



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 10, pp. 20456-20461, October, 2017

**International Journal of
Recent Scientific
Research**

DOI: 10.24327/IJRSR

Research Article

THE EFFECTIVENESS OF FOUR COMMERCIALY AVAILABLE MOUTHRINSES IN THE TREATMENT OF HALITOSIS: A DOUBLE BLIND RANDOMIZED CONTROLLED TRIAL

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DOI: <http://dx.doi.org/10.24327/ijrsr.2017.0809.0897>

ARTICLE INFO

Article History:

Received 05th July, 2017

Received in revised form 08th

August, 2017

Accepted 10th September, 2017

Published online 28st October, 2017

Key Words:

Halitosis, Mouth rinse, Volatile Sulphur Compounds, Halimeter.

ABSTRACT

Aim: To assess the effectiveness of four commercially available mouthrinses in the treatment of halitosis of oral origin. **Materials and methods:** Forty patients with halitosis of oral causes and willing to participate in the study were recruited. The inclusion criteria were: halitosis of oral origin, systemically healthy patient, baseline levels of volatile sulfur compounds (VSC) ≥ 2 (using halimeter). The participants were randomly allocated to the following groups: group A - Rexidine® mouthrinse, group B - Colgate total® mouthrinse, group C - Listerine® mouthrinse, group D - Hiora® mouthrinse. The baseline scores of volatile sulfur compounds were recorded using a Halimeter (Tanita Breathalert™). The patients were advised to use the mouthrinses as per the manufacturer's recommendation. The VSC scores were recorded again after 7 days & 15 days. The patient's feed-back for any adverse effects was also recorded. **Results:** All the four mouthrinses were effective in managing halitosis of oral origin. Participants of group C using Listerine® mouthrinse displayed maximum reduction of VSC, both on day 7 and 15. Following this was group B (Colgate total®) & then group A (Rexidine®). Group D (Hiora®) showed minimum reduction in VSC compared to the other 3 groups assessed.

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INTRODUCTION

Halitosis, an offensive or unpleasant odour emanating from oral cavity, is known by various terminologies like oral malodour, foetor oris (Al-Zahrani *et al*, 2011), fetid halitus or stinking mouth. (Tas A *et al*, 2011) Longstanding oral malodour may decrease self confidence and social interactions. (Morita M and Wang HL 2001) It can be extra oral or intra oral in origin and may or may not be linked to an underlying pathological cause. Microbial putrefaction (approximately 80% are gram negative, anaerobic bacteria) of food debris, saliva, cells and blood is the root cause of intraoral malodour. (Van den Broek, 2008) Bacterial interactions responsible for oral malodour are most likely to occur in the gingival crevices and periodontal pockets. However it can also arise from the posterior dorsal surface of the tongue as a consequence of its large and irregular surface which makes it an ideal niche for oral bacteria and also the availability of desquamating epithelial cells and remnants for putrefaction. (Rösing and Loesche, 2011) (Bollen and Beikler, 2012) (Shinada K, 2010) (Tolentino *et al*, 2011) (Albuquerque *et al*, 2010) Other oral

pathological sources that have been suggested as cause of halitosis are dental cavities, exposed tooth pulps, healing wounds, interdental food impaction, dentures used overnight or not regularly cleaned, fixed orthodontic appliances, restorative crowns that are not well adapted, cysts with fistula draining into the mouth, peri-implantitis, pericoronitis, oral cancer, ulcerations and factors causing a decreased salivary flow rate. (Al-Zahrani *et al*, 2011) (Tas A *et al*, 2011) (Suzuki N *et al*, 2008) (Keles M *et al*, 2011) These bacteria produce volatile sulphur compounds (VSC) by catabolising organic substrates (particularly cysteine) and amines, polyamines by hydrolyzing peptides. (Scully *et al*, 1997)

There are two fundamental means of evaluating oral malodor: organoleptic and instrumental. In the organoleptic method, oral malodor is evaluated at various distances from the oral cavity by the examiner's sense of smell. (Rosenberg *et al*, 1991) (Millett *et al*, 1996) (Seemann *et al*, 2001) (Greenman *et al*, 2004) For instrumental measurement, various devices are used such as gas chromatographs (e.g. Oral Chroma), electronic noses, and sulfide monitors (e.g. Halimeter, Interscan,

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Chatsworth, Calif).(Carranza 10th Edition) Use of Halimeter to assess the halitosis is a reliable, convenient and easy method, which analyzes the concentration of the VSCs appropriately. Hence, in the present study, Halimeter was used to gauge the halitosis. Various mouthwashes are recommended for use as a part of daily oral hygiene practice and some particularly to overcome halitosis. In this study a few of the mouthwashes with different formulations, claimed to be effective for the treatment of halitosis, were tested to assess their actual effectiveness in the treatment of halitosis using Halimeter.

MATERIALS AND METHODS

The study was conducted in a dental college to assess the effectiveness of four mouthrinses in the treatment of halitosis of oral origin.

Sample recruitment

Forty patients reporting to the Out-Patient-Department of the institute with halitosis of oral causes and willing to participate in the study, were recruited. The participants were recruited for the study only if they met all the inclusion criteria. The ethical committee of the college approved the study and written informed consent was obtained from all selected patients after explaining the protocol

Randomization

Double blinding was assured by concealing the treatment protocol for both operator as well as patient. Computer generated random number table was used for block randomization of subjects and based on the type of mouthwash used, 40 subjects allotted into four groups as: Group A - REXIDINE[®] mouthrinse, Group B - Colgate Total[®] mouthrinse, Group C - Listerine[®] mouthrinse, Group D - Hiora[®] mouthrinse.

Inclusion criteria

The inclusion criteria for the study were as follows:

1. Halitosis of oral origin.
2. Systemically healthy patient.
3. Baseline levels of sulfur compounds (VSC) ≥ 2 (using Halimeter).

Study Protocol

After induction into the study, the baseline scores of volatile sulfur compounds (VSC) were recorded using a Halimeter (Tanita Breath Alert[™], Japan). The patients were advised to use the mouthrinses as per the manufacturer's recommendation. The VSC scores were recorded again after 7 days & 15 days. The patient's feed-back for any adverse effect was also recorded.

Statistical Analysis

The data obtained from the examinations was entered in an Excel sheet and subjected to Wilcoxon Signed Rank Test and Paired t-Student Test which was suitable for the data to be statistically analysed. A difference was considered to be statistically significant if the p value was < 0.05 .

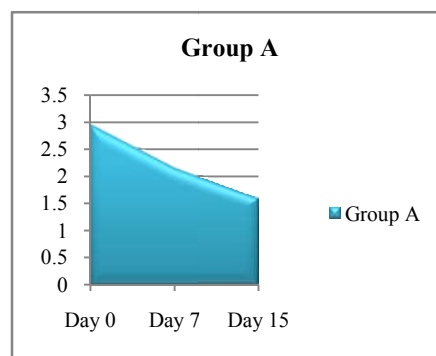
RESULTS

The result of the present study showed that all the four mouthrinses were effective in managing halitosis of oral origin. All four groups showed nearly same VSC at the baseline. However participants of Group C (Listerine[®] mouthrinse) displayed maximum reduction of VSC, both on 7th and 15th day. The VSC mean value of Group C participants (Listerine[®] mouthrinse) was the lowest while Group D participants (Hiora[®] mouthrinse) had the highest VSC score on day 15 when compared to the other three groups, as it is seen in table 1.

Table 1 (*Highly Significant)

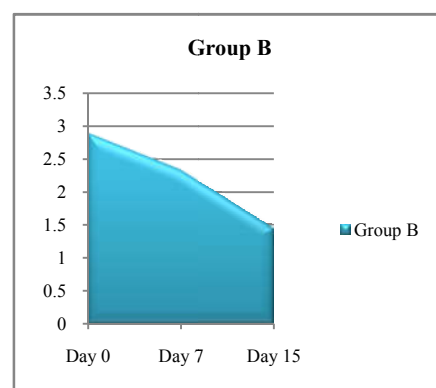
Group	Baseline	Day 7	Day 15	p value
Group A	2.95	2.15	1.58	0.02
Group B	2.89	2.33	1.44	0.03
Group C	2.97	1.95	1.04	0.001*
Group D	2.87	2.37	1.79	0.04

Group A participants (REXIDINE[®] mouthrinse) showed statistically significant reduction in the VSC scores when measured at baseline, day 7 and day 15 with a p value < 0.05 . Group A VSC score reduction has been shown in graph 1.



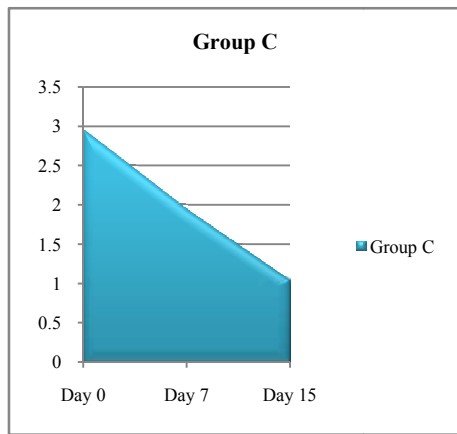
Graph 1

Participants of Group B who were given Colgate Total[®] mouthrinse to use daily showed statistically significant reduction in the VSC scores at baseline, day 7 and day 15 with p value obtained was < 0.05 (graph 2).



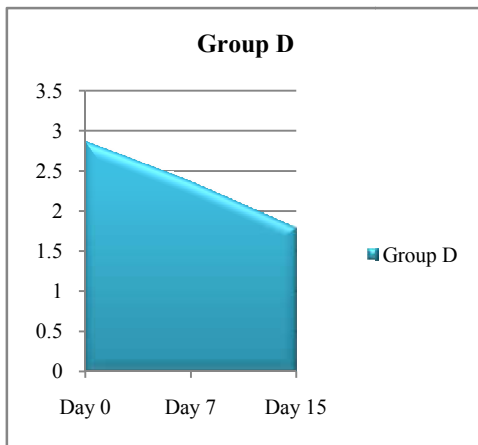
Graph 2

Group C participants who were given Listerine[®] mouthrinse to use showed statistically significant reduction in the VSC scores when measured at baseline, day 7 and day 15 with a p value < 0.05 . Listerine[®] mouthrinse resulted in maximum reduction of VSC, both on day 7 and 15 (graph 3).



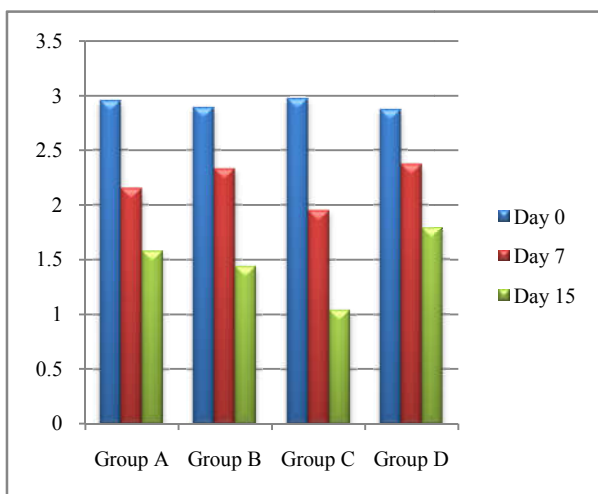
Graph 3

Participants of Group D who were given Hiora[®] mouthrinse to use daily which resulted in a statistically significant reduction in the VSC scores at baseline, day 7 and day 15. The p value obtained was <0.05. But Hiora[®] mouthrinse resulted in minimum reduction of VSC; both on day 7 and 15 when compared to the other three mouthwashes (graph 4).



Graph 4

All the four mouthwashes showed statistically significant reduction in VSC scores at baseline in comparison with day 7 and day 15 with a p value<0.05 for each group, but when compared to each other Group C participants



Graph 5

using Listerine[®] mouthrinse displayed maximum reduction of VSC while Hiora[®] mouthrinse resulted in minimum reduction of VSC, both on day 7 and 15. The comparison of all four mouthwashes has been shown in graph 5.

DISCUSSION

Halitosis is a common problem faced by people in day to day life which not only affects the people suffering from it, but also the people who interact with them. Halitosis develops due to a range of causes which include oral causes like thick tongue coating, or a change in the bacterial milieu due to periodontitis and gingivitis. (Delanghe *et al*,1997) (Lang and Filippi,2004) (Seemann *et al*,2006) (Bornstein *et al*,2009) (Calil *et al*,2009) (Quiryren *et al*,2009) (Zürcher *et al*, 2014) (Tornout *et al*,2013) Halitosis not only has implications in the social and psychological bearings of an individual, but the causative compounds of halitosis of oral origin have also been proved to affect the health of the periodontium directly.

Gram-negative anaerobic bacteria have been found to be strongly responsible for causing halitosis of intraoral origin. (Morita M and Wang HL 2001) (Tonzetich J,1977) The oral microbes implicated to cause oral malodour include Prevotella melaninogenica, Treponema denticola, Porphyromonas gingivalis, Porphyromonas endodontalis, Prevotella intermedia, Bacteroides loescheii, Enterobacteriaceae, Tannerella forsythia (Bacteroides forsythus), Centipeda periodontii, Eikenella corrodens, Fusobacterium nucleatum vincentii, Fusobacterium nucleatum nucleatum, Fusobacterium nucleatum polymorphum, and Fusobacterium periodontium. (Morita M and Wang HL 2001) (Awano *et al*, 2002) The bacterial disintegration of food residue, the shed epithelial cells, and blood and saliva components leads to production of volatile sulphur compounds (VSC) and other odoriferous substances (Morita M and Wang HL 2001) (Tonzetich J,1977) (Persson *et al*,1990) by putrefaction. (Rösing and Loesche, 2011) (Bollen and Beikler, 2012) (Shinada K,2010) The unpleasant smell of breath mainly originates from the VSCs, specially hydrogen sulfide, methylmercaptan and dimethylsulfide as first discovered by Tonzetich. (Tonzetich J,1977) Other compounds such as diamines like putrescine, cadaverine, indole, skatole, butyric and propionic acid may also be offensive. (Tonzetich J,1977) Apart from the offensive odor, VSCs increase the permeability of pocket and mucosal epithelium and lead to exposure of the underlying connective tissues of periodontium to bacterial metabolites. (Carranza,10th Edition) Methymercaptan increases the production of interstitial collagenase and cathepsin B production and also the production of interleukin-1 by mononuclear cells which in turn leads to further connective tissue breakdown. (Lancero *et al*, 2002) (Ratkey *et al*,1996) Certain studies show that human gingival fibroblasts develop an affected cytoskeleton on exposure to methylmercaptan which can also lead to altered cell proliferation and migration. (Ratkey *et al*,1996) (Brunette DM *et al*,1996) Wound healing impairment is also seen with VSCs. (Carranza,10th Edition) Halitosis can be detected and monitored by various methods. The two fundamental means of evaluating oral malodour are organoleptic and instrumental. (Rosenberg *et al*, 1991) (Millett *et al*, 1996) (Seemann *et al*, 2001) (Greenman *et al*, 2004) The instrumental measurement is carried by various devices such as gas chromatographs (e.g, Oral Chroma), electronic noses, and sulfide monitors (e.g,

Halimeter). (Carranza, 10th Edition) In the current study, a halimeter named 'Tanita Breath Checker' was used to check each patient's malodour grade. This device was chosen as it is a reliable method which analyzes the concentration of the VSCs appropriately, is easy to use and is not technique sensitive. It is also a convenient method for the examiner as well as the patient. Pre and post treatment readings on the Halimeter motivate the patient positively. Moreover it does not cause any embarrassment to the patient like the other methods where the patient has to spit in a bowl or sniff his own saliva. However Halimeter does not identify the different VSCs.

Various treatment modalities of halitosis of oral origin include use of antimicrobial toothpastes and mouthwashes, regular atraumatic tongue cleaning, professional and personal tooth cleaning. (Porter and Scully, 2006) Mouthwashes used for the treatment of oral malodour act by reducing either the bacterial load or the associated odoriferous compounds. (Porter and Scully, 2006) Mouthrinses can reduce halitosis by chemically neutralizing odoriferous compounds, including VSCs. Chlorhexidine gluconate (0.12%) mouthrinse (Rexidine[®]), a bisbiguanide, is considered to be the most effective antiplaque agent. (Jones CG, 1997) It causes disruption of bacterial cell membrane by the chlorhexidine molecules, increasing its permeability and resulting in cell lysis and bacterial death. (Jones CG, 1997) (Kuyyakanond and Quesnel LB, 1992) Due to its strong antibacterial action and substantivity in the oral cavity, chlorhexidine rinsing provides significant reduction in VSC levels. (Rosenberg et al, 1991) (Yaegaki and Sanada, 1992) (Loesche and De Boever, 1995) (Rosenberg and McCulloch CA, 1992) (Steenberghe et al, 2001) (Young A et al, 2003) The mouthwash or spray has been found to be more effective at reducing oral malodour for several hours besides improving oral hygiene alone. (Quirynen et al, 1998) However side effects of chlorhexidine include unpleasant taste, burning sensation of the oral mucosa if used too frequently and long term use can also cause reversible staining of the teeth. Cetylpyridinium chloride (0.075%) mouthwashes (Colgate Total[®]) reduce oral malodour for several hours. (Rosenberg and McCulloch CA, 1992) Cetylpyridinium is a quaternary ammonium compound which inhibits bacterial growth by adhesion to the oral microorganisms but there is still debate over the action of cationic antiseptics in the oral cavity, and what is clear is the lack of substantivity of cetylpyridinium chloride. (Cortelli et al, 2008) This is highlighted by a persistence of antimicrobial activity of Cetylpyridinium in the mouth of only 3 hours, which compares poorly with the greater than 12-hour action of Chlorhexidine. (Roberts and Addy, 1981) Methyl salicylate (0.060%) mouthrinse (Listerine[®]) which is an essential oil has long-lasting effects in reducing anaerobic bacteria overall as well as Gram-negative anaerobes and VSC producing bacteria due to its antibacterial action. (Fine et al, 2005) (Rosenberg et al, 1992) The mechanism of action involves bacterial cell wall destruction, bacterial enzymatic inhibition and extraction of bacterial lipopolysaccharides. (Mandel ID, 1994)

A Herbal mouthwash containing *Salvadora persica* tree twigs (Hiora[®]) is another mouthrinse which has been marketed over the counter for treatment of halitosis. Research suggests that *Salvadora* has an abrasive, antiseptic and astringent property. (Batwa et al, 2006) (Almas et al, 1997) Aqueous

extract of *Salvadora persica* has shown to have an inhibitory effect on the growth of *Candida albicans* that may be attributed to its high sulfate content. (Almas et al, 1997). Elvin-Lewis et al. (1980) and Almas and Al-Bagieh (1999) suggested that this effect may be due to the interaction with bacteria, which prevents their attachment on the tooth surface. A comparison of the alcoholic and aqueous extracts of *Salvadora persica* revealed that the alcoholic extract had more potent antimicrobial activity than did the aqueous extract. (Almas et al, 1997) Hiora has been claimed to be alcohol free as well as free from any chemical agent and also claims to be free from any kind of side effects.

In the present study, all four mouthwashes showed good potential in reduction of oral malodour, but when all four were compared Listerine[®] mouthrinse displayed maximum reduction in halitosis, followed by Colgate Total[®] and then Rexidine[®]. Hiora[®] proved to be the least effective when compared to the rest. The results were in concurrence with the studies conducted by Malhotra et al (2011), where the effectiveness of a commercially available herbal mouthrinse with chlorhexidine gluconate at the clinical and patient level was assessed; and by Thaweboon S et al (2011) where the effect of an essential oil-containing mouth rinse on VSC-producing bacteria on the tongue was evaluated. However, in the studies conducted by Saad S (2010) and Per S Thrane et al (2010), chlorhexidine containing mouthwash was found to be most effective as when compared to the mouthwashes containing zinc chloride and propylene glycol in reduction of halitosis. Also, in the current study when the four mouthwashes were compared regarding their taste, Hiora[®] was most preferred by the patients followed by Colgate Total[®], Listerine[®] and then Rexidine[®], which again concurred with the study conducted by Malhotra et al (2011). Another point of interest noted in this study was that two out of ten subjects prescribed Hiora[®] mouthrinse developed ulceration in the oral cavity and had to discontinue the treatment. This was contrary to the claim by the company that the mouthrinse is free of any side effects.

CONCLUSION

All the mouthrinses were shown to be effective in treating halitosis with Listerine[®] being the best, while the herbal mouthrinse was preferred by the patients. However the herbal mouthrinse subjects developed ulcerations as a side effect contrary to the company's claim.

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How to cite this article:

Saina Elahi.2017, The Effectiveness of Four Commercially Available Mouthrinses In The Treatment of Halitosis: A Double Blind Randomized Controlled Trial. *Int J Recent Sci Res*. 8(10), pp. 20456-20461.
DOI: <http://dx.doi.org/10.24327/ijrsr.2017.0810.0897>
