Review Article

Halitosis: An oral microbial faction

Abstract

Halitosis is a widespread condition and believed to affect one-quarter of the population around the world; also, most people have this condition from time to time. Breath malodour may be an important factor in social communication, and therefore may be the origin of concern not only for a possible health condition but also for frequent psychological alterations, leading to social and personal isolation. The most conspicuous malodorous compounds are termed volatile sulphur compounds (VSCs), with hydrogen sulphide, methyl mercaptan, and dimethyl sulphide accounting for roughly 90% of the VSCs. A number of oral bacteria, especially Gram-negative anaerobic species found in the subgingival plaque, produce a diverse array of malodorous compounds as byproducts of their metabolism, including VSCs and short-chain organic acids. Assessment and management of halitosis is of paramount importance in enhancing the overall health; moreover, dentists play a significant role in combating halitosis by reducing the oral microbial stack. Thus, the aim of the present review was to describe the aetiological factors, assessment tools, and therapeutic approaches related to halitosis.

Access this article online

Website
http://www.cysonline.org

DOI
10.4103/2229-5186.76984

Quick Response Code

Key words:
Dental, halitosis, microbial

Introduction

Oral halitosis—bad breath originating from the oral cavity–regularly affects about one in four adults.[1] Halitosis is widespread and is believed to affect one-quarter of the population around the world, and most people suffer with this condition from time to time.[2] Because of its personal nature, this condition can cause social embarrassment, emotional, and psychological distress leading to a lack of self-esteem, self-image, and self-confidence.[3] In this context, breath malodour may be an important factor in social communication, and therefore may be a matter of concern not only for a possible health condition but also for frequent psychological alterations, leading to social and personal isolation.[4] Halitosis should not be confused with momentary disturbing odour caused by morning bad breath, food intake, or smoking because these odours do not reveal a health problem as a persistent breath malodour, by definition, reflects some pathology. In a special patient category, subjects imagine that they have breath malodour. This condition is called imaginary breath odour or halitophobia and is associated with obsessive compulsory disorders and hypochondria.[5] Halitosis-causing bacteria are the primary sources of volatile sulphur compounds (VSC). Its chief components are hydrogen sulphide and methyl mercaptans, which are produced through the bacterial metabolic degradation of food debris, desquamated cells, saliva proteins, dental plaque, and microbial putrefaction. The intensity of clinical bad breath has been shown to be appreciably associated with amount of intraoral VSC level and directly correlated with periodontal health status. The success of any halitosis intervention appears to pivot on reduction of VSC levels and other foul volatiles and, consequently, a majority of it focus on mechanical and chemical options.

Halitosis: Origin and Aetiology

Halitosis can arise from a variety of sources, including sinuses, gastrointestinal tract, ingested food, lungs, and, most frequently, the oral cavity. Oral production of malodorous substances is most commonly associated with byproducts of bacterial metabolic degradation and occurs on oral surfaces, in periodontal pockets, and especially on the dorsal tongue surface. These products result from microbial fermentation of proteins, peptides, and mucins found in saliva, blood, gingival crevicular fluid, lysed neutrophils, desquamated epithelial cells, and any residual food retained on the oral surfaces.[6] The most conspicuous malodorous

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How to cite this article: Saini R, Saini S, Saini SR. Halitosis: An oral microbial faction. Chron Young Sci 2010, 1:36-9

compounds are termed volatile sulphur compounds (VSCs), with hydrogen sulphide, methyl mercaptan, and dimethyl sulphide accounting for roughly 90% of VSCs.[7] Many oral bacteria, especially Gram-negative anaerobic species found in the subgingival plaque, produce a diverse array of malodorous compounds as byproducts of their metabolism, including VSCs and short-chain organic acids such as valeric acid, butyric acid, putrescine, and skatole.[6,8] An estimated 90% of halitosis cases originate within the oral cavity, and the VSCs are believed to be produced by Gram-negative proteolytic anaerobes. These microbes are located in the stagnant areas of the mouth, such as the periodontal pockets, tongue surface, and interproximal areas between the teeth. The putrefaction of amino acids within the oral cavity *per se* is a physiological process; however, it is enhanced by other modifying factors, such as periodontal diseases, circumstances leading to dry mouth, and other systemic conditions.[3] It is thus understandable that the VSC levels in mouth positively correlates with depth of periodontal pocket; moreover, the amount of VSCs in breath increases with the number, depth and bleeding tendency of periodontal pockets. The low oxygen tension in deep periodontal pockets also results in low pH and an activation of the decarboxylation of amino acids to cadaverine and putrescine, two malodorous diamines.[5] Periodontal diseases, in particular, Acute Necrotising Ulcerative Gingivitis (ANUG), severe periodontitis, pericoronitis, dry socket, and other oral infections and ulcers have been classically associated with oral malodour.[4] Predisposing factors include poor oral hygiene, gingival and periodontal disease, disorders of the oral mucosa, reduced salivary flow and wearing of dental appliances.[9] The oral microorganisms most likely to cause oral malodour are Gram-negative bacteria species such as *Treponema denticola*, *Porphyromonas gingivalis*, *P. endodontalis*, *Prevotella intermedia*, *Bacteroides loescheii*, Enterobacteriaceae, *Tannerella forsythensis*, *Centipeda periodontii*, *Eikenella corrodens*, and *Fusobacterium nucleatum*. However, no obvious association exists between halitosis and any specific bacterial infection, which suggests that bad breath reflects complex interactions between several oral bacterial species.[10]

Assessment and Monitoring

The right approach for halitosis includes evaluating and assessing all local and systemic parameters of the patient and correlating with best available scientific diagnostic tool for its confirmation. The various methods for assessment are listed in Table 1. Organoleptic measurement and gas chromatography are reliable methods, but clinically not easily implemented. The use of organoleptic measurement is suggested as the gold standard. Gas chromatography is the preferable method if precise measurements of specific gases are required. Sulphide monitoring is an easily used method, but has the limitation that important odours are not detected. The scientific and practical value of additional or alternative measurement methods, such as the benzoyl–arginine–naphthyl–amide (BANA) test, chemical sensors, salivary incubation test, quantifying β-galactosidase activity, ammonia monitoring, ninhydrin method, and polymerase chain reaction, have yet to be fully established.[9] Detection of VSC in the breath does not mean it is halitosis. When VSC level detected in mouth exceeds 150-200 ppb, only then the condition is classified as halitosis.[11]

Table 1: Malodour assessing tools

Diagnostic tool	Characteristics
Medical history[5]	Questioning about any medical and dental history Food and drinking habits Period and time of peak bad breath History of any medication
Self-examination[12]	For assessing intraoral sites Motivates patient for proper oral hygiene Performed Smelling a metallic spoon after rubbing back of tongue Smelling a toothpick after exploring the interdental area Smelling saliva spit in a cup Smelling the saliva after licking in hand
Organoleptic rating[13]	Gold standard for measurement of halitosis Trained judge sniffs the expired air and assesses and rates the malodour using an intensity rating, in the range of 0 to 5 0 = No odour 1 = Barely noticeable odour 2 = Slightly but clearly noticeable odour 3 = Moderate odour 4 = Strong offensive odour 5 = Extremely foul odour
Portable volatile sulfide monitor[14]	Electronic device that analyses concentration of hydrogen sulphide and methly mercaptan but without discriminating them, eg, halimeter, Interscan Four hours of fasting required to perform the test Unit has volumetric sensor that correlates to the sulphur containing gas
Gas chromatography[15]	Analyse the air, saliva, or gingival crevicular fluid for any volatile compounds Useful for identifying non-oral cause Measures the VSC separately without any fasting
Dark-field microscopy[16]	Periodontitis is a Gram-negative anaerobic infection associated with higher incidence of motile organisms and spirochetes; oral microbial flora can be evaluated by the microbiological culturing
Saliva Incubation Test[17]	Organoleptic evaluation of saliva headspace aids in monitoring the malodour Organoleptic rating highly correlates with VSC and Organoleptic rating of patients' breath
Electronic nose[18]	Artificial nose mimicking functions of human nose Under trial but holds a promising future

Table 2: Management of Halitosis

Treatment tool	Characteristics
Mechanical reduction of oral microbiological load[19-21]	One-stage full-mouth disinfection, ie, scaling and root planing of entire oral cavity, including deep subgingival pockets Instructions to reinforce brushing, interdental cleansing aids like flossing and toothpicks Tongue cleaning (with tongue scrapper) of furry tongue coating as dorsum of tongue is the primary source of oral malodour; about one-third of bacterial population was found only on the tongue and not in or on the surfaces of other oral sites Denture hygiene and cleaning Chewing to stimulate salivary flow
Chemical reduction of oral microbiological load[22-26]	Adjunct to mechanical method Oran rinses mainly includes chlorhexidine, essential oils, hydrogen peroxide, triclosan, stannous fluoride, etc Chlorhexidine is the strongest and effective because of: High substantivity in oral cavity Anti-plaque and antibacterial action One week rinse with 0.12% chlorhexidine reduces VSC by 73% Chlorhexidine with zinc lactate (without alcohol) gives promising results, eg, halita mouth rinse
Conversion of volatile sulfide compounds[27]	Metal ions with affinity for sulphur are rather efficient in capturing the sulphur-containing gases, zinc is the most potent one Mouth rinse with zinc, eg, halita Dentifrices contain baking soda, stannous fluoride, triclosan, and zinc give appreciable results for controlling malodour
Masking Malodour[28]	Lozenges, sprays, and rinses give a transitory remedy for bad breath Enhanced saliva secretion Lowering pH of saliva
Regular review	Regular follow-up to dentist, especially periodontist Periodic scaling and root planing Re-evaluation and assessment Reviewing systemic and drug history Diet counseling and modifications

Management of Halitosis

After a constructive diagnosis for oral halitosis has been made, the treatment plan is implemented, which comprises riddance of the contributory agent and improvement of oral health. The treatment modalities include mechanical and chemical reduction of oral microbiota, conversion of VSCs, masking the malodour, and regular view. Key characteristics of each are listed in Table 2. The primary prevention of oral malodour is done by reduction in bacterial populations, especially those present on the tongue, by using a variety of antimicrobial agents (chlorhexidine, triclosan, essential oils) or mechanical devices, like regular toothbrushing and interdental cleaning by dental floss, toothpick, and tongue cleaners.

Conclusion and Remarks

In conclusion, it is suggested that a majority of cases of oral malodour are the result of bacterial proteolytic activity in the mouth; therefore, dentists can assist patients to control the condition by providing full-mouth disinfection and treatment modality for oral problems, eg, providing suggestions on oral hygiene, or referring them for medical opinion when a non-oral cause is assumed. Like other oral diseases with microbial etiology, halitosis may be acquiescent to specific and non-specific antimicrobial rehabilitation targeted towards the associated bacteria.

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Source of Support: Nil, **Conflict of Interest:** None declared