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The aetiology and treatment of oral halitosis: an update

有關口臭的病源和治療的新發現

Halitosis refers to the condition of offensive mouth odour. More than 90% of cases of halitosis originate from the oral cavity. The implicated bacteria (*Fusobacterium nucleatum, Prevotella intermedia*, and *Tannerella forsythensis*) are located in stagnant areas in the oral cavity, such as the dorsal surface of tongue, periodontal pockets, and interproximal areas. These bacteria proteolyse the amino acids releasing volatile sulphur compounds. The management of halitosis involves determining and eliminating the causes, which includes identifying any contributory factors, because certain medical conditions are also associated with characteristic smells. Professional advice should be given on oral hygiene and diet, and treatments should include dental scaling, and root planing of the associated periodontal pockets to reduce the bacterial loading. In addition to the normal oral hygiene practice, tongue cleaning and use of mouthwash are advocated. This paper discusses the common aetiological factors, classification of oral halitosis, and its treatment.

口臭指口部有令人難受的氣味。九成以上的病例顯示，口臭是源自口腔，涉及的細菌包括具核梭杆菌、中間普雷沃菌，以及福氏擬桿菌。這些細菌藏在口腔一些靜止的位置，例如舌頭的背側面、牙周囊袋，以及牙縫範圍。它們把胺基酸進行蛋白水解，釋放揮發性強的硫化物。治療口臭先要確定病因，包括找出致病的各種因素，因為有些疾病會引起獨特的氣味，這樣才能對症下藥，根除病源。醫護人員亦應當對口腔衛生和飲食習慣提供專業意見，替病人清除牙石，以及在有細菌積聚牙周囊袋進行牙根整平術，以減少細菌數量。除了正常的口腔衛生護理，亦應鼓勵病人清潔舌頭和使用漱口液。本文討論口臭的一般成因、類型及治療。

Key words:
Halitosis;
Mouthwashes;
Oral hygiene;
Sulphur compounds;
Tongue/microbiology

關鍵詞：
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Introduction

The subject of halitosis has received considerable attention over the past few years. Oral malodour clinics have been set up in different parts of the world, and the consumption of over-the-counter products to improve mouth odour is a big business in the United States. 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.

These concerns can even be traced back to ancient times; for example, the Far East has a long history of the practice of tongue cleaning. The chewing of natural products for breath freshening has long been practised around the world, such products include cloves (Iraq), parsley (Italy), anise seeds (Far East), cinnamon (Brazil), and guava peels (Thailand).[1] Mouthwashes containing flavoured elements, such as menthol, eucalyptol, and methyl salicylate, are also widely used.

Halitosis is widespread and is believed to affect one quarter of the population around the world and most people have this condition from time to time.[2] Those affected are usually unaware of their condition possibly because of smell adaptation. Another explanation could be the pathways between the inhaled and exhaled air diverge—because the expelled air from the mouth travels horizontally, whereas the air breathed in travels primarily vertically, there is a lowered chance of detecting the smell from the expelled air.[1] With regard to the local situation, misunderstandings prevail in the Hong Kong Chinese community on the subject of halitosis. In general, halitosis is regarded as a characteristic

symptom of indigestion or as a 'heat condition' of the internal organs.[3]

Aetiology and classification

It is now widely accepted that the primary cause of halitosis is the release of volatile sulphur compounds (VSCs), which include hydrogen sulphide, dimethyl sulphide, and methyl mercaptan. These compounds produce different kinds of unpleasant mouth odour and to varying degrees (Table 1).[4-7] Methyl mercaptan (CH_3SH) is believed to be the most malodourous component and has been shown to correlate closely with the organoleptic ratings.[8,9] It was reported that participants found methyl mercaptan about 3 times more objectionable than hydrogen sulphide.[9]

An estimated 90% of halitosis cases originate within the oral cavity,[10,11] 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 will be enhanced by other modifying factors, such as periodontal diseases, circumstances leading to dry mouth, and other systemic conditions. Patients with periodontal disease have been demonstrated to have deep periodontal pockets that are associated with increased levels of VSCs.[12,13] The presence of active periodontal inflammation has also been suggested to be more important for the production of oral malodour than just these periodontal pockets.[14] For individuals with a healthy periodontium, the principal site for bacterial loading is at the post-dorsal surface of the tongue.[13,15,16] The principle bacteria that are implicated in the creation of oral malodour include *Fusobacterium nucleatum, Prevotella intermedia,* and *Tannerella forsythensis*. *Prophyromonas gingivalis* and *Treponema denticola* are also implicated by some authors.[8,14]

Most of the protein found in mouth is in the form of glycoprotein and sugar-feeding microbes can cleave residues from these glycoproteins, leaving naked peptides to be digested by other bacteria.[17] These other bacteria proteolyse the sulphur-containing amino acids (eg cystine and methionine) from the proteins in the saliva, shed epithelium, food debris, gingival crevicular fluid, interdental plaque, and postnasal drip thereby releasing the VSCs.[18-20] A number of different classifications of halitosis have been proposed, including those based on treatment needs and aetiology as described below and illustrated in Box 1.[21]

Exogenous

Oral odour can be affected by the intake of food and drinks, which can either dry the mouth, such as alcohol-containing liquids (wine and some mouthwashes) and cigarettes, or by providing high concentrations of protein or sugar. Furthermore, dairy products are known to break down in the mouth leading to the release of amino acids that are rich in sulphur. Both onion and garlic also contain high concentrations of sulphur, which can pass through the lining of intestine into the bloodstream, and subsequently

Table 1. Characteristic smells of compounds that can be recovered from the mouth odour

Compound	Smell
Hydrogen sulphide (H_2S)	Rotten eggs
Methyl mercaptan (CH_3SH)	Faeces
Skatole	Faeces
Cadaverine	Corpses (cadaver)
Dimethyl sulphide ($(CH_3)_2S$	Rotten cabbage
Putrescine	Decaying meat
Indole	Small quantity in perfumes, smelly in large amounts
Isovaleric acid	Sweaty feet

Box 1. Classification and aetiology of halitosis

A: Exogenous (transient)
- Food-induced, eg raw onion, garlic, spices, smoking, alcohol, and dairy products that contain protein
- Morning breath

B: Endogenous (true oral halitosis)
- Oral
- Drug-induced
- Systemic diseases

C: Psychogenic
- Pseudohalitosis
- Halitophobia

Table 2. Predisposing or modifying factors to halitosis

Oral source	Drug	Systemic disease
Periodontal disease (especially acute necrotising ulcerative gingivitis)	*Type A:*	Nasal sepsis (eg sinusitis, postnasal drip)
Infected extraction site oral sepsis	Drugs that cause or predispose to dry mouth, eg antidepressant, antihistamine, anticholinergic drug, some antihypertensive, antiparkison, antipsychotic, anxiolytic, diuretic, and anorexiant	Diabetic ketosis
Residual postoperative blood (eg gum bleeding)		Gastro-intestinal disease
Debris under dental appliances (eg upper removable appliance, bridge, denture)		Hepatic failure
Ulcers		Renal failure
Dry mouth due to mouth breathing or medication intake	*Type B:*	Respiratory infection and sinusitis
Tonsilloliths	Solvent abuse	Hiatus hernia
		Trimethylaminuria
		Fish-odour-syndrome (rare, smells of rotten fish, due to insufficient enzyme to break down trimethylamine)
		Postirradiation therapy
		Sjogren syndrome

be released into the lungs and then exhaled. Smoking not only raises the concentration of volatile compounds in the mouth and lungs, but also further aggravates the situation because of its drying effect on the oral mucosa. Moreover, 'morning breath' is related to the decreased saliva production and secretion resulting in the transient desiccation of the mouth.

Endogenous

With the exception of some systemic conditions, endogenous causes of halitosis (Table 2) produce their effect either by (a) predisposing by promoting bacterial putrefaction, or (b) reducing or modifying the saliva flow. Specific disease conditions may be characterised by particular smells; hence, the recognition of such smells may help in the diagnosis of an underlying medical condition.

Psychogenic

Finally, there are different categories of psychogenic halitosis.[22] Pseudohalitosis, for example, is a condition in which the patients feel that they are suffering from halitosis but the mouth odour is neither offensive nor noticeable to other people. Halitophobia refers to the condition of an exaggerated fear of having halitosis; those affected may or may not have had halitosis beforehand.

Management

The management of halitosis entails four steps:

1. confirm the diagnosis;
2. identify and eliminate the predisposing and modifying factors;
3. identify any contributing medical conditions and refer for management; and
4. review and reassure.

The management of halitosis starts by taking a detailed history of the condition, duration, the severity, and the impact on the patient's everyday life. Any predisposing and modifying factors are investigated and concerns from the patient's family members are also noted. The examination involves clinical, radiographical, and special tests. The contributing medical conditions, once identified, are referred for treatment accordingly. Clinical examination checks the patient's oral hygiene, caries, periodontal status, and also plaque retention factors are recorded. Radiographical examination look for evidence of dental caries, alveolar bone defects, and defective restorations. Special tests are performed to detect the foul-smelling VSCs along with the associated bacteria. The results collected can be used to confirm the diagnosis and to monitor the treatment progress. There are many diagnostic techniques of which organoleptic measurement, gas chromatography, and halimeter examination are described below.

Organoleptic measurement is based on the subjective sensation of the examiner to the mouth odour. The measurement is recorded on a point scale according to the examiner's perception of the intensity of oral halitosis from the expelled air through a straw at a specific distance. Such a measurement is a true reflection of the severity and intensity of oral halitosis. The examination is simple to conduct and does not require specialist equipment; however, the test specificity and reproducibility is low. Calibration of the examiner's sense of smell can be performed using a T & T Olfactometer (Daiichi, Yakuhin Sangyo, Tokyo, Japan).[23] One potential risk of the organoleptic measurement is the transmission of diseases via the expelled air—a particular concern following the severe acute respiratory syndrome and bird flu infections of recent years.

Gas chromatography is a quantitative analysis of the specific gases of interest, and the results are specific and reproducible. In case of oral halitosis, VSCs including hydrogen sulphide, methyl mercaptan, and dimethyl sulphide are the targets of examination. The apparatus setup is complicated and the usage of such instrument requires operators with in-depth experience; hence, its practicality for day-to-day use is limited.

The halimeter (Fig) is a portable instrument measuring the VSC concentration in the oral cavity. It is sensitive to volatile compounds and has to be calibrated to the background air prior to taking a reading. Before conducting the examination, the subjects are instructed not to drink, smoke, eat, chew gum, suck confectionary, use mouthwash or breath fresheners, or perform oral hygiene for at least 4 hours. Also, they have to avoid the use of cosmetic products, for example, perfumes, after-shave, and scented lipstick prior to the appointment. Just before taking the measurement, the patient is instructed to keep their mouth closed for 3 minutes. A straw connected to the halimeter is placed gently over the dorsum of the tongue without touching and the patient is asked to keep the mouth wide open. A measurement is taken once a peak reading has been reached. A result of less than 100 is normal, whereas a reading between 100 and 180 would indicate minor halitosis, and a reading of greater than 250 indicates chronic halitosis. There may be false-positive results due to other

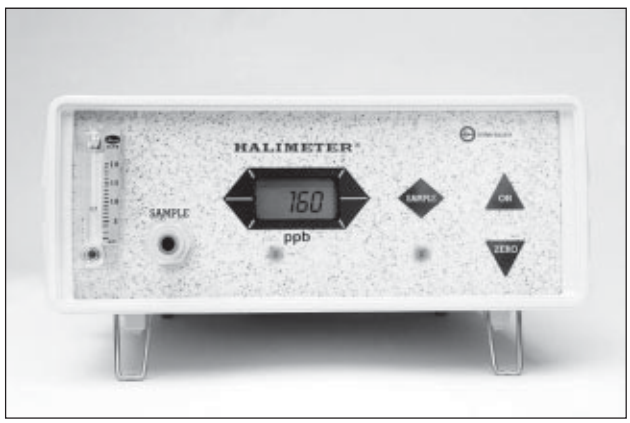

Fig. Halimeter

volatile vapours, such as acetone, ethanol, and methanol that do not contribute to oral halitosis.

Treatment

After a positive diagnosis for oral halitosis has been made, the treatment plan is implemented, which comprises the elimination of the causative agent and the improvement of the oral health status. The treatment modalities include the following:

1. oral hygiene instruction to reinforce brushing, flossing technique, and denture hygiene;
2. mechanical approach of scaling and root planing of the root pockets,[24] and tongue cleaning[25];
3. chemical approach of using a mouthwash;
4. dietary advice to reinforce mouth cleaning after eating or drinking dairy products, fish, meat, garlic, onion, coffee, and smoking; and
5. regular review.

Tongue cleaning is the mechanical removal of the furry tongue coating, which must be performed gently and thoroughly. This can best be accomplished by using a tongue cleaner, which in some patients may induce a gagging reflex. Mechanical removal of the tongue coating can reduce VSC concentration by 52% in the mouth air of a periodontally healthy individual.[25] Nevertheless, the presence of tongue coating does not necessarily precede oral halitosis. The use of mouthrinses in the management of oral halitosis range from antiseptic mouthwashes to chemical agents that are designed specifically to deal with the VSCs. For example, Listerine (Pfizer, Caringbah, Australia), which is an alcohol-based antiseptic mouthrinse containing essential oils, kills the odourgenic micro-organisms and hence, reduces the oral odour.[26] Another brand, Oxyfresh (Oxyfresh Worldwide Inc, Selangor, Malaysia) contains chlorine dioxide, which directly oxidises the VSCs to non-malodourous products,[27] and is capable of killing the odourgenic micro-organisms.[28] Zinc, as an active ingredient in the mouthwashes, decreases the level of VSCs by forming non-volatile zinc sulphides.[29-31] Mouthwashes containing chlorhexidine (0.2%) like Corsodyl (Smithkline Beecham Consumer Healthcare, Maidenhead, United Kingdom) decreases the peak VSCs by 43%, and the organoleptic score by 50%.[32] Furthermore, chlorhexidine (0.12%) together with mechanical cleansing for 1 week has been shown to reduce VSCs by 73.3% and mouth odour by 68.6%.[17] Unfortunately, the long-term use of chlorhexidine may impair taste and irritate soft tissue as well as discolour teeth. Dietary advice focuses on the avoidance of odourous food and encouraging habits like chewing gum to stimulate saliva secretion, eating fresh fibrous vegetables, and drinking plenty of liquids.

With regard to halitosis of psychogenic origin, the management includes discussion of the situation with the patient. The measurement of the mouth odour with the help of a halimeter is invaluable to demonstrate to the patient that halitosis may or may not be present. Advice can also be given to the patient to prevent and to manage halitosis as illustrated in Box 2.

Box 2. Dos and Don'ts

Do
- Visit your dentist regularly
- Have your teeth cleaned periodically by a dental professional
- Floss or otherwise clean between your teeth, as recommended by your dentist
- Choose unscented floss so that you can detect those areas between your teeth that give off odours, and clean them more carefully
- Brush your teeth and gums properly
- Ask your dentist to recommend a tongue cleaner. Clean your tongue all the way back gently, but thoroughly
- Drink plenty of liquids
- Chew sugar-free gum for a minute or two at a time, especially if your mouth feels dry, chewing parsley, mint, cloves, or fennel seeds may also help
- Clean your mouth after eating fish, meat, garlic, onion, drinking milk products, coffee, and smoking
- Unless your dentist advises otherwise, soak dentures overnight in antiseptic solution
- Get control over the problem. Ask a family member to tell you whenever you have bad breath

Do not
- Let your concern about having bad breath ruin your life. Do not be passive
- Be depressed. Get help. Do not ignore your gums—you can lose your teeth as well as have bad breath
- Drink too much coffee—it may make the situation worse
- Give mouthwash to very young children because they can swallow it
- Clean your tongue so hard that it hurts
- Rely on mouthwash alone—practise complete oral hygiene

In conclusion, dentists can help patients to manage the situation by giving advice on oral hygiene, or can refer them for medical advice when a non-oral cause is suspected. As frontline health care workers, we are expected to encounter this kind of problem from time to time, thus a holistic approach should be followed to improve the quality of life of our patients. Because there is increasing interest and demand on such a topic, more research and studies are desirable to explore, and to increase our knowledge of this condition.

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