HALITOSIS- A REVIEW ON A COMMON SOCIAL PROBLEM
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Abstract
Halitosis also called as oral malodour or breath odour is a commonly experienced condition with a variety of etiologic factors. Although several non-oral sites have been related to oral malodour, recent data suggests that 90% of all bad breath originates from mouth itself. The etiological chain of halitosis relates to the presence of odiferous substances in exhaled air, especially the volatile sulphur compounds (VSC) produced by bacteria. In general, intraoral conditions, like insufficient dental hygiene, periodontitis or tongue coating are considered to be the most important cause (85%) for halitosis. Therefore, dentists and periodontologists are the first-line professionals to be confronted with this problem. Appropriate diagnosis and management is required to solve this problem. The present review will focus on different aspects of halitosis, its etiology, diagnosis, clinical management and treatment. The literature, especially with randomized clinical trials, is scarce and additional studies are needed.

Key Words: Halitosis, Microorganisms, Periodontitis

Introduction
Human breath is composed of highly complex substances with numerous variable odors which can generate unpleasant conditions like halitosis. Halitosis is a Latin word which is derived from halitus (breathed air) and the word which is derived from halitus (breathed air) and breath. Foetororis, oral malodor, mouth odor, unpleasant conditions like halitosis. Halitosis is a Latin word which is derived from halitus (breathed air) and the word which is derived from halitus (breathed air) and breath. Exhalation of volatile substances emanating from the mouth air and breath. Foetororis, oral malodor, mouth odor, bad breath, and bad mouth odor are the other terms which are used to describe halitosis.

Halitosis is a common condition which affects most of the adult population. Although various extra oral sites and causes have been suggested, 80%-90% of halitosis originates from mouth itself.

Definition
Halitosis is defined as breath that is offensive to others, caused by a variety of reasons including but not limited to periodontal disease, bacterial coating of tongue, systemic disorders and different types of food.

Classification
I. Based on etiology, halitosis can be divided into the following categories (Dominic et al 1982): 3
   i) Local factors of pathological origin
   ii) Local factors of non-pathological origin
   iii) Systemic factors of non-pathological origin
   iv) Systemic factors of pathological origin.

II. Based on causes it can be also classified as (Bogdasarian 1986): 2
   i) Normal breath and physiologic mouth odour
   ii) Odours from oral conditions
   iii) Odours from Nasopharynx, Pharynx and Lungs
   iv) Odours excreted via the Lungs.

III. Glickman 1894: 6
   1) Local Causes
      - Pathologic, Non Pathologic
   2) Systemic Causes

IV. Classification of halitosis with corresponding treatment needs (Miyazaki et al): 7

<table>
<thead>
<tr>
<th>Classification</th>
<th>Treatment Need</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Genuine halitosis</td>
<td>TN-1:</td>
<td>Obvious malodour, with intensity beyond socially acceptable level, is perceived.</td>
</tr>
<tr>
<td>I.A. Physiologic halitosis</td>
<td>TN-1 and TN-2:</td>
<td>1. Malodour arises through putrefactive process within the oral cavity. Neither specific disease, nor pathologic condition that could cause halitosis is found. 2. Origin is mainly the dorsoposterior region of the tongue. 3. Temporary halitosis due to dietary factors (e.g., garlic) should be excluded.</td>
</tr>
<tr>
<td>I.B. Pathologic halitosis</td>
<td></td>
<td>1. Halitosis caused by disease, pathologic condition, or malfunction of oral tissues. 2. Halitosis derived from tongue coating, modified by pathologic condition (e.g., periodontal disease, xerostomia) is included in this subdivision.</td>
</tr>
</tbody>
</table>
(ii) Extraoral

TN-1 and TN-3:

1. Malodour originates from nasal, pernasal, and/or laryngeal regions.
2. Malodour originates from pulmonary tract or upper digestive tract.
3. Malodour originates from disorders anywhere in the body, whereby, the odour is blood borne and emitted via the lungs (e.g., diabetes, hepatic cirrhosis, uremia, internal bleeding).

II. Pseudo-halitosis

TN-1 and TN-4:

1. Others do not perceive obvious malodour although the patient stubbornly complains of its existence.
2. Condition is improved by counseling (using literature support, education, and explanation of examination results) and simple oral hygiene measures.

III. Halitophobia

TN-1 and TN-5

1. After treatment for genuine halitosis or pseudohalitosis, the patient persists in believing that he/she has halitosis.
2. No physical or social evidence exists to suggest that halitosis is present.

Category | Description
--- | ---
TN-1 | Explanation of halitosis and instructions for oral hygiene (support and reinforcement of patients own self care for further improvement of their oral hygiene)
TN-2 | Oral prophylaxis, professional cleaning and treatment for oral diseases, especially periodontal diseases.
TN-3 | Referral to a physician or medical specialist.
TN-4 | Explanation of examination data, further professional instruction, education and reassurance.

TN-5 | Referral to a clinical psychologist, psychiatrist or other psychological specialist.

Origin

The main etiological factor of oral malodour is proteolytic degradation of peptides present in the saliva by microorganisms in the oral cavity. Due to this process, volatile sulphur compounds (VSCs) mainly hydrogen sulphide (H₂S), methyl mercaptan (CH₃SH) and dimethyl sulphide (CH₃)₂S are formed. These VSCs are mainly produced by Gram-negative anaerobic oral bacteria. Other molecules involved in this bacterial degradation process are: diamines (indole and skatole) or polyamines (cadaverin and putrescin) and they seem to play a less important role in the expression of bad breath. The most predominant substrates in this VSC production are cysteine, cystine and methionine. The main substrate for skatole and indole production is tryptophan, whereas lysine and ornithine are the basis for the putrescin/cadaverin production.

Volatile molecules contributing to oral malodour

<table>
<thead>
<tr>
<th>Volatile sulphur compounds</th>
<th>Bacteria responsible for VSC production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl mercaptan: CH₃SH</td>
<td>Peptostreptococcus anaerobius</td>
</tr>
<tr>
<td>Hydrogen sulphide: H₂S</td>
<td>Micros prevotii</td>
</tr>
<tr>
<td>Dimethyl sulphide: (CH₃)₂S</td>
<td>Eubacterium limosum</td>
</tr>
<tr>
<td>Propionic acid: CH₃CH₂COOH</td>
<td>Bacteroides spp.</td>
</tr>
<tr>
<td>Butyric acid: CH₃CH₂CH₂COOH</td>
<td>Centipedia periodontii</td>
</tr>
<tr>
<td>Diamines</td>
<td>Prevotella intermedia</td>
</tr>
<tr>
<td>Putrescine: NH₂(CH₂)₃NH₂</td>
<td>Prevotella loescheii</td>
</tr>
<tr>
<td>Cadaverine: NH₂(CH₂)₅NH₂</td>
<td>Porphyromonas gingivalis (BANA positive)</td>
</tr>
<tr>
<td>Butyric acid: CH₃CH₂CH₂COOH</td>
<td>Treponemadenticola (BANA positive)</td>
</tr>
<tr>
<td>Propionic acid: CH₃CH₂COOH</td>
<td>Selenomonas artemidis</td>
</tr>
</tbody>
</table>

Alcohols

1-propanol

Alkalines

2-methyl-propane

Nitrogen-containing compounds

Urea: (NH₂)₂CO

Ammonia: NH₃

Ketones

Propionic acid: CH₃CH₂COOH
CH₃SH from methionine | Fusobacterium nucleatum  
| Eubacterium periodonticum  
| Bacteroides spp.

CH₃SH from serum | Treponemadenticola  (BANA positive)  
| Porphyromonas gingivalis  (BANA positive)  
| Porphyromonas endodontalis

Others | Prevotellamalolinigenica  
| Tanerellaforsythenis  
| Eikenellacorrodens  
| Solobacterium moorei  
| Treponemalopulmonis  
| Centipedaperiodontii  
| Atopobiumparvulum

**Etiology**

**Oral causes**
- Tongue coating – It is the most common cause of bad breath. The dorsum of the tongue, which is irregular and has a surface of 25 cm² is an ideal niche for oral bacteria.¹³
- Morning breath—Due to the reduced saliva production during night, anaerobic putrefaction will increase, causing the typical morning breath.
- Odontogenic halitosis—Poor oral hygiene, dental plaque, dental caries, accumulation and putrefaction of food remnants and unclean acrylic dentures contribute to bad breath. Gingivitis and periodontitis are the main causes of the problem.
- Xerostomia—The lack of salivary flow leads to the reduction of the antimicrobial activity of the saliva and the transition from Gram-positive bacteria to Gram-negative species. Also an increase of the salivary pH by the intake of amino acids, and a change in the oxygen depletion can lead to malodour.¹²
- Other oral causes—Stomatitis, intra-oral neoplasia, exposed tooth pulps (with necrotic content), extraction wounds (with blood clot or purulent discharges), or crowding of teeth (favouring food entrapment) can also be involved.¹³ Moreover, peri-implantitis, peri-coronitis, recurrent oral ulcerations and herpetic gingivitis, are described as source for bad breath.

**ENT and pulmonary pathology**
- Maximally 10% of the oral malodour cases originate from the ears, nose and throat (ENT) region, from which 3% finds its origin at the tonsils.¹⁴ The presence of tonsilloliths, represents a 10-fold increased risk of abnormal VSC levels.¹⁵
- Nasal causes—Postnasal drip (caused by mucus of the paranasal sinuses) contacting the dorsum of the tongue and foreign bodies in the nasal cavity can produce a foul odour.
- Sinusitis can also lead to halitosis due to VSC production.
- Pulmonary pathlogy—Bronchiectasis, lung abscesses and other endobronchial chronic disorders, i.e. necrotizing pulmonic neoplasias may cause a disagreeable odour.

**Gastro intestinal pathology**
- Oesophagus—Only in specific cases, such as in Zenker’s diverticulum, a chronic unpleasant odour appears.¹⁷ Bleeding of the oesophagus can also cause a musty odour.
- Stomach—Infections with Helicobacter pylori can cause peptic ulcers. Lee et al¹⁸ confirmed that significant VSC are produced by H. pylori. Moreover, it is suggested that H. pylori was detected in subjects with periodontitis, suggesting that progression of periodontal pocket and inflammation may favour colonization by this species and that H. pylori infection may be indirectly associated with oral pathological halitosis following periodontitis.
- Intestines—In cases of intestinal obstruction, a faecal mouth odour maybe detectable.

**Metabolic disorders**
- Renal disease in the form of chronic renal failure is associated with high blood urea nitrogen levels and low salivary flow rates. The dispersed odour is a typical uremic odour in combination with a dry mouth.
- Diabetic ketoacidosis leads to a typical breath odour. Type 2 diabetes demonstrates a typical sweet and fruity odour.¹⁹
- Trimethylaminuria is a disorder in which the volatile, fish-smelling compound, trimethylamine accumulates and is excreted in the urine, and is also found in the sweat and breath. So patients suffering from this metabolic disorder will have a fishy odour.
- Pancreatic insufficiencies can also cause oral bad odours.²⁰

**Hepatology and endocrinology**
- ‘Fetor hepaticus’: a sweet, excremental odour (the breath of death) can originate from liver in cases of hepatic encephalopathy. Due to a reduced liver function, waste products are eliminated through the lungs producing this particular odour.

**Odours in the case of metabolic or endocrinological problems**²⁰

<table>
<thead>
<tr>
<th>Odour</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruity odour</td>
<td>Type-1 diabetes in children</td>
</tr>
<tr>
<td></td>
<td>Type-2 diabetes in adults</td>
</tr>
<tr>
<td></td>
<td>Alcoholic ketoacidosis</td>
</tr>
<tr>
<td>Faecal odour</td>
<td>Intestinal obstruction</td>
</tr>
<tr>
<td>Ammonia of fishy odour</td>
<td>Kidney-insufficiency</td>
</tr>
<tr>
<td></td>
<td>Trimethylaminuria</td>
</tr>
<tr>
<td>Mouse odour</td>
<td>Phenylketonuria</td>
</tr>
<tr>
<td>Cooked cabbage odour</td>
<td>Methionine adenosyltransferase deficiency</td>
</tr>
<tr>
<td>Sweating feet odour</td>
<td>Isovaleric acid</td>
</tr>
<tr>
<td></td>
<td>Deficiency on chromosome 15</td>
</tr>
<tr>
<td>Burned sugar odour</td>
<td>Maple syrup urine disease</td>
</tr>
</tbody>
</table>
Medication

Studies have shown that the use of bisphosphonates can cause jawbone necrosis, and is a clear origin for a filthy odour.

Clinical Management

DIAGNOSIS

Self-assessment

The patient cannot smell his own breath and relies upon others for this information. The patient should therefore be emphasized that self-assessment is always the best for diagnosis of oral malodour.

Spoon test

The spoon test is used to assess halitosis originating from the posterior part of the dorsum of the tongue.21 A sterile plastic spoon is used to scrape the dorsum of the tongue. After about 5 seconds, the odor from the contents of the spoon is assessed, holding the spoon about 5cms away from the nose.

Dental floss odor test

This test is used to assess the odor originating from the inter-dental regions. The examiner passes a sufficient length of un-waxed floss through the inter-dental regions of posterior teeth. The odor is assessed by holding the floss about 3cms from the nose.

Saliva odor test

The patient is instructed to expectorate about 1-2 ml of saliva into a glass tube. The tube is covered immediately and incubated at 37°C for five minutes. The glass tube is then held about 4cms away from the nose for assessing odor.22

Organoleptic measurements

The human nose remains the “Gold Standard” in detecting oral halitosis. The most widely used scoring system for ranking halitosis is the Organoleptic Score popularized by Rosenberg and McCulloch.23 When organoleptical scoring is performed, a well-trained clinician determines if the odor samples smells bad or not, giving a score to the intensity.

Theses scores range from 0 up to 5

**Organoleptical scoring** 23

<table>
<thead>
<tr>
<th>Rosenberg &amp; McCulloch scale</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No detectable odour</td>
</tr>
<tr>
<td>1</td>
<td>Hardly detectable odour</td>
</tr>
<tr>
<td>2</td>
<td>Light odour</td>
</tr>
<tr>
<td>3</td>
<td>Moderate odour</td>
</tr>
<tr>
<td>4</td>
<td>Strong odour</td>
</tr>
<tr>
<td>5</td>
<td>Extremely strong odour</td>
</tr>
</tbody>
</table>

From every patient, different samples are analysed:

- Mouth odour (smelled at 10 cm from the oral cavity: while the patient normally breathes and while the patient counts loudly to10);
- Saliva odour (measured by the wrist-lick test: the patient licks at the wrist, and after 10 s of drying, a score is given to this sample);
- Tongue coating (a score is given to debris, scraped from the dorsum of the tongue with a periodontal probe); interdental ‘floss’ (after flossing with dental tape, the odour of the floss is scored);
- Nasal odour (while the patient is breathing through the nose (mouth closed), a score is given to the exhaled air);
- Prosthesis odour (if the patient wears a partial or full removable denture, scoring of the odour of this prosthetic is noted).

The advantages of organoleptical scoring are: inexpensive, no equipment needed and a wide range of odours is detectable. As disadvantages, the extreme subjectivity of the test, the lack of quantification, the saturation of the nose and the reproducibility can be mentioned. Still, organoleptical scoring is considered as the gold standard in the detection of oral bad breath.

Portable gas analysis

The Halimeter (Interscan Corporation, Chatsworth, CA, USA) and Oral Chroma (Abimedical Corporation, Miyamae-ku Kawasaki-shi, Kanagawa, Japan) are electronic devices available to detect some of the volatile sulphur components in expired air. These portable machines have a lot of advantages: easy to handle, fast results, portable and reproducible. Furthermore, they are rather inexpensive and can be controlled by untrained staff. As disadvantage, the limited diversity in the explored gasses should be stated.

Gas chromatography

In halitosis research, the gas chromatography (GC) analysis can be performed on breath, saliva and tongue debris. Almost all different air components can be detected.

Advantages: High sensitivity and specificity, non-invasive.

Disadvantages: expensive and a well-trained staff is needed.

Microbiologic tests

An alternative strategy to assess halitosis is to detect the microorganisms and their enzymes which can produce VSCs. Three species associated with periodontal disease, Treponemadenticola, Porphyromonas gingivalis and Tannerellaforsyithia, produce both VSC and volatile fattyacids and can be detected by the presence of an enzymes that degrades benzoyl- DL-arginine-naphthylamide (BANA), a synthetic trypsin substrate, forming a colored compound 5 to 10 minute chair-side test – the BANA Test.
Therapy

Oral causes

Since the oral causes are related to microorganisms, the therapy can consist of: (i) mechanical reduction of the intraoral nutrients and micro-organisms; (ii) chemical reduction of microorganisms; (iii) inverting volatile fragrant gases into non-volatile components or (iv) masking of the malodour.

Mechanical reduction

Tongue coating is the most prominent factor and therefore, extensive tongue cleaning especially scraping of the dorsum of the tongue reduces the available microorganisms, leading to an improvement of the odour. Van der Sleen et al demonstrated that tongue brushing or tongue scraping have the potential to successfully reduce breath odour and tongue coating. A one-stage full-mouth disinfection, as described by Bollen et al combining scaling and root planning in combination with chlorhexidine, has a significant microbiological improvement up to 2 months and reduces the organoleptical scores, in particular for saliva samples.

Chemical reduction

Rinsing the oral cavity can be done with the following components help to reduce oral malodour.
- Chlorhexidine (CHX): CHX is the most efficient molecule against plaque. Rosenberg showed that rinsing with 0.2% CHX causes a reduction of 43% in VSCs and of 50% in the organoleptical scores on a day-long basis.
- Essential oils: these products give only a short-term and restricted effect (25% reduction) for 3 h.
- Chlorodioxide: chlorodioxide is a strong oxidizing product that can reduce oral malodour by the oxidation of H2S, CH3SH, cysteine and methionine. A reduction of 29% in odour after 4 h was reported.
- Triclosan: triclosan is effective against the majority of oral bacteria. And 84% reduction of VSCs after 3 h is proved.
- Aminefluoride/tinfluoride: the combination of AmF/SnF2 can cause an 83% reduction in the morning halitosis.
- H2O2: a concentration of 3% of this product can result in a 90%VSC reduction after 8 h

Transformation of volatile sulphur components

Metal ions with affinity for sulphur; pick up sulphur-containing gasses. Zinc, mercury and copper is the most important metals. A commercial rinse (containing 0.005% CHX, 0.05% cetylpyridinium chloride (CPC) and 0.14% zinc lactate) seems to be much more efficient than CHX alone, due to the effect of zinc. Zinc plus CHX seem to have a synergistic effect.

Masking effect

The use of chewing gum may decrease halitosis, especially through increasing salivary secretion mouth rinses containing chlorine dioxide and zinc salts have a substantial effect in masking halitosis, not allowing the volatilization of the unpleasant odour.

Medical approaches

If oral approaches are not successful in reducing/eliminating halitosis, patients should be referred to otorhinolaryngologist, followed by the gastroenterologist. If halitophobia is considered, a psychologist or psychiatriest should be included.

Conclusion

This article highlights on the possible causes and the various management modalities of halitosis patients. This aspects are very useful for general practitioners, especially with regard to patients with pseudohalitosis, who may seek treatment from them. Evaluation of the psychological condition of patients with halitosis is important and needs multidisciplinary approach.

References

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