



# Effectiveness of a Novel Delivery System on Salivary Flow Rate, Quality of Life, and Inhibition of Caries Associated Microbiota in Sjögren's Syndrome Patients

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## ABSTRACT

**Background:** Sjögren's Syndrome (SS) is a systemic autoimmune disease characterized by dry mouth (xerostomia) symptoms due to salivary gland destruction by lymphocyte infiltration. An extract from licorice root (*Glycyrrhiza uralensis*) has been shown to exhibit growth inhibitory effects on plaque formation by *S. mutans* as well as bacterial glycosyl-transferase activity (1). Meanwhile, a natural sugar alcohol called xylitol also demonstrates anti-cariogenic properties by reducing the amount of bacterial acid production and to further promote tooth remineralization by increasing the flow of saliva, which is a common effect observed in sweeteners (2). **Objectives:** 1) To increase salivary flow rate (SFR), 2) To reduce growth of *S. mutans* and *Lactobacilli* spp., and 3) improve the overall quality of life (QoL) for SS. **Methods:** SS patients were recruited and randomly provided a 10-day regimen of lollipop consumption (2 lollipops per day). The lollipops contain only one of licorice root extract (1, 3), xylitol, or an artificial sweetener. Before and after the treatment period, saliva samples (resting and mechanically stimulated) were collected to determine SFR in mL/min and microbial analysis was performed to measure amounts of *S. mutans* and *Lactobacilli* spp. Self-administered questionnaires helped evaluate subjective experiences. **Results:** 1) Amounts of *Lactobacilli* spp. were reduced in all treatment groups, while only some *S. mutans* levels were reduced. 2) Two particular lollipop treatments effectively increased saliva flow (resting and stimulated). 3) One treatment allowed SS patients to feel a statistically significant improvement in their QoL after 10 days. 4) Sixty percent of SS patients in the study reported that the lollipops showed effectiveness in dry mouth relief or that mouth felt more pleasant. **Conclusions:** SS patients who used the lollipops twice daily for only 10 days exhibited an increase in saliva production (beyond the duration of lollipop consumption) and demonstrated a decrease in oral bacterial load, especially *Lactobacilli* spp. A majority of patients also found the lollipops to be a positive experience of xerostomia relief.

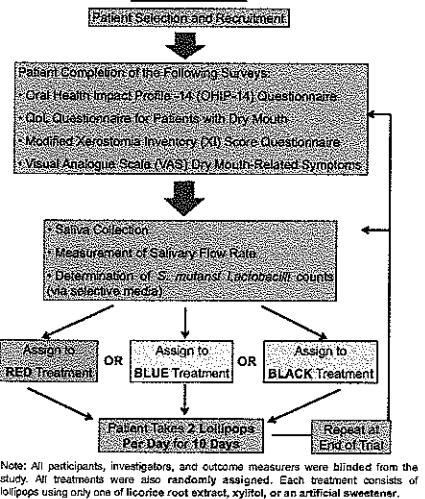
## HYPOTHESIS

Due to the beneficial oral health effects of licorice root extract and xylitol, we anticipate that SS patients receiving the lollipop therapy containing these active ingredients will experience dry mouth relief via stimulating saliva flow as well as exhibit caries-risk reduction.

## OBJECTIVES

- To improve the salivary flow rate of SS patients for a prolonged period of time beyond the duration of lollipop consumption.
- To reduce the levels of *S. mutans* and *Lactobacilli* spp. in the oral microbiota of SS patients.
- To improve the overall QoL for SS patients.

## METHODS



## RESULTS

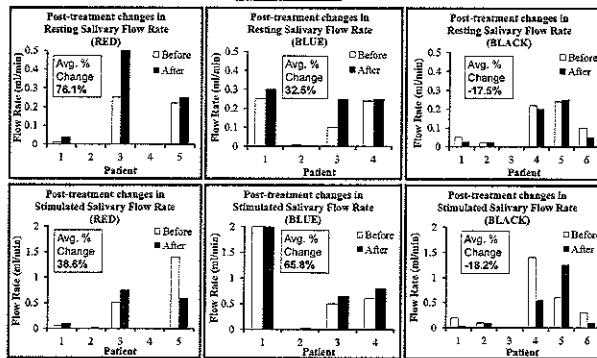


Figure 1. Pre-treatment and post-treatment measurements of resting and stimulated saliva flow rate in SS patients after 10-day lollipop trial. Top row, measurement of resting saliva flow rate before and after receiving treatment. Bottom row, measurement of stimulated saliva flow rate before and after receiving treatment. Stimulated saliva was obtained by mechanical chewing of a flavourless gum base. Average percentage changes to saliva flow rate are reported as % relative change prior to treatment. These average percentage changes are displayed inset for each treatment.

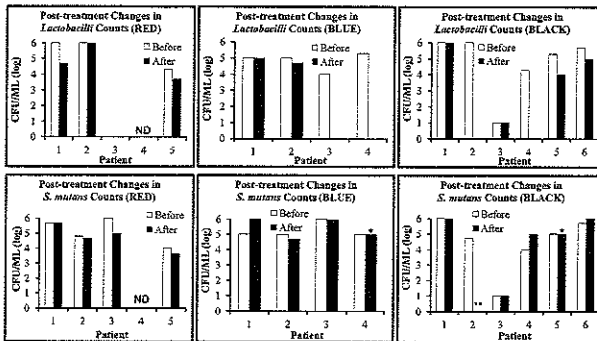


Figure 2. Pre-treatment and post-treatment counts of *S. mutans* and *Lactobacilli* from the saliva of SS patients after 10-day lollipop trial. Top row, counts of *Lactobacilli* before and after treatment. The average percent change of *Lactobacilli* counts for each colour are as follows: RED (-42.5%), BLUE (-62.5%), BLACK (-55.0%). Bottom row, counts of *S. mutans* before and after treatment. The average percent change of *S. mutans* counts for each colour are as follows: RED (+41.1%), BLUE (+212.5%), BLACK (+212.0%). ND; not determined or non-countable. Single asterisk (\*); yeast detected on *S. mutans* media. Double asterisk (\*\*); yeast overgrowth on both selective media and thus non-countable.

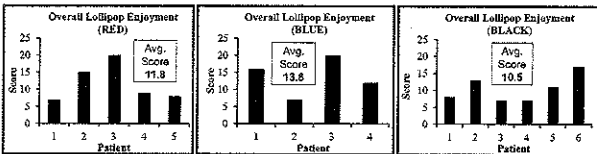


Figure 3. Overall Lollipop Enjoyment Survey to assess the patients' satisfaction and overall experience in using the lollipops as a method of relieving their dry mouth. Higher scores are more favourable. Average scores for each group are displayed inset of each graph.

## RESULTS (Continued)

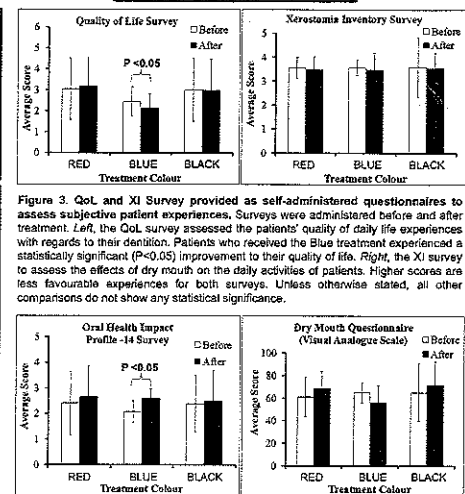


Figure 3. QoL and XI Survey provided as self-administered questionnaires to assess subjective patient experiences. Surveys were administered before and after treatment. Left, the QoL survey assessed the patients' quality of daily life experiences with regards to their dentition. Patients who received the Blue treatment experienced a statistically significant ( $P < 0.05$ ) improvement to their quality of life. Right, the XI survey to assess the effects of dry mouth on the daily activities of patients. Higher scores are less favourable experiences for both surveys. Unless otherwise stated, all other comparisons do not show any statistical significance.

Figure 4. OHIP-14 Survey and Dry Mouth Questionnaire (with VAS) to assess subjective patient experiences. Surveys were administered before and after treatment. Left, OHIP-14 assessed a patient's satisfaction of their dentition and oral health. Patients who received the Blue treatment experienced a statistically significant ( $P < 0.05$ ) decrease in their oral health satisfaction. Right, the VAS assessed the degree of dry-mouth related symptoms in patients. Higher scores are less favourable experiences for both surveys. Unless otherwise stated, all other comparisons do not show any statistical significance.

## CONCLUSIONS

- ALL THREE treatments were able to reduce levels of *Lactobacilli* in SS patients.
- In addition to *Lactobacilli*, the RED treatment was also able to reduce levels of *S. mutans*.
- Both RED and BLUE treatments were able to increase resting and stimulated salivary flow rates in SS patients after 10 days of treatment, with RED treatment having a greater effect on resting saliva and BLUE treatment having a greater effect on stimulated saliva.
- Patients receiving the BLUE treatment experienced a statistically significant improvement in their quality of life, but this was contrasted with the condition of their oral health. They also experienced a clinically significant improvement in dry mouth related-symptoms.
- 60% of patients claimed that the lollipops provided at least some relief to their dry mouth or found the experience to be pleasant.
- Study and patient recruitment is ongoing in order to increase the statistical confidence of our data and to reinforce our current findings. Patients are also welcome to try the therapy with other lollipop colours as a means of branching off a cross-over study.

## FURTHER READINGS

- Ho, J., Chan, L., Heber, D., Shi, W., and Lu, Q.-Y. (2006) Antibacterial Compounds from *Glycyrrhiza uralensis*. *J. Nat. Prod.* 69: 121-124.
- Ly, K.A., Milgrom, P., and Rodan, M. (2006) Xylitol, Sweeteners, and Dental Caries. *Pediatric Dentistry*, 28:154-163.
- Patena, M.C., Tallman, J.A., Braun, T.M., and Jacobson, J.J. (2010) Clinical reduction of *S. mutans* in preschool children using a novel licorice root extract lollipop: a pilot study. *Arch. Pediatr. Dent.* 11: 274-279.

## ACKNOWLEDGEMENTS

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