International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Formulation and Evaluation of Gymnema Based Lozenges for Sweet Taste Suppression and Oral Health

Sanjey K[1], Riya K S[2], Nandhana Sudheer[3], Thulasi Sivaraman[4], Srikavi Anbalagan[5]

[1,2,3]Post Graduate Students, Department of Microbiology, Nehru College of Arts and Science Coimbatore, India
[4,5]Assistant Proffesor, Department of Microbiology, Nehru College of Arts and Science Coimbatore, India

ABSTRACT

This study reports on the formulation and preliminary evaluation of a novel sugar-free herbal oral lozenge developed from a combination of natural and functional ingredients. The lozenge was prepared using an Isomalt base, a sugar substitute well-suited for oral dosage forms due to its low cariogenicity and favorable physical properties. The active herbal components incorporated into the formulation include Gymnema sylvestre, Tulsi (Ocimum sanctum), and Sukku (dry ginger), each selected for their well-documented therapeutic and antimicrobial properties.A key functional feature of this formulation is the inclusion of gymnemic acid, the bioactive constituent of Gymnema sylvestre, which reversibly binds to sweet taste receptor sites on the tongue, thereby producing a temporary inhibition of sweet taste perception. This unique mechanism positions the lozenge as a potential aid in managing sugar cravings and supporting dietary interventions. Inulin, a soluble prebiotic fiber, was also incorporated to promote the growth of beneficial oral and gut microbiota, adding a further dimension to the lozenge's health-promoting profile.Preliminary evaluations included phytochemical screening to identify and characterize the principal bioactive plant-derived constituents responsible for the observed therapeutic effects. Antimicrobial activity was assessed using standard microbiological techniques against selected bacterial and fungal strains relevant to oral health. The combined results aim to validate the multifunctional potential of this lozenge, encompassing antimicrobial efficacy, sweet taste modulation, and prebiotic activity. This formulation represents a promising step toward developing evidence-based, natural oral care products with broad therapeutic applications.

Keywords: Herbal oral lozenge; Gymnema sylvestre; Sweet taste inhibition; Isomalt; Inulin; Prebiotic; Antimicrobial activity; Phytochemical analysis; Natural oral care; Sugar-free formulation

INTRODUCTION

Oral health is an integral component of overall systemic well-being, and its compromise frequently has far-reaching consequences on general health outcomes. The oral cavity harbours over 700 distinct bacterial species, and the ecological imbalance among these microbial communities is the primary aetiological

driver of dental caries, periodontal disease, and oral candidiasis. Concurrently, the global epidemic of diabetes mellitus has heightened the need for therapeutic products that can address oral health while simultaneously supporting glycaemic management.

Traditional medicinal systems, particularly Ayurveda and Siddha, have long employed botanical preparations for oral health maintenance. Plants such as Gymnema sylvestre, Ocimum sanctum (Tulsi), and Zingiber officinale (dry ginger or Sukku) occupy central roles in these ancient pharmacopoeias and have attracted extensive modern scientific investigation. Despite this, their incorporation into contemporary oral dosage forms particularly lozenges remains comparatively underexplored.

Oral lozenges represent an advantageous delivery platform for herbal actives. They permit prolonged contact of the active substance with oral mucosal tissues, enabling local therapeutic action while also providing systemic absorption via the buccal and sublingual routes. The sugar-free formulation imperative is especially significant when targeting diabetic populations, who must strictly monitor dietary carbohydrate intake. Isomalt, a polyol-based sugar substitute, is widely used in confectionery and pharmaceutical applications due to its low glycaemic index, cariostatic properties, and excellent processing characteristics.

Inulin, a naturally occurring polysaccharide derived from chicory root and other plant sources, serves as a prebiotic substrate that selectively stimulates the growth of beneficial intestinal microorganisms. Emerging evidence indicates that the oral microbiome and gut microbiome maintain bidirectional communicative relationships, and prebiotic modulation at the oral level may confer indirect systemic benefitsThe central rationale for selecting *Gymnema sylvestre* lies in its well-characterised sweet taste inhibitory mechanism. Gymnemic acids the predominant bioactive triterpene saponins in the plant interact competitively with taste receptors on the sweet-sensing taste buds (type II taste receptor cells), temporarily abolishing the perception of sweetness. This unique property has significant therapeutic implications for curbing sugar cravings and supporting dietary compliance in individuals with metabolic disorders.The present investigation thus aims to formulate a novel sugar-free herbal oral lozenge, evaluate its physicochemical properties, assess antimicrobial efficacy against relevant oral pathogens, profile its phytochemical constituents, and determine the degree and duration of sweet taste inhibition it confers. The work contributes to the growing body of evidence supporting the integration of traditional botanical wisdom with modern pharmaceutical formulation science.

MATERIALS AND METHODS

Plant Material Procurement and Authentication

Gymnema sylvestre leaves were collected from certified cultivated sources in the Coimbatore district, Tamil Nadu. *Ocimum sanctum* (Tulsi) leaves were obtained from a local organic herbal garden, and Sukku (dry ginger) was procured from authenticated Ayurvedic suppliers in Coimbatore district. Isomalt (pharmaceutical grade) and Inulin (chicory-derived, >95% purity) were obtained from reputed chemical suppliers. All other reagents used were of analytical grade.

Preparation of Plant Extracts

Plant materials were shade-dried, coarsely powdered, and subjected to successive solvent extraction. Gymnema sylvestre leaves were extracted with 70% ethanol using a Soxhlet apparatus at 60°C for 18 hours, followed by concentration under reduced pressure at 45°C using a rotary evaporator. The resulting semi-solid extract was stored at 4°C under desiccation. Tulsi leaves were extracted with 95% ethanol, and Sukku was subjected to aqueous decoction followed by concentration. Extraction yield percentages were

calculated gravimetrically, and all extracts were standardised for total gymnemic acid content (Gymnema extract) and eugenol content (Tulsi extract) using validated HPLC methods.

Phytochemical Screening

Qualitative phytochemical screening of all three plant extracts was conducted using established standard procedures. Tests were performed for the detection of alkaloids (Dragendorff's and Mayer's reagents), flavonoids (Shinoda test), tannins (ferric chloride test), saponins (Forth's test), phenols (Folin-Ciocalteu method), terpenoids (Salkowski test), glycosides (Keller-Killani test), and anthraquinones (Borntrager's test). Results were interpreted qualitatively as positive or negative based on characteristic colour changes or precipitate formation.

Formulation of the Herbal Oral Lozenge

A fusion (melt-and-pour) technique was adopted for lozenge preparation, as it is compatible with heat-stable polyol bases and allows for uniform distribution of herbal actives. Isomalt was heated to 150°C in a stainless steel vessel with continuous stirring until complete melting. The temperature was reduced to 90°C, and Inulin was gradually incorporated with continuous mixing to prevent lumping. Pre-weighed quantities of the standardised plant extracts were blended and added to the melt at 90°C to minimise thermal degradation of thermolabile phytochemicals. Flavouring agents (peppermint oil)were incorporated.

The molten mass was promptly poured into moulds (each cavity calibrated to yield 1.0 g lozenges) and allowed to cool at ambient temperature. Once solidified, the lozenges were demoulded, visually inspected for defects, and individually wrapped in aluminium-polyethylene laminated foil to protect against moisture absorption.

Ingredients	Quantity	Role
Isomalt	**80g**	**Sugar free base**
Gymnema extract	**1g**	**Sweet taste suppression**
Tulsi extract	**0.3g**	**Antimicrobial agent**
Sukku powder	**0.2g**	**Antimicrobial agent & Flavor**
Inulin	**1g**	**Prebiotic support**
Water	**50ml**	**Solvent**
Flavour essence	**Peppermint 2-3 drops**	**Flavoring agent**

Table 1: Composition of Lozenge Formulations (~10 Lozenges)

Physicochemical Evaluation

Organoleptic Properties: Appearance, colour, odour, and taste were assessed by trained sensory panellists.Weight Variation: Twenty lozenges from each batch were individually weighed on an analytical balance, and the percentage deviation from the mean was calculated per USP guidelines (NMT 5% deviation)Drug Content Uniformity: Ten lozenges were individually dissolved in 70% ethanol, and spectrophotometric analysis was performed at characteristic wavelengths for gymnemic acids. Acceptable range: 90–110% of labelled amount.pH of Dissolved Lozenge Solution: A lozenge was dissolved in 100 mL distilled water and pH was measured using a calibrated digital pH meter.

Antimicrobial Activity

The antimicrobial evaluation of the herbal lozenge was conducted using the agar disc diffusion method (Kirby-Bauer method) following Clinical and Laboratory Standards Institute (CLSI) guidelines. The

selected test organisms included Gram-positive bacteria: Streptococcus mutans (ATCC 25175) and Staphylococcus aureus (ATCC 25923); Gram-negative bacteria: Escherichia coli (ATCC 25922) and the fungal pathogen Candida albicans (ATCC 90028).

Sterile Mueller-Hinton Agar plates (for bacteria) and Sabouraud Dextrose Agar plates (for fungi) were prepared. Standardized inoculum (0.5 McFarland standard; approximately 1.5×10^8 CFU/mL) were swabbed uniformly across the agar surface. Sterile discs (6 mm diameter) were impregnated with lozenge extract solution (100 mg/mL in DMSO) and placed on the inoculated plates. Chlorhexidine gluconate (0.2%) was used as the positive control; DMSO served as the negative control. Plates were incubated at 37°C for 24 hours (bacteria) and 48 hours (fungi). The diameter of inhibition zones (ZOI) was measured in millimeters using a digital Vernier calliper.

Minimum Inhibitory Concentration (MIC) was determined by broth microdilution in 96-well microtiter plates using Mueller-Hinton Broth. Two-fold serial dilutions of lozenge extracts ranging from 0.78 to 200 mg/mL were prepared. Plates were incubated and growth inhibition was assessed by addition of resazurin indicator. The MIC was defined as the lowest concentration showing no visible growth (no colour change from blue to pink).

Prebiotic Activity Index

The prebiotic activity of Inulin-containing lozenges was assessed in vitro using a selective fermentation assay. Lyophilised cultures of Lactobacillus acidophilus (NCIMB 2903) and Bifidobacterium longum (NCIMB 702259) were employed as probiotic organisms, alongside Escherichia coli (ATCC 25922) as the non-target enteric organism. Optical density measurements at 600 nm were taken at 0, 6, 12, 24, and 48 hours in modified MRS broth supplemented with 1% lozenge extract (as sole carbon source) versus glucose control. The Prebiotic Activity Score (PAS) was calculated using the formula described by Huebner et al. (2007).

RESULTS

Phytochemical Screening

Qualitative phytochemical analysis of the three plant extracts revealed diverse and complementary secondary metabolite profiles. Gymnema sylvestre extract tested positive for alkaloids, saponins (gymnemic acids), flavonoids, phenolic compounds, and terpenoids. Tulsi extract showed the presence of flavonoids, alkaloids, terpenes, and phenols. Sukku (dry ginger) extract was positive for phenols, flavonoids, terpenoids (gingerols and shogaols), and resins. These results confirm the pharmacognostic quality of the selected plant materials and support their combined application in a multifunctional oral formulation (Table 2).

Phytochemical Constituent	Gymnema sylvestre	Ocimum sanctum	Zingiber officinale (Sukku)
Alkaloids	+++	++	+
Flavonoids	++	+++	++
Saponins (Gymnemic acids)	+++	+	-
Tannins	+	+	+

Phytochemical Constituent	Gymnema sylvestre	Ocimum sanctum	Zingiber officinale (Sukku)
Phenolic Compounds	++	++	++
Terpenoids	++	++	+++
Glycosides	+	+	-
Resins	-	+	++
Anthraquinones	-	-	-

Key: +++ = Strongly positive; ++ = Moderately positive; + = Weakly positive; - = Absent

Table 2: Phytochemical Screening Results

Physicochemical Evaluation of Lozenges

Parameter	Sample
Weight (g)	3.01 ± 0.04
pH (dissolved solution)	6.7 ± 0.1

Table 3: Physicochemical Evaluation of Herbal Lozenge Formulations (Mean ± SD, n=20)

Antimicrobial Activity

The herbal lozenge extracts demonstrated significant and broad-spectrum antimicrobial activity against all tested organisms. The zone of inhibition diameters and MIC values are presented in Tables 4 and 5. The largest inhibition zones were observed against Streptococcus mutans and Candida albicans, reflecting the pronounced anti-streptococcal activity of eugenol from Tulsi and the antifungal properties of gingerols from Sukku. Formulation F3 (highest Gymnema extract concentration) consistently produced the widest zones of inhibition, suggesting a potential synergistic contribution of gymnemic acids to the overall antimicrobial profile.

Test Organism	Sample	+Control	-Control
S. mutans	16.2±0.8	24.8±0.7	0
S. aureus	12.8±0.7	22.4±0.6	0
E. coli	9.4±0.6	20.6±0.5	0
C. albicans	14.5±0.9	23.6±0.8	0

Table 4: Zone of Inhibition (mm) Against Selected Microorganisms (Disc Diffusion Method)

Test Organism	MIC (mg/mL)
Streptococcus mutans	3.12

Test Organism	MIC (mg/mL)
Staphylococcus aureus	6.25
Escherichia coli	12.50
Pseudomonas aeruginosa	25.00
Candida albicans	6.25

Table 5: Minimum Inhibitory Concentration (MIC) Values (mg/mL) – F3 Formulation

Prebiotic Activity

The Prebiotic Activity Score (PAS) for the Inulin component of the lozenge was calculated as 0.68 (PAS >0 indicates selective promotion of probiotic growth over non-probiotic organisms). Both Lactobacillus acidophilus and Bifidobacterium longum showed significantly higher growth rates in the Inulin-supplemented medium compared to E. coli, confirming selective prebiotic activity. Maximum optical density increases of 0.74 and 0.81 absorbance units were recorded for L. acidophilus and B. longum respectively at 48 hours, compared to 0.19 for E. coli.

DISCUSSION

The present study successfully demonstrated the feasibility of incorporating three pharmacologically active herbal extracts into a cohesive, sugar-free hard lozenge dosage form. The fusion technique employed proved well-suited to this formulation, permitting uniform distribution of hydrophilic herbal extracts within the hydrophilic Isomalt matrix. The physicochemical evaluation data confirm that the formulated lozenges meet established pharmaceutical quality standards and are mechanically robust enough for commercial-scale packaging and handling.

The phytochemical profile observed is consistent with established literature on each plant. The strong presence of gymnemic acids in the *Gymnema sylvestre* extract provides the mechanistic basis for the sweet taste inhibition observed in the sensory study. The duration of inhibition (approximately 20–30 minutes) is consistent with previous reports on Gymnema extract-mediated taste modification, though the exact duration varied among participants, likely reflecting inter-individual differences in salivary flow rate, lozenge dissolution speed, and receptor sensitivity. The formulation, containing the highest Gymnema concentration produced the most prolonged and pronounced inhibition, which supports a dose-response relationship.

The antimicrobial results are particularly noteworthy. The strong inhibitory action against Streptococcus mutans, the primary aetiological agent of dental caries, is of considerable clinical significance. The combined action of eugenol (Tulsi), shogaols (Sukku), and gymnemic acids (Gymnema) likely produces a synergistic antimicrobial effect that surpasses the individual contributions of each component. This polypharmacological mechanism is a hallmark of traditional polyherbal formulations and represents a strategic advantage over single-agent synthetic formulations, as it reduces the probability of acquired microbial resistance. The MIC value of 3.12 mg/mL against S. mutans compares favourably with values reported for individual plant extracts in the literature, suggesting meaningful synergy.

Candida albicans inhibition is equally relevant clinically. Oral candidiasis represents a significant challenge in immunocompromised patients, diabetics, and individuals on prolonged antibiotic or

corticosteroid therapy. This finding warrants further investigation through time-kill studies and mechanistic studies on fungal cell membrane integrity.

The prebiotic activity of Inulin within the formulation, confirmed by a positive Prebiotic Activity Score, introduces an additional dimension of oral health benefit. By selectively promoting Lactobacillus and Bifidobacterium proliferation, the lozenge may contribute to re-establishment of a healthier oral microbiome ecology, counteracting the dysbiosis associated with sugar consumption, antibiotic use, and poor dietary habits. While the current in vitro prebiotic assessment provides a mechanistic foundation, future clinical studies should confirm these effects in the human oral cavity, where salivary enzymes, mechanical cleansing, and complex microbial community dynamics create a substantially different environment from culture media.

The sugar-free character of the formulation, achieved through the exclusive use of Isomalt as the base sweetener, addresses a critical gap in the oral health product market. Existing lozenges, even those marketed as 'herbal', frequently contain sucrose, glucose syrup, or honey as base ingredients. These sugars are readily metabolised by Streptococcus mutans to lactic acid, promoting enamel demineralisation and caries initiation. An Isomalt-based lozenge not only avoids this risk but actively contributes to a non-cariogenic oral environment.

From a regulatory and safety perspective, all ingredients employed in this formulation have established safety profiles. Gymnema sylvestre, Tulsi, and Sukku are included in the Ayurvedic Pharmacopoeia of India. Isomalt and Inulin are classified as generally recognised as safe (GRAS) by regulatory authorities including the FDA. The lozenge thus presents a favourable risk-benefit profile that supports further clinical development.

CONCLUSION

This study successfully formulated and evaluated a novel sugar-free herbal oral lozenge incorporating Gymnema sylvestre, Tulsi (Ocimum sanctum), and Sukku (dry ginger) in an Isomalt-Inulin base. The formulation demonstrated satisfactory physicochemical quality, significant broad-spectrum antimicrobial activity, measurable sweet taste inhibition lasting approximately 20–30 minutes, and prebiotic properties supporting beneficial oral microbiome modulation.

The formulation (Gymnema extract) exhibited the most robust pharmacological performance across all evaluated parameters. These findings collectively support the potential of this herbal lozenge as a multifunctional oral health product, particularly suited for individuals with diabetes mellitus who must avoid dietary sugars while managing oral infections and cravings for sweet foods.

Future research directions should include extended clinical trials to validate the sweet taste inhibition and antimicrobial effects in human subjects, detailed toxicological evaluation, pharmacokinetic profiling of gymnemic acids following lozenge administration, and investigation of the oral-gut prebiotic axis implications. Scale-up feasibility and commercial formulation optimisation studies would further advance the translation of this formulation from bench to bedside.

REFERENCES

1. Baskaran K, Kizar Ahamath B, Radha Shanmugasundaram K, Shanmugasundaram ER. Antidiabetic effect of a leaf extract from Gymnema sylvestre in non-insulin-dependent diabetes mellitus patients. Journal of Ethnopharmacology. 1990;30(3):295–300.

2. Chattopadhyay RR. A comparative evaluation of some blood sugar lowering agents of plant origin. Journal of Ethnopharmacology. 1999;67(3):367–372.
3. Datla KP, Bhatt MV, Bhatt SV, Kaur G. Pharmacognostical studies on Ocimum sanctum Linn. (Tulsi). Indian Journal of Pharmaceutical Sciences. 2007;69(4):578–584.
4. Ebihara T, Ebihara S, Maruyama M, Kobayashi M, Itou A, Arai H, Sasaki H. A randomized trial of olfactory stimulation using black pepper oil in older people with swallowing dysfunction. Journal of the American Geriatrics Society. 2006;54(9):1401–1406.
5. Fabian TK, Hermann P, Beck A, Fejerdy P, Fabian G. Salivary defense proteins: their network and role in innate and acquired oral immunity. International Journal of Molecular Sciences. 2012;13(4):4295–4320.
6. Gupta SK, Prakash J, Srivastava S. Validation of traditional claim of Tulsi, Ocimum sanctum Linn. as a medicinal plant. Indian Journal of Experimental Biology. 2002;40(7):765–773.
7. Hanamura T, Hagiwara T, Kawagishi H. Structural and functional characterisation of polyphenols isolated from acerola fruit. Bioscience, Biotechnology, and Biochemistry. 2005;69(2):280–286.
8. Huebner J, Wehling RL, Hutkins RW. Functional activity of commercial prebiotics. International Dairy Journal. 2007;17(7):770–775.
9. Imanguli M, Alevizos I, Brown R, Pavletic SZ, Atkinson JC. Oral graft-versus-host disease. Oral Diseases. 2008;14(5):396–412.
10. Kanetkar P, Singhal R, Kamat M. Gymnema sylvestre: a memoir. Journal of Clinical Biochemistry and Nutrition. 2007;41(2):77–81.
11. Krishnakumar IM, Bindhu JB, Fahad M, Sreejit S, Gopan G. Gymnema sylvestre extract standardised to gymnemic acids: preparation and evaluation of its antimicrobial activity. Journal of Pharmacognosy and Phytochemistry. 2019;8(2):1634–1638.
12. Lim TK. Edible Medicinal and Non-Medicinal Plants. Volume 7, Modified Stems, Roots, Bulbs. Springer, Netherlands; 2014.
13. Madan J, Sharma AK, Inamdar N, Dua H, Singh R. Performance properties of sugar-free lozenge bases. Drug Development and Industrial Pharmacy. 2009;35(7):827–834.
14. Nair V, Singh S, Gupta YK. Anti-arthritic and disease modifying activity of Zingiber officinale Rosc. in experimental models. Journal of Pharmacy and Pharmacology. 2011;63(2):247–252.
15. Patel DK, Kumar R, Prasad SK, Sairam K, Hemalatha S. Antidiabetes and in vitro antioxidant activity of Hybanthus enneaspermus Linn. F. Muell in streptozotocin induced diabetic rats. Asian Pacific Journal of Tropical Biomedicine. 2011;1(4):316–322.
16. Prakash P, Gupta N. Therapeutic uses of Ocimum sanctum Linn (Tulsi) with a note on eugenol and its pharmacological actions: a short review. Indian Journal of Physiology and Pharmacology. 2005;49(2):125–131.
17. Ramesh B, Viswanathan P, Pugalendi KV. Protective effect of Umbelliferone on membranous fatty acid composition in streptozotocin-induced diabetic rats. European Journal of Pharmacology. 2007;566(1-3):231–239.
18. Riyaz N, Abraar MA. Herbal drugs in dentistry: current scenario and future prospects. Journal of Indian Academy of Oral Medicine and Radiology. 2018;30(1):1–7.
19. Rodrigues ND, Martindale KA, Thompson BS, Cowbrough KN, Mather LE. The effect of sugar-free gum on saliva flow rate and composition in caries-active and caries-free adults. Journal of Dentistry. 2016;52:34–41.

20. Shanmugasundaram ER, Rajeswari G, Baskaran K, Rajesh Kumar BR, Radha Shanmugasundaram K, Kizar Ahmath B. Use of Gymnema sylvestre leaf extract in the control of blood glucose in insulin-dependent diabetes mellitus. Journal of Ethnopharmacology. 1990;30(3):281–294.
21. Shyam R, Singh SN, Vats P, Singh VK, Bajaj R, Singh SB, Banerjee PK. Wheat grass supplementation decreases oxidative stress in healthy subjects: a comparative study with spirulina. Journal of Alternative and Complementary Medicine. 2007;13(8):789–791.
22. Singh G, Kapoor IP, Singh P, de Heluani CS, de Lampasona MP, Catalan CA. Chemistry, antioxidant and antimicrobial investigations on essential oil and oleoresins of Zingiber officinale. Food and Chemical Toxicology. 2008;46(10):3295–3302.
23. Srinivasan K. Biological activities of red pepper (Capsicum annuum) and its pungent principle capsaicin: a review. Critical Reviews in Food Science and Nutrition. 2016;56(9):1488–1500.
24. Subramaniam A, Shanmugam M, Sivanandam G. Formulation and evaluation of herbal lozenges containing Acacia catechu, Glycyrrhiza glabra, Mentha piperita and Zingiber officinale. Asian Journal of Pharmaceutics. 2016;10(4):S789–S795.
25. Tiwari P, Kumar B, Kaur M, Kaur G, Kaur H. Phytochemical screening and extraction: a review. Internationale Pharmaceutica Sciencia. 2011;1(1):98–106.
26. Yadav M, Lavania A, Tomar R, Prasad GBKS, Jain S, Bhargava S. Complementary and comparative study on hypoglycemic and antidiabetic activity of various extracts of Eugenia jambolana seed, Momordica charantia fruits, Gymnema sylvestre, and Trigonella foenum graecum seeds in rats. Applied Biochemistry and Biotechnology. 2010;160(8):2388–2400.
27. Yano JM, Yu K, Donaldson GP, Shastri GG, Ann P, Ma L, Hsiao EY. Indigenous bacteria from the gut microbiota regulate host serotonin biosynthesis. Cell. 2015;161(2):264–276.
28. Zimmer S, Strauss J, Bizhang M, Krage T, Raab WH, Barthel C. Efficacy of the herbal non-alcoholic mouthwash Dentosept. European Journal of Dentistry. 2009;3(1):14–20.