sensitive. The pretest and posttest questionnaire QoL of the study subjects remained essentially the same.

Discussion

Four of the ten subjects with symptoms of xerostomia experienced a feeling of dry mouth and increased sensitivity of the gums. They reported the need to drink more water to avoid a feeling of dry mouth and usually had a saliva pH below 6.0. Although some patients in the early phase of multiple medication therapy may develop the symptoms of a dry mouth, salivary pH can still be close to neutral, or 6.5 to 7. The goal of the current study was to evaluate the salivary shift after use of lozenges; thus, only patients with acidic saliva (pH < 6) were recruited for the study.

Subjects with different diseases were included in the study. The most common diseases in these subjects were arterial hypertension, diabetes, and arthritis. Other diseases and conditions in this group were depression, asthma,

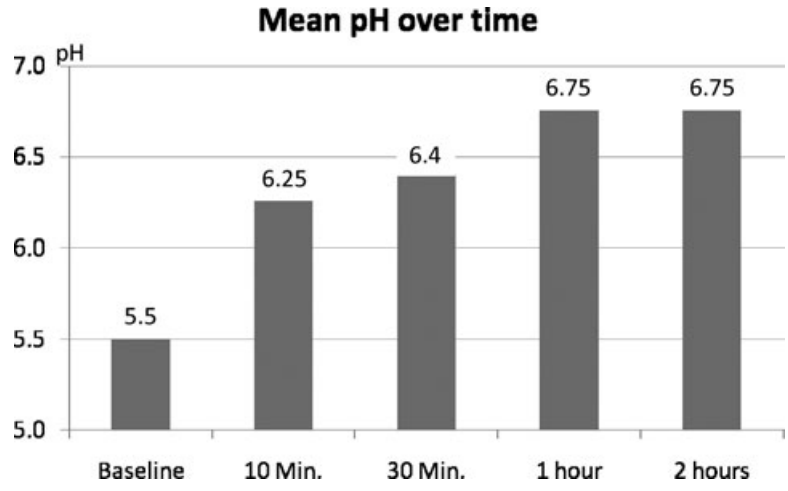

Figure 1 Change in pH over time.

thyroid disturbances, HIV, and artificial joint prosthesis. The subjects recruited for this pilot study took a variety of medications. The most common were Atenolol, Prozac, Nexium, Fosamax, and Naproxen. The most common medications known to cause xerostomia are antidepressants, muscarinic and alpha-receptor antagonists, and diuretics.[7] Thus, patients involved in the current study were recipients of the most common xerogenic medications.

Conclusions

Salivary pH in elderly patients with multiple medication therapy and acidic saliva was improved by the use of Salese lozenges. Patients suffering with xerostomia may use Salese lozenges for at least 10 to 30 minutes to increase salivary pH. This pilot study should be followed by an expanded study to evaluate the effect of the lozenges in a larger population. Further research should be performed to evaluate the long-term use of these lozenges and their impact on xerostomia.

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Appendix: Quality of life questionnaire

1) Are you having problems with dry mouth?	yes	no
2) Are there foods that you cannot eat?	yes	no
3) Do you have trouble swallowing?	yes	no
4) Do you have problems opening your mouth?	yes	no
5) Are your gums and mouth sensitive to touch?	yes	no
6) Are your teeth sensitive to hot?	yes	no
7) Are your teeth sensitive to cold?	yes	no
8) Can you taste your food?	yes	no
9) Do you have problems with your prosthesis?	yes	no
10) Can you chew your food?	yes	no