

# Halitosis: A Review of the Etiologic Factors and Association with Systemic Conditions and its Management

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## ABSTRACT

Halitosis is a general term defined as an unpleasant or offensive odor emanating from the breath, arising from either oral or nonoral sources. Extraoral factors, such as ear-nose-throat conditions or gastrointestinal, respiratory, and systemic diseases, may also contribute to oral malodor. Although, halitosis has a multifactorial etiology, local factors play an important role in the majority of cases. Halitosis may lead to significant personal discomfort and social embarrassment. Assessment of halitosis can be performed using organoleptic measurements, sulfide monitoring, gas chromatography, microbial testing and chemical test strips. Management approaches are based on masking oral malodor, reducing the levels of volatile organic compounds (VOCs) and volatile sulfur compounds (VSCs), and mechanical and/or chemical treatment. This review aims to identify the etiology of oral halitosis, describe the methods available for assessment and differential diagnosis and introduce a variety of management strategies. The importance of a multidisciplinary approach for the improvement of overall health and for the management and prevention of halitosis is highlighted.

**Keywords:** Halitosis, Oral malodor, Systemic disease, Metabolic disease, Management.

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## INTRODUCTION

Halitosis is defined as an offensive odor emanating from the oral cavity, mouth air and breath, regardless of the cause, affecting 50 to 65% of the world's population.<sup>1,2</sup> Synonyms for this condition include fetor oris, fetor ex-ore, oral malodor, and more commonly, bad breath.<sup>3</sup> Halitosis is often accompanied by a bad taste in the mouth.<sup>4</sup>

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Halitosis is caused by oral, systemic, or psychological conditions and may be classified accordingly as genuine halitosis, pseudo halitosis and halitophobia.<sup>5-7</sup> Genuine halitosis is subclassified as either physiological or pathological, and the latter can be either intraoral or extraoral in origin.

Due to the social embarrassment and personal discomfort that halitosis causes, this condition is one of the primary reasons that a patient may visit the dentist.<sup>8,9</sup> However, halitosis is largely underreported. The prevalence and cause of halitosis vary among different populations and between genders. The condition may be transient, or it may follow a protracted course. The etiology may be related to physiological factors or intra- or extraoral pathological disorders, or it may be psychogenic in nature.<sup>10</sup> Malodor arising exclusively from the oral cavity (oral malodor) is most often a result of poor oral hygiene. Identifying the cause of halitosis is vital because it could indicate an underlying systemic disease or neoplasm. Moreover, the psychological status of a patient is closely related to the degree of malodor,<sup>11</sup> and diagnosing and treating halitosis can improve the psychosocial behavior of the patient.<sup>9</sup>

## ETIOLOGY

Although, halitosis has a multifactorial etiology, localized factors play the most important role in the majority of cases, and 90% of oral odor originates from the oral cavity as a result of microbial metabolism on the tongue dorsum, in the saliva, and in the periodontal pockets. Volatile sulfur compounds (VSCs) have been cited as the predominant source of the foul odor.<sup>12-14</sup> Halitosis is broadly categorized as genuine halitosis, pseudohalitosis and halitophobia.<sup>3</sup> Transient oral malodor caused by the use of tobacco, betel nuts, and alcohol or the consumption of certain foods, such as garlic or onions and durian, spices, or medications should not be confused with halitosis.<sup>3</sup> These substances cause an oral malodor that lasts for several hours and can be eliminated by discontinuing their use.

## Oral Causes of Halitosis

The oral cavity and, in particular, the dorsum of the tongue, are largely responsible for intraoral halitosis

through the formation and degradation of an oral biofilm and residual food debris that result in the production of VSCs<sup>15</sup> Table 1. Oral malodor is caused by the metabolic breakdown of organic substrates contained in the oral debris by Gram negative micro-organisms present in the mouth. The byproducts of this breakdown are predominantly volatile sulfur compounds, such as methyl mercaptan, hydrogen sulfide and dimethyl sulfide, which produce the malodor and form the basis for malodor testing.<sup>16</sup> These breakdown products have been found to be associated with distinct bacterial species. Hydrogen sulfide is produced predominantly by the genera *Porphyromonas*, *Fusobacterium* and *Neisseria*, whereas methyl mercaptan is produced mostly by the genera *Veillonella*, *Selenomonas*, *Prevotella*, *Megasphaera* and *Atopobium*.<sup>17</sup>

The most frequent causes of oral malodor are tongue coating and periodontitis.<sup>18</sup> The presence of tongue coating is related primarily to oral hygiene and less frequently to smoking, periodontal status, the presence of dentures, and dietary habits.<sup>19</sup> Other causes of oral malodor include necrotizing gingivitis, xerostomia, stomatitis, herpetic gingivitis, pericoronitis, peri-implantitis, recurrent oral ulcerations, dry socket, exposed and necrotic tooth pulp and intraoral neoplasms.<sup>9</sup>

### Systemic Causes of Halitosis

Extraoral causes of halitosis include nasopharyngeal and respiratory pathologies, gastrointestinal disorders, metabolic diseases, pharyngotonsillar problems and general systemic conditions, such as liver cirrhosis, chronic renal failure and malignancy<sup>10</sup> (Table 2). Stress is a predisposing factor for halitosis.<sup>3</sup> Foreign objects in the noses of children are a cause of sepsis and malodor. Other causes of malodor are respiratory infections, such as sinusitis, bronchitis, bronchiectasis, tonsillitis, tonsilloliths and

neoplasms. Patients with a cleft palate or lip are also likely to have oral malodor.<sup>20</sup>

The occurrence and severity of halitosis has been associated with gastroesophageal reflux disease (GERD).<sup>8</sup> GERD-associated manifestations in the oral cavity include dental erosions, halitosis, a nonspecific burning sensation, mucosal ulceration/erosion, loss of taste sensation and xerostomia.<sup>21</sup> Moshkowitz et al<sup>22</sup> found a strong association between the occurrence and severity of halitosis and GERD.

There is also a possible association between *H. pylori* infection and oral malodor.<sup>20</sup> Metabolic disorders, such as hypermethioninemia, can produce halitosis due to the circulation of odiferous compounds in the bloodstream and their subsequent exhalation.<sup>23</sup> In some cases, the oral malodor can be distinctive, helping the clinician to arrive at a possible diagnosis. Trimethylaminuria, also called 'fish odor syndrome', due to the characteristic rotten fish odor produced from the mouth and body, is a metabolic disorder resulting in an excess of trimethylamine due to a genetic defect in the activity of flavin mono-oxygenase or an excess of its precursors due to treatment with drugs such as choline.<sup>23</sup>

A 'fruity' odor is suggestive of diabetic or alcoholic ketoacidosis.<sup>49</sup> Feter hepaticus refers to a sweet ammoniacal or musty odor emanating from the mouth and urine of a patient with liver failure or hepatic encephalopathy because of the presence of mercaptans that directly enter the lungs by portal venous shunting. A fecal odor is present in patients with intestinal obstruction. 'Uremic fetor' is a uriferous odor that emanates from the breath of patients with chronic renal failure. This condition occurs as a result of the breakdown of urea to ammonia, and the malodor is usually accompanied by an unpleasant metallic taste.<sup>24</sup> Victims of poisoning or heavy metal toxicity can be identified by the presence of certain distinct odors. Toxic levels of arsenic, molybdenum and selenium lead to a garlicky odor, cyanide ingestion produces an odor of bitter almonds, and hydrogen sulfide smells similar to rotten eggs.<sup>24</sup>

### Genuine Halitosis

Genuine halitosis can be physiological or pathological in nature. Pathological halitosis can arise from local (intraoral) causes or systemic (extraoral) causes.<sup>20</sup>

### Physiological and Transient Causes

Morning breath-associated malodor is transient in nature and is due to the overnight activity of bacteria on oral debris, which is increased due to hyposalivation. Other physiological causes of halitosis are starvation and

**Table 1:** Common local factors in the etiology of halitosis

Oral disease	Acute necrotizing ulcerative gingivitis	
	Acute gingivitis	
	Adult and aggressive periodontitis	
	Pericoronitis	
	Dry socket	
	Xerostomia	
	Oral ulceration	
	Oral malignancy	
	Nasopharyngeal conditions	Sinusitis, antral malignancy, rhinitis, post-nasal drip, nasal foreign bodies or obstructions, nasal polyps, nasal malignancy, tonsillitis, tonsilloliths, post-tonsillectomy eschar, pharyngitis, pharyngeal ulceration, pharyngeal cancer, laryngitis
		Other causes

**Table 2:** Common systemic causes of halitosis

System	Conditions
Hepatic system	Liver cirrhosis, hepatic diseases, hepatic failure (fetor hepaticus)
Renal system	Uremia, renal failure
Cardiovascular system	Leukemia, other hematological diseases
Genetic disorders	Trimethylaminuria (fish odor syndrome), cystinosis, dimethylglycinuria, hypermethioninemia
Metabolic disorders	Diabetes mellitus, diabetic ketoacidosis, acquired hypermethioninemia, nonhereditary trimethylaminuria
Medication (S)	Disulfiram, dimethyl sulfoxide, cysteamine, amphetamines, antidepressants, antipsychotics, narcotics, analgesics, decongestants, antihistamines, diuretics, some antihypertensives, alpha-blockers, alpha 2-agonists, beta-blockers, muscle relaxants, other anticholinergics, anti-Parkinson's, anxiolytics, anorexiant, chemotherapy, chloral hydrate, nitrates, nitrites
GIT	Pharyngoesophageal diverticulum (Zenker's diverticulum), gastroesophageal reflux disease, Helicobacter pylori infection, pyloric stenosis, hiatal hernia, digestive disorder, gastrointestinal inflammation, gastrointestinal disease, duodenal obstruction, erratic bowel movement, gastrointestinal malignancy
Respiratory	Respiratory tract infections, pulmonary abscess, tuberculosis, bronchitis, chronic obstructive pulmonary disease (COPD), bronchiectasis, lung cancer
Others	Acute febrile illness Menstruation (menstrual breath) Use of tobacco products Food consumption — spices, garlic, onion, caffeine, alcohol

menstruation, which influence the production of VSCs.<sup>20</sup> Patients undergoing fixed orthodontic treatment have a high degree of predisposition to oral malodor, indicating the need to observe more stringent oral hygiene protocols.<sup>25</sup> Oral malodor can also occur postoperatively, following third molar surgery. Halitosis increases during the first week after surgery and decreases thereafter until preoperative levels are reached after 15 days.<sup>26</sup>

### Pseudohalitosis and Halitophobia

Patients with self-reported halitosis do not always present with clinical malodor. Pseudohalitosis refers to a condition in which the patient reports with a complaint of bad breath but does not actually have it. This group of patients can be convinced that they do not suffer from halitosis with counseling and by explaining the results of the examination.<sup>9,11</sup>

Halitophobia is the fear of having bad breath. Patients with halitophobia generally suffer from some form of psychiatric syndrome that is linked to social phobia. Patients with halitophobia are never convinced by the clinician's claim that the halitosis does not exist and require psychiatric consultation.<sup>9</sup>

### DIAGNOSIS

The diagnosis of halitosis should begin with a complete oral examination to identify the local factors and causes of halitosis. Analysis of the intensity of the oral malodor is an important step in the process of diagnosing halitosis. 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, and it is assigned a severity grade at a constant distance.<sup>27</sup> For instrumental measurement, various devices are used, including gas chromatographs, electronic noses and sulfide monitors.<sup>28</sup> Organoleptic measurement is the most popular diagnostic procedure.<sup>9,29,30</sup> The exhaled air is evaluated for malodor by smelling the air that is expelled from the mouth and the nose for a subjective determination. Malodor arising from the nose is indicative of respiratory pathology. The intensity of malodor is then scored on a scale of 0 to 5, 0 indicating that there is no malodor and 5 representing a very strong malodor.<sup>20</sup> However, this diagnostic method is uncomfortable for the patient and is influenced by external parameters, such as food intake, and the measurements need to be calibrated. Saliva incubation is an indirect way to score breath odor. This method is objective, simple and less invasive.<sup>18</sup>

There are nearly 700 different compounds found in mouth air, and it is difficult to objectively determine their concentrations in a clinical setting by any method.<sup>31,32</sup> Studies have shown that only VSCs composed of hydrogen sulfide (H<sub>2</sub>S), methyl mercaptan (CH<sub>3</sub>SH), and dimethyl sulfide ([CH<sub>3</sub>]<sub>2</sub>S) correlate with the strength of oral malodor.<sup>33</sup> Other compounds, including cadaverine, have an insignificant contribution to the production of oral malodor.<sup>31</sup> Gas chromatography (GC) is used to evaluate breath odor in halitosis research by measuring the level of volatile sulfur compounds. This method is highly sensitive and specific, but it is expensive and cannot be used in everyday practice.<sup>9</sup>

Electronic portable devices for gas analysis, such as the Halimeter (a portable sulfide monitor) and Oral Chroma™ (Abilit Corp., Osaka, Japan), are less expensive

and cumbersome than conventional gas chromatographs, but they are not as diverse in their ability to assess different gases.<sup>9</sup> Systemic causes of halitosis can typically be identified through a process of elimination followed by the appropriate systemic exam. Some conditions are associated with distinctive oral odors, which can lead to a possible diagnosis.

## MANAGEMENT

The management of halitosis is based on the elimination of any etiologic factors and improvement of the oral health status.<sup>5,34</sup> The type of halitosis determines the treatment needs of the patient, but general measures to change the patient's lifestyle, such as cessation of smoking and alcohol consumption, diet modification, adequate hydration and practices to achieve a healthy stress-free state of mind, should be encouraged. Patients with physiological halitosis can be managed with a treatment regime that includes counseling and instruction on oral hygiene and oral and dental care. Pathological halitosis that has an oral cause is most often a result of periodontitis, and in these patients, periodontal treatment should be added to the treatment regimen.<sup>11</sup>

Oral and dental care includes mechanical and chemical methods that can be incorporated into everyday oral hygiene practices. Mechanical methods to clean the dorsum of the tongue, such as tongue scraping and tongue brushing, are important hygienic procedures to reduce the level of volatile sulfur compounds, tongue coating and the corresponding malodor, particularly morning breath-related malodor in periodontally healthy subjects and in patients with gingivitis.<sup>35-37</sup> However, the effect of mechanical treatment on chronic malodor has not been established.<sup>38</sup> The use of a manual toothbrush with a tongue cleaning attachment at the back of the toothbrush head has been shown to reduce morning breath-associated malodor.<sup>39</sup> The combined use of tooth brushing and tongue cleaning significantly reduces halitosis when compared with either method alone.<sup>40</sup>

Mouthwashes with active ingredients are beneficial in reducing oral malodor and can be divided into those that have a masking effect and those that have a neutralizing or therapeutic effect. The majority of mouthrinses have a masking effect; however, those containing zinc and chlorine dioxide are the most effective in neutralizing odoriferous sulfur compounds and masking oral malodor. Mouthrinses that contain antimicrobial agents such as chlorhexidine and cetylpyridinium chloride with zinc show a therapeutic effect based on the reduction of the levels of halitosis-producing bacteria present on the tongue.<sup>9,41,42</sup> Mouthrinses containing amine fluoride/stannous fluoride (ASF) significantly reduced oral malodor,

both in terms of the VSC levels and the organoleptic rating, and are associated with fewer side effects when compared to CHX-containing products.<sup>43</sup> Due to the oxidizing properties and antimicrobial effects of chlorine dioxide (ClO<sub>2</sub>), mouthwashes containing this ingredient are effective in reducing tongue coating, plaque levels, and the *Fusobacterium nucleatum* count in the saliva.<sup>44</sup>

Dentifrices prevent the formation of volatile sulfur compounds and can improve morning breath due to the presence of sodium lauryl sulfate (SLS).<sup>45</sup> Stannous-containing sodium fluoride dentifrices, toothpastes containing 0.2% zinc sulfate and flavored dentifrices reduce oral malodor and lower the levels of malodor-causing VSCs compared to conventional dentifrices.<sup>46-48</sup> Triclosan dentifrices are effective against daytime and overnight oral malodor.<sup>49</sup>

However, chemical methods of reducing halitosis are a temporary measure, and the action of the majority of these agents lasts only for a few hours. Antibacterial components, such as chlorhexidine, cetylpyridinium chloride, triclosan, essential oils, chlorine dioxide, zinc salts, benzalkonium chloride, hydrogen peroxide and sodium bicarbonate, have been used in the treatment of halitosis, either alone or in combination, and either as a single mode of therapy or together with a mechanical treatment for tongue coating.

A combined therapeutic night-time oral hygiene regimen incorporating an antibacterial toothpaste, mouthrinse and the use of a powered toothbrush maximizes the reduction of breath odor.<sup>50</sup> Other products that have been shown to reduce the level of VSCs and suppress oral malodor include sugar-free chewing gum containing zinc acetate, magnolia bark extract and eucalyptus extracts,<sup>51,52</sup> tablets containing bovine lactoferrin and lactoperoxidase, or a protease such as actinidine.<sup>53,54</sup> Traditional therapies, such as oil pulling with sesame oil, have also shown to be beneficial for treating halitosis.<sup>55</sup> For patients with refractory halitosis, a 1-week empirical regime of metronidazole (200 mg, three times a day) can help eliminate occult anaerobic infections and may be beneficial.<sup>20</sup> Patients with halitosis due to an underlying systemic disorder should be referred to an appropriate specialist for further management.<sup>11</sup> Respiratory infections need to be identified, cultured for antibiotic sensitivity and treated accordingly. Foreign objects in the upper respiratory tract should be removed. Tonsillectomy is an effective treatment option for patients with halitosis caused by chronic tonsillitis<sup>56</sup> and for patients with tonsilloliths.<sup>57</sup> Cryptolysis with a carbon dioxide laser is a less painful and better tolerated option for patients with tonsilloliths, and this procedure can be performed in an outpatient setting.<sup>57</sup> If halitosis is caused by underlying

chronic sinusitis, the treatment should be based on resolving the underlying cause.<sup>9</sup>

A gastroenterology consultation is required for patients with halitosis as a result of regurgitation esophagitis and *H. pylori* infection. Treatment with proton pump inhibitors and eradication of *H. pylori* infection have been shown to be beneficial.<sup>58</sup> Surgical treatment should be considered in patients with hernias and diverticuli. Feter hepaticus and halitosis due to endocrinological problems require referral to the respective specialist, and in severe cases, liver transplantation may be required.<sup>9</sup>

In patients with pseudohalitosis, a treatment plan that includes counseling, education, and explaining the results of the examination to the patient is sufficient and well accepted. However, patients with halitophobia do not respond well to education and counseling and require referral to a psychologist.<sup>11</sup>

## CONCLUSION

Halitosis is the term given to any unpleasant odor arising from the mouth or expired air and can result from poor oral hygiene, lesions or infectious processes in the oral cavity or pharynx, or it may arise from a deeper systemic cause. Approximately 10 to 30% of the population suffers from this problem regularly. Halitosis can be classified based on its etiology as true halitosis, pseudohalitosis or psychogenic halitosis and halitophobia. True halitosis can have either a physiological or pathological etiology. The diagnosis is made by conducting a simple oropharyngeal examination, by using objective measurements or by performing a complete systemic evaluation. Management is based on the etiology of the condition and includes eliminating local factors, modifying habits, implementing mechanical methods, using chemical agents, referral to a specialist, long-term care, patient education and follow-up. A proper diagnosis may identify a previously occult systemic disease or neoplasm, and it may indicate the need for a more comprehensive treatment plan to improve the physical and psychosocial well-being of the patient.

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