

# Is Synthetic Mouthwash the Final Choice to Treat Oral Malodour?

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## ABSTRACT

The aim of the review was to critically appraise the various pros and cons of the synthetic and herbal agents used in mouthwashes against halitosis and facilitate users to choose appropriate mouthwashes according to their need. Oral Malodour (OMO) or halitosis is a global epidemic with social and psychological impact. Use of mouthwash has been adopted worldwide to control halitosis within a past few decades. Alcohol and Chlorhexidine are common agents in synthetic mouthwashes, while Tannins and Eugenol are derived traditional herbal extracts. Each agent signifies some unique properties distinguishing them from others. Herbal ingredients are gaining the attention of the profession due to its mild side effects and competitive results. Herbal mouthwashes can be a safer choice in combating OMO, as an alternate to synthetic mouthwashes.

**Key Words:** *Alcohol. Chlorhexidine. Tannin. Eugenol. Essential oils. Oral malodour. Halitosis. Herbal mouthwash. Synthetic mouthwash.*

## INTRODUCTION

Oral cavity reflects one's general health thereby it requires proper and timely maintenance.<sup>1</sup> The oral cavity can also emit a foul smell and the main causative factor producing the bad odour is the Volatile Sulphide Compounds (VSCs), a protein degradation by-product. The oral cavity is known to be the habitat of wide variety of microbial resident,<sup>2</sup> and the main bacteria causing this foul smell are from the anaerobic Gram-negative family within the periodontal pockets, on the surface of the teeth and tongue.<sup>3</sup> The VSC is said to be directly proportional to the depth and bleeding tendency of the periodontal pockets.<sup>4</sup> This concept was further explained and defied in a latest study showing that there is no link between OMO and periodontal pocket depth ( $\geq 5$  mm), until sign of bleeding is evident upon probing.<sup>5</sup>

Socially unacceptable, bad foul and embarrassing smell exhaled during breathing is called Oral Malodour (OMO) or Oral Halitosis.<sup>6</sup> OMO is a socio-psychological handicap and debilitating condition.<sup>7</sup> According to many studies, over 50% of the population can be a victim of mild to severe forms of OMO due to numerous causes.<sup>4</sup> Though, OMO can be caused by many extra oral conditions including eating habit, smoking, inflammation of nose, liver or biliary cirrhosis etc., origin of the 90% of the OMO is considered to originate from the mouth cavity itself. The main reason of OMO originating from

the oral cavity is mainly due to the bacterial metabolism which is taking place on the tongue, in the periodontal pockets and saliva.<sup>4</sup> The tongue contains the biggest reservoir of the oral bacteria and the surface of the tongue is called the tongue coating which contains the debris made up of the cellular components like bacteria, white blood cells and the desquamated epithelial cells. The other non-cellular elements include gingival and nasal secretions along with saliva proteins. In many cases, the thickness of the tongue coating was found directly related to the presence or absence of OMO.<sup>8</sup>

It has been claimed that over 90% of the causative factors are found inside the oral cavity. It may be either due to low salivary flow while sleeping, in mouth breathers, faulty restorations, removable dentures, peri-implantitis or as a cause of carelessness in maintaining oral hygiene. Only 10% of OMO is instigated due to extra oral sources.<sup>9</sup>

The latter 10% needs the specific management for that specific systemic ailment, but the 90% of the causes are best treated by adopting some mechano-chemical approach. Tongue scrapping and teeth brushing are the best mechanical techniques advised, whereas the use of mouthwashes and toothpastes come under the chemical tactics.<sup>10</sup>

According to the history, Greeks were the first to use mouthwashes. They used donkey milk as mouth rinses.<sup>11</sup> Hippocrates manufactured the first ever documented rinsing solution for the freshness of their breath.<sup>12</sup>

Mouthwashes have become an important tool for comprehensive control of OMO. However, mouth rinses containing chlorhexidine and alcohol have some limitations in patients with specific conditions or ailments.

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**Table I:** Data extracted from the *in vivo* studies conducted on different ingredients of mouthwashes.

Ref No.	References	Year	Ingredient	Sample size	Conclusion
01	Deshpande	2012	CHX	10 children of ages 6-12 years and DMFT >/ 4.	Antimicrobial activity of herbal extracts in higher doses is equivalent to 0.2% CHX.
06	Polat HB	2008	CHX	80 participants undergoing 3rd Molar Surgery.	CHX rinses is effective on 3rd Molar associated malodour.
15	Van Strydonck D	2005	CHX	40 healthy volunteers used alcoholic and non-alcoholic mouthwashes on 72 hours old plaque.	No significant difference was found in the current study, except a difference in taste.
26	Wikén Albertsson K	2010	CHX + Essential oil	20 subjects of mean age of 54 years.	Both essential oils and alcohol free CHX reduces the plaque acidogenicity equally.
34	Young A	2003	CHX	13 test subjects using Cysteine challenge method.	0.2% CHX remains effective even after 3 hours of use
40	Kraivaphan P	2012	Essential oils	104 subjects stratified on the basis of Quigley-Hein plaque index scores and Loe-Silness gingival index scores.	Essential oils can significantly reduce plaque and gingivitis after usage of 6 months.
43	Suchetha A	2013	Eugenol	75 subjects diagnosed with chronic gingivitis.	Herbal formulations can be useful in plaque removal.
47	Malhotra R	2011	Herbal + CHX	23 males and 27 females (total 50).	Herbal mouthwashes though less effective than CHX, but are good alternates.

\* CHX= Chlorhexidine

**Table II:** Review articles reviewed to gather the data.

Ref no.	Reference	Year	Review upon
3	Van Zyl A	2011	Halitosis
4	Quirynen M	2003	CHX / essential oil
7	Quirynen M	2002	CHX / halitosis
9	Armstrong BL	2010	Halitosis
10	Lourith N	2010	Mouthwash
12	Bosy A	2004	Halitosis / mouthwashes
13	Lee S, Zhang W	2007	Halitosis
14	Kukreja BJ	2012	Natural ingredients
18	Van Zyl AW	2010	Halitosis
19	Watts A	2001	Discoloration / mouthwashes
22	Lemos-Júnior CA	2008	Alcohol
23	Ciancio SG	2009	Alcohol
28	Pemberton M	2012	CHX
29	Strydonck DA	2012	CHX
30	Van den Broek A	2008	Halitosis
31	Porter S	2006	Halitosis
35	Werner CWA	2009	Alcohol
33	Scully C	2008	Halitosis
36	Bhowmik D	2012	Eugenol / essential oil
47	Farah CS	2009	Mouthwashes

**Table III:** A comparison table of various effects of synthetic and natural mouthwashes.

Factors	Synthetic	Natural
Safety	√	√√
Effective on OMO	√√	√
Side effects	√√	√
Adaptability for patients	√√	√√
Pregnancy	√	√√
Lactating mothers	√	√√
Patients with resin based fillings	√	√√
Onset of action	√√	√
Safety in children	√	√√
Taste	√	√√
Shelf life	√√	√
Cost	√	√√

This review will highlight the role and effectiveness of alcohol and chlorhexidine (the most common used ingredients present in the synthetic mouthwashes) on OMO, when compared with Eugenol and Tannin (widely used plant extracts in herbal oral rinses).<sup>13</sup>

Knowledge of major ingredients (Alcohol, Chlorhexidine, Tannin and Eugenol) used in commercially available mouthwashes was gathered. Out of over 100 sources reviewed for this paper none were before the year 2000, with a very few exceptions. The patents, original articles and review papers were included. Tables II and III summarize the types of articles reviewed in this article. Most of these articles were found from the Scopus, PubMed, Springer link and Wiley's online library, however, some other engines were also considered due to the limitations in getting the articles related to plant extract. The main keywords used were halitosis, essential oils, tannins, chlorhexidine and alcohol. Unauthentic sources and all references from books and websites were excluded (Table I and II).

The main aim was to facilitate the dental practitioners and upgrade their awareness to understand the available alternates in treating Oral Malodour where certain mouthwash is contraindicated.

**Synthetic mouthwashes:** Alcohol or more precisely the ethyl alcohol is used in mouthwashes. The amount of alcohol added to the mouthwashes can range from 6% to 26.9%.<sup>14</sup> It is mainly added to increase the shelf life of the mouthwash.<sup>15</sup> Alcohol acts as a disinfectant when added to the mouthwash.<sup>16</sup> Alcohol serves to kill bacteria which can contribute to the foul smell in a person's breath.<sup>14,17</sup> Among the compounds produced by bacteria causing foul smell is volatile sulphur compounds and, therefore, the added ingredient of alcohol in mouthwashes can eliminate foul smell by eliminating oral bacteria that may be involved in the production of volatile sulphuric compounds.<sup>13</sup>

In addition to the role of alcohol as a disinfectant, alcohol can also act as a desiccant. Alcohol has a drying effect on the oral mucosa<sup>18</sup> and, therefore, patients with xerostomia tend to avoid usage of alcohol containing mouthwash.<sup>1</sup> The mouth is supposed to maintain accepted levels of moisture in order to ensure integrity of the oral health.<sup>19</sup> Elimination of moisture below a certain level can lead to tooth decay, OMO, fungal infection risk and other oral health issues.<sup>20</sup> Hence, in patients with oral or salivary problems, alcohol based mouthwashes should not be prescribed.

Long-term use of alcohol based mouthwashes may lead to some unwanted and harmful results like burning sensation in the mouth and susceptibility to cancer.

Alcohol itself can be a contributing factor for malodour. Alcohol is an irritant to the oral epithelium. Leukoplakia has also been reported due to prolong use of the mouthwashes containing alcohol. Acetaldehyde, a potential carcinogen is also found intra orally in people using alcohol based mouth rinses.<sup>21</sup> Thus, one can conclude that the long-term use of the alcohol mouthwashes should strictly be avoided.

On the contrary, alcohol has no effect on the oral epithelial dysplasia and are harmless antiplaque, anti-gingivitis agents and can only be injurious in meagre cases like in infants or to a patient undergoing recovery from alcohol addiction.<sup>22</sup> Various studies support that the prolong use of alcohol based mouthwash does not lead to cancer.<sup>23</sup> Still potentially being more hazardous, the use of alcohol mouthwash should cautiously be prescribed in high risk patients.

Chlorhexidine gluconate is considered the gold standard due to its dual bacteriostatic and bactericidal properties. It has a quick onset and long lasting effects.<sup>24</sup> Chlorhexidine mouthwashes are mostly composed of 0.12% or 0.2% of the compound mixed in deionized water, glycerine, propylene glycol and hydrogenated castor oil.<sup>7</sup> It has been reported to impede microbial activities in the mouth. Chlorhexidine is a bisbiguanide form of biocide.<sup>2</sup> The biocide compound functions on the principle of membrane disruption causing cell death. In the secondary stages, it leads to inhibition of glycosidic and proteolytic enzymes.<sup>25</sup> It binds to the oral mucosa and tooth enamel. It has a more potent effect on Gram-positive bacteria than on the Gram-negative.<sup>26</sup>

Chlorhexidine has sufficed in achieving reduction in oral bacterial viability, inhibition of plaque growth and prevention of gingivitis.<sup>27</sup> Furthermore, it also reduces the morning OMO upto 90%.<sup>4</sup> However, the most significant concern of the compound lies in the verity that it should not be used by hypersensitive individuals.<sup>28</sup> Moreover, there is a varied extent to which chlorhexidine leads to causing supragingival calculus. Hence, its usage should be limited based on the practicality that its usage is not quantified for effects, especially on

periodontitis.<sup>29</sup> The recommended use of 0.12% chlorhexidine twice daily for 1 minute is quite expedient, provided no other dentifrice, especially toothpastes containing anionic mediators are used, since it affects the potency of chlorhexidine.<sup>30</sup>

The unpleasant taste and burning sensation of the oral mucosa is also a debatable side effect of chlorhexidine mouthwashes.<sup>31</sup> Another significant effect that should be considered in the usage of chlorhexidine is the fact that it causes staining of the enamel, tongue dorsum and restorations.<sup>3</sup> It is reported that an approximate 56% of chlorhexidine mouthwash users exhibit teeth staining,<sup>32</sup> indicating pronounced stains amongst individuals with existing plaque stains.<sup>29</sup> On the other hand, it has a relieving effect on mouth sores and in rare circumstances, it is also used to treat gingivitis.<sup>29</sup> It is found to be the most potent mediator to nullify the VSCs causing OMO.<sup>32</sup> Chlorhexidine 0.12% is effective in reducing 63% VSCs OMO, while the chlorhexidine in concentration of 0.2% has upto 70% neutralizing effect on the OMO.<sup>32</sup> Furthermore, chlorhexidine 0.2% is found more curative amongst all other concentrations.<sup>33</sup> It was also shown that chlorhexidine was more effective than alcohols due to its extended retention time, post applied.<sup>26</sup>

Hence, chlorhexidine has better tolerance and fewer side effects when compared to alcohol mouthwashes.

**Natural ingredients:** Eugenol is an active member of the widely used essential oils in various mouthwashes.<sup>34</sup> It is derived from the clove oil, cinnamon and basil. It belongs to the phenyl propanes group which is an OMO inhibitor in the form of Eugenol acetate.<sup>35</sup>

The use of Eugenol is being practiced in China and India for over 2000 years to combat OMO. It is extremely potent against Gram-positive, Gram-negative and acid-fast bacteria.<sup>4</sup> It has low cytotoxic activity and fungicidal activity against *Candida albicans*.<sup>36</sup> A prophylactic use of Eugenol against several species of *Candida* in the saliva is recommended.<sup>37</sup> It is also evident that the use of clove (which contains 70% to 90% of Eugenol) stimulates the salivary flow, hence can be used in patients with known xerostomia. Eugenol is also used to treat OMO associated with the dry socket and tobacco smokers as the refreshing effect of Eugenol is also effective in neutralizing the austerity of the tobacco smoking mouth breath.<sup>5</sup>

In other instances, it is combined with astringents and added in mouthwash formulae.<sup>38</sup> The latter is widely used in mouthwash, especially after tooth extraction. Eugenol is antiseptic and does not contain toxic chemical compounds. This would imply that its usage can be diversified to include children.<sup>5</sup> Moreover, additions of Eugenol to mouthwash can be beneficial to one's oral health.<sup>39</sup>

It has been reported that addition of Eugenol in mouthwash leads to the elimination of inflammation in the tooth gums as it contains antibacterial and anti-inflammatory effects.<sup>40</sup> The antibacterial effect of Eugenol can also help combat OMO as the essential oil have been shown to clinically reduce the production of VSCs by more than 45%.<sup>12</sup> Eugenol could also have a role in oral hygiene measures as it has been shown that Eugenol has a lethal effect on bacteria residing in crevicular fluid and interproximal spaces, where mechanical strategies fail.<sup>4</sup>

Eugenol mouthwash can assist in ensuring that inflammation or burning of the mucosa is minimized.<sup>41</sup> This poses significant advantages, based on the actuality that most people do not prefer the painful burning sensation associated with mouthwash. Ultimately, Eugenol has analgesic properties which imply that it has the capability to relieve pain.<sup>6</sup> This may serve to assist after brushing with toothpaste, especially amongst individuals who experience pain from the gums. Yet, based on the actuality that Eugenol is an antibacterial, it can lead to considerable diminution of bacteria in the mouth.<sup>42</sup>

The unique properties of Eugenol give it a notch high over synthetic mouthwashes due to more pros and less cons.

Tannins are biosynthetic materials which have potent antibacterial effect. They are stipulated to contain antioxidant and antimicrobial agents.<sup>43</sup> Its antimicrobial property prevents OMO by eliminating the VSCs produced by the bacteria. The antioxidant property of tannin in mouthwash prevents the activities of aerobic bacteria by increasing the oxygen supply. In essence, it has considerable effects in ensuring diminution in the oral bacterial load, with the additional advantage of higher stability value tested at different temperatures.<sup>43</sup>

A study conducted on 25 females subjects emphasizes on the usage of tannins mouthwash. The study was conducted using chlorhexidine and alcohol mouthwash as the controls. It indicated that low levels tannin mouthwash, 1% were as effective as 125 concentration of chlorhexidine and alcohol mouthwash.<sup>43</sup> This implies that safety on oral health is to an extent assured through the usage of tannin. It was also noted that 1% mouthwash containing tannin was effective against 26% - 32% of the oral aerobic bacteria and, therefore, has an effect combatting OMO.<sup>43</sup> The initial advantage of tannin is that it does not contain toxic chemicals and, therefore, tannin does not pose significant threats while being used as an ingredient in mouthwash. It is found safe during pregnancy and breastfeeding. Moreover, tannins in mouthwash do not contribute to inflammation or dry mouth.<sup>44</sup> This is because they are not desiccants. Additionally, only lower amount of tannin are required in the mouthwash to combat bacteria and maintaining the

moisture content of the mouth.<sup>44</sup> Thus, either way, there are no severe effects of using tannins in mouthwash.<sup>45</sup> However, tannins are not synthetically manufactured. This means that their availability and wide scale production for economic purposes is limited.<sup>46</sup> Nevertheless, in accordance to oral care, tannins are the most preferred ingredients to be utilized in mouthwash.

Henceforth, we can conclude that although tannin does not effectively meet the gold standards of the synthetic mouthwashes, it is still acceptable as the safest choice amongst the rest.

## DISCUSSION

The review was aimed to assess effectiveness of key ingredients in mouthwash in eliminating the OMO.

According to the literature review, the therapy needed to eliminate OMO should be mechanical debridement of the bacteria and its by-products residing in the oral cavity and mainly found on the dorsum of the tongue.<sup>10</sup>

The combined effect of mechanical and chemical debridement is potent in eliminating OMO when compared to either one of the approaches used.<sup>10</sup>

Use of alcohol in mouthwash is recommended in patients who are not responding to OMO treatments using mouthwashes with non-alcoholic ingredients, although care must be taken in prescribing it as it may have aggressive effects on oral mucosa.

The use of alcohol in the preparation of mouthwashes should be avoided due to its aggressive effects on oral cavity. It should be precisely limited for such targeted cases in which non-alcoholic preparations are not responding, although its uses may be preferred in patients who are not responding to treatments using non-alcohol mouthwash.

Chlorhexidine is cautioned for its use as a routine mouthwash, as it may discolour the teeth. Chlorhexidine in comparison with essential oil mouthwashes is generally recommended to be used for short term and its use does not create resistance to bacteria.<sup>47</sup> In addition, the essential oil mouthwashes are considered safer and do not have long-term side effects, however, some studies have also reported the erosive effects on enamel surface.<sup>48</sup>

For OMO originating from a localized area such as periodontal pockets, the use of chlorhexidine gel and chips are better choice instead of prescribing a 0.2% chlorhexidine mouthwash in general. This will significantly reduce the unwanted results in many cases. Further, synthetic mouthwashes should warily be used that the mucosal exposure time does not surpass 60 seconds per day whenever prescribed.<sup>23</sup>

Herbal mouthwashes on the other hand are gaining much more popularity among the patients and practi-

tioners due to their meagre side effects, low cost and pronounced challenging therapeutic effects in neutralizing the OMO. It is found as the best safe choice among the children, lactating mothers and pregnant females.<sup>12</sup>

Herbal mouthwashes depict equally challenging therapeutic effects like 1% tannin is as effective as 0.2% chlorhexidine in reducing bacterial count (about 32%). Whereas when tannin is used with alcohol (1% tannin and 10% alcohol) it has a potent effect of over 32% for the bacterial eradication. Besides, when it was used alone without alcohol, the anihilation was 26%, which is not a significant difference in potency, when weighed with the side effects of alcohol.<sup>43</sup>

Although herbal mouthwashes are slightly less effective as plaque inhibitors, they are of preferred choice by patients due to their better taste and rare side effects. Hence, mouthwashes can serve as good alternative for patients with special needs like in case of diabetics and xerostomics.<sup>47</sup> The herbal mouthwashes can be a preferred clinician's choice since chlorhexidine and alcohol also show a negative effect on the physical properties of the dental fillings.

Eugenol, another popular herbal extract is the most renowned historical breath freshener with strong germicidal and fungicidal properties. Its use has been narrowed down due to its spicy taste and some cases of hypersensitivity. Since Eugenol has a bio-unfriendly nature, its utilization in crude form should be discouraged, and its unique and effective properties can best be utilized as an additive in certain mouthwashes (Table III).

## CONCLUSION

Mouthwash recommendations should be based on the condition and severity of oral diseases. Though, synthetic mouthwashes have scientifically proven efficacy against broad spectrum oral diseases, Herbal mouthwashes have a wide range of safety along with efficacy. Therefore, it should be taken in note that before prescribing mouthwashes for OMO, clinicians should weigh the possible side effects and contraindications of the active ingredients within synthetic mouthwashes as herbal mouthwashes can be recommended more safely for its proven anti-OMO property. The authors recommend that the future studies should also focus in devising mouthwashes with combined synthetic and herbal ingredient, to have efficacy and safety side by side.

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