An introductory report on the effect of use of dextranase-containing mouthwash on oral health status of human volunteers

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ABSTRACT

Background: Dextran is a branched polysaccharide and one of the polymers, present in the biofilm matrix. The dextran plays a perilous role in dental plaque formation, which is involved in the development of some common oral diseases like dental caries. The dextran-hydrolyzing enzymes are under investigation to treat and manage the dental plaques. **Aims and Objective:** The present study reporting the preliminary observations on the effect of the use of dextranase-containing mouthwash (DMW) on dental plaque and oral health. **Materials and Methods:** DMW was prepared with food-grade dextranase, preservatives, gelling agents, and water as detailed. Four weeks of experimental design was employed in fourteen healthy volunteers. The selected volunteers were recommended to use DMW for at least twice a day. The plaque index (PI), probing depth (PD), gingival index (GI) and bleeding on probing (BOP) of the volunteer's teeth have been assessed before and after four weeks of DMW use. **Results:** The volunteers were insisted to use a DMW solution twice a day for four weeks. The PI, PD, GI, and BOP was measured before and after the treatment. The plaque index of the subject at baseline and after treatment was 2.22 ± 0.48, and 1.88 ± 0.50, respectively. PI was significantly reduced after the use of DMW solution for four weeks. The value of PD was 2.00 and 2.00 at baseline and after the use of DMW, respectively. The value of PD was not changed when compared to the baseline values. The sensory evaluation of DMW was performed using questionnaires. **Conclusion:** The preliminary study results suggested that the use of DMW solution for four weeks (twice a day) notably reduced the PI without any change in PD. However, GI and BOP values were not affected after the use of DMW. The participants, based on the sensory evaluation, accepted the prepared DMW solution. Additional detailed research on the impact of DMW on oral hygiene is needed to confirm the beneficial effects of DMW.

Key words: Dextran; Dextranase-Containing Mouthwash; Oral Health

INTRODUCTION

The formation of biofilm on the surface of the tooth is known as dental plaque (DP), which is composed of several microbial strains. Generally, a mixture of microbial cells formed as a polymer matrix includes microbial secretions and salivary compounds characterize DP.[1] The dental enamel, gingiva, dentin, cementum, mucosa, carious lesion, denture,

dental implant are vulnerable to oral biofilm formation. The structure and composition of biofilm diverge based on the site of the plaque formation and maturation.[2] The oral pH, antagonistic substances, availability of nutrients, host defense system are the factors associated with the development and maturation of oral biofilm.[3]

Streptococci, actinomycetes, and *Lactobacillus* are the commonly found bacterial species in dental biofilm. *Streptococcus* species are the leading species among the cariogenic bacterial population and have the ability to initiate biofilm formation on clean tooth surfaces[3]. *Streptococcus mutans* is one of the predominant bacterial pathogens associated with DP formation, which is responsible for the production of the extracellular polysaccharide matrix. The functional and severity of biofilm rely on bacterial composition.[1]

Mostly, the composition and structure of the cariogenic biofilms are not steady, and the composition of the biofilm change drastically based on the availability of nutritional materials.[4] *S. mutans* is not a permanently principal bacterial species of oral biofilm.[5-7] However, *S. mutans* is the major matrix maker. In the presence of starch and sucrose, *S. mutans* can rapidly amend the development of cariogenic biofilms.[4,8,9]

Dextran is a branched polysaccharide and one of the polymers, present in the biofilm matrix. The dextran plays a perilous role in dental plaque formation, which is involved in the development of some common oral diseases like dental caries. The enzyme that hydrolase the α-(1-6)-d-glycoside linkages in dextran called dextranase.[10] The dextran-hydrolyzing enzymes are under investigation to treat and manage the dental plaques.[11] The present study reporting the preliminary observations on the effect of the use of dextranase-containing mouthwash (DMW) on dental plaque and oral health.

MATERIALS AND METHODS

Preparation of DMW
DMW was prepared with food-grade dextranase, preservatives, gelling agents, and water as detailed (Table. 1).

Subjects and experimentation
Four weeks of experimental design was employed in fourteen healthy volunteers. The selected volunteers were recommended to use DMW for at least twice a day. The plaque index (PI), probing depth (PD), gingival index (GI) and bleeding on probing (BOP) of the volunteer's teeth have been assessed before and after four weeks of DMW use (Table 2).

Inclusion criteria
- Volunteers must be more than 18 years old
- The volunteer has clinically recognized plaque and/or gingivitis

Table 1: The composition of mouthwash

Phase	Ingredients
A	Preservative
	Sweetener
	Gelling agent
	H_2O
B	Dextranase
C	Flavoring agent
D	Gel-forming agent
	H_2O

Table 2: Gingival index and Bleeding on probing index

Index	Before DMW use	After DMW use
Gingival index	No inflammation	No inflammation
Bleeding on probing	No bleeding	No bleeding

- The volunteer should have Periodontal Screening and Recording (PSR) Scores of 0-2
- No antibiotic use for at least the last 1 month at the time of the experiment
- The volunteer should be a non-smoker
- The volunteer should give informed consent.

Exclusion criteria
- Volunteers with systemic diseases such as diabetes, heart diseases, etc.
- Volunteers with blood-associated diseases
- Volunteers have tissue disease in teeth or dead teeth
- Pregnant and breastfeeding women.

Skin irritation test
2.0 µl of mouthwash was applied on small area (2 × 2 cm) of the upper arm and left for 24 h. After 24 h, the sites were examined for irritation, and formation of edema and erythema.[12,13]

Measurement of plaque index (PI), probing depth (PD), gingival index (GI) and bleeding on probing (BOP)
The PI, PD, GI, and BOP scores of the subjects before and after four weeks of experiments were recorded as detailed previously by Feier et al.[14], Gupta et al.[15], Gopinath et al.[16], and Checchi et al.[17], respectively.

The sensory test
The acceptability of the DMW solution was assessed by sensory analysis. The parameters include color, odor, flavor, distribution, homogeneity, stickiness, time for coating of mouthwash, clean feeling after cleansing, fresh feeling after use, ability to remove plaque, ease of use, overall satisfaction have been measured. A 5-point hedonic scale, where 0- dislike extremely; 1- dislike slightly; 2- neither like

nor dislike; 3- like slightly and 4- like extremely was used to assess the suitability.[18]

Statistical analysis

The results were evaluated using STATA15, and the paired t-test was performed to determine the statistical difference between before and after-treatment values.

RESULTS

The volunteers were insisted to use a DMW solution twice a day for four weeks. The PI, PD, GI, and BOP was measured before and after the treatment (Table 2). The plaque index of the subject at baseline and after treatment was 2.22 ± 0.48, and 1.88 ± 0.50, respectively. PI was significantly reduced after the use of DMW solution for four weeks (Figure 1). The value of PD was 2.00 and 2.00 at baseline and after the use of DMW, respectively. The value of PD was not changed when compared to the baseline values (Figure 2).The status of dental plaque after the use of DMW has been represented in figure 3. The sensory evaluation of DMW was performed using questionnaires. The results of the sensory evaluation were represented in figure 4.
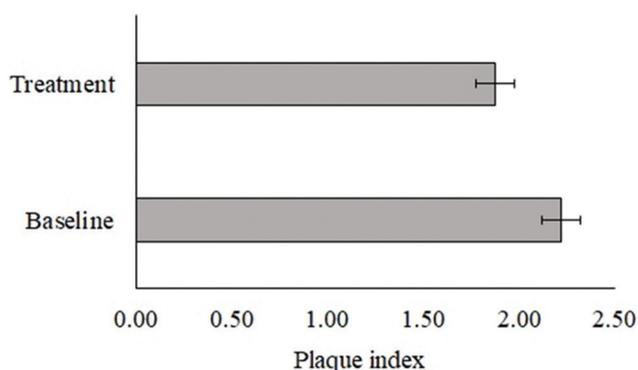
Figure 1: The change in plaque index of the subjects after four weeks of use of DMW. The results were represented as the mean ± standard error.
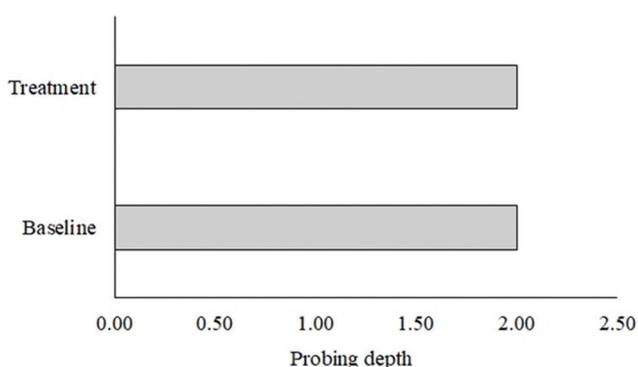
Figure 2: The change in probing the depth of the subjects after four weeks of use of DMW. The results were represented as the mean ± standard error.

DISCUSSION

Very limited reports are available on the effects of medicated mouthwash solutions on oral hygiene. The use of neem extract-based mouthwash solution significantly reduced the PI and GI in children after twenty-one days of use.[19] Likely, the use of *Garcinia mangostana* L. pericarp extract containing gel enhanced the periodontal treatment, significantly.[20]

The efficacy of the DMW solution was reported previously. The mouthwash preparation with Lipomyces *statkeyi* KSM22 dextranase exhibited anti-plaque activity[21] and DMW reduced the plaque adhesion after seven days of use.[22]

The results of the current study showed that the use of DMW improved the PI, and has not affected the PD. The GI and BOP values were not affected after the use of DMW. The sensory evaluation study reported that volunteers moderately liked the DMW. The results suggested that the use of DMW could improve the oral hygiene of the volunteers.

CONCLUSION

The preliminary study results suggested that the use of DMW solution for four weeks (twice a day) notably reduced the PI without any change in PD. However, GI and BOP
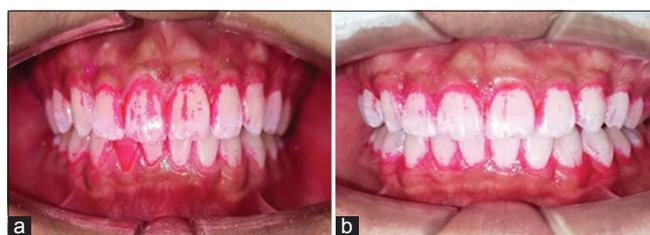
Figure 3: The change in the appearance of dental plaques after the use of DMW solution. A. baseline, B. After 4-weeks of treatment.
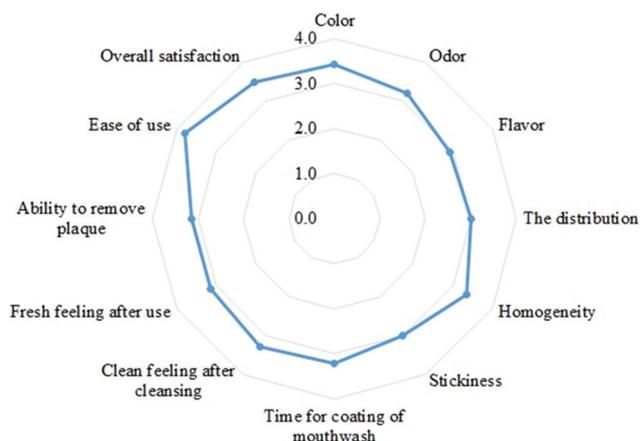
Figure 4: The sensory response of volunteers against DMW.

values were not affected after the use of DMW. The participants, based on the sensory evaluation, accepted the prepared DMW solution. Additional detailed research on the impact of DMW on oral hygiene is needed to confirm the beneficial effects of DMW.

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