ORAL MALODOUR: PHILOSOPHICAL AND PRACTICAL ASPECTS

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Anne Bosy R.D.H., M.Ed., M.Sc.

ABSTRACT

Although oral malodor or bad breath is an unpleasant condition experienced by most individuals, it typically results in transient discomfort. At least 50 per cent of the population suffer from chronic oral malodor, however, and approximately half of these individuals experience a severe problem that creates personal discomfort and social embarrassment. The mouth air of chronic malodor sufferers is tainted with compounds such as hydrogen sulphide, methyl mercaptan and organic acids, which produce a stream of foul air that is gravely offensive to the people in their vicinity. Sufferers often make desperate attempts to mask their oral malodor with mints and chewing gum, compulsive brushing and repeatedly rinsing with commercial mouthwashes. While dental diseases have been strongly associated with this condition, there is considerable evidence that dentally healthy individuals can exhibit significant levels of mouth odor. Proteolytic activity by ;microorganisms residing on the tongue and teeth results in foul-smelling compounds, and is the most common cause of oral malodor. A specialized device called the halimeter is available to measure the volatile sulphur compounds in mouth air. Many of the manufacturers of bad breath remedies claim that their products contain antibacterial mechanisms with sufficient strength to control oral malodor over long periods of time. None, however, effectively eliminate the problem. Interest in oral malodor research and clinical treatment has increased in the last few years, and this distressing problem is finally getting the attention it deserves.
Key Words: *halitosis, bad breath, oral malodor, sulphur compounds, tongue coating*

SOMMAIRE

Bien que les mauvaises odeurs de la bouche ou las mauvaise haleine soient un désagrement qu'éprouvent la pluparat des gens, elles causent ordinairement un malaise qui est passager. Cependant, au moins 50 pour cent des gens souffrent d'une mauvaise haleine chronique et, pour environ la moitié d'entre ceux-ci, le problèm serieux, créant des malaises personnels et des embarras sociaux. L'air qui est dans la bouche des personnes souffrant d'une mauvaise haleine chronique est vicié par des composés comme le sulfure d'hydrogène, le méthylmercaptan et des acides organiques, lesquels produisent un flot d'air infect très répugnant pour les gens dans leur bouche avec des pastilles de menthe ou de la gomme àmâcher, des brossages compulsives et des rinçages répétés avec des rinse-bouche commerciaux. Bien que les maladies dentaires aient été vivement associées àcet état, il est amplement prouvéque des personnes jouissant d'une bonne santédentaire peuvent dégager une mauvaise haleine en quantité importante. L'activité protéolytique des micro-organismes qui se trouvent sur la langue et les dents entraîne la formation de ccomposés qui sentent mauvais et constitue la cause la plus fréquente des mauvaises odeurs de la bouche. Pour mesurer les composés de sulfure volatiles dans l'air de la bouche, il existe un appareil specialize appelé halimètre. Par ailleurs, de nombreux fabricants de remèies contre la mauvaise haleine soutiennent que leurs produits contiennent des agents antimirobiens ayant un pouvoir suffisant pour enrayer la mauvaise haleine durant de nombreuses heures. Pourtant, aucun n'élimine tout àfait le problème. Depuis quelques années, on s'intéresse davantage aux recherches sur la mauvaise haleine et à son traitement clinique. Aussi ce pénible problème reçoit-il enfin l'attention qu'il mérite.

Mots clés: *halitose, haleine fétide, mauvaises odeurs de la bouche, composés de sulfure, langue saburrale.*

Normal breath is sweet with an aroma that reminds one of the pleasant odor of blooming chestnuts[1]. Restoring this aroma is a sought after goal for the millions of Canadians who suffer from oral malodor, which creates a barrier between them and their friends, family and co-workers.

Until recently, oral malodor was a problem that few sufferers discussed openly, even with their most trusted confidants. Now, however, a growing number of product-based treatment centres are opening across the country. These centres claim that they can cure oral malodor as long as the sufferer agrees to use specific rinses. The task facing the dental practitioner is to assess the origin of the patient's oral malodor, and provide an appropriate treatment regime.

Because individuals differ in their sensitivity to smells, the way we perceive oral malodor is often complex. Factors such as the individual's health, fatigue and state of mind influence the ability to detect odours.[2] Individual experience also influences how we perceive odors. For example, while the odor of pine oil is rarely offensive by itself, its association with bathroom cleaners may create a strong association with public washrooms.[3] Another factor is the distinctive odors of individuals or groups of people, which are sometimes associated with diet. According to the Chinese, for instance, Caucasian breath smells of dairy products. Caucasians, on the other hand, can often detect a particular odor of cooking condiments on the breath of Chinese people[3].

A substance must be in a gaseous form and must reach the small receptors in the nasal cavities located in the upper area of the nose, to be smelled.[3] Some of the after-taste of food or drink is also a smell sensation that develops after swallowing.[2] The close relationship between taste and smell is clearly demonstrated by sufferers of bad breath who become aware of their condition through the bad taste they experience in their mouths. However, these individuals typically say that they cannot actually smell their bad breath.

Oral malodor is an ancient problem. It was referred to in the Eber papyrus as early as 1550 B.C., and mentioned in the Talmud (a book containing ancient Jewish civil and religious law).[1] Hippocrates (ca. 460-400 B.C.) who wrote that it was essential for every girl to have pleasant breath developed a mouthwash of unadulterated wine, anise, dill seed and myrtle[4] for this purpose. Maccius Platus (254-184 B.C.) a Roman dramatist who was sufficiently offended by his wife's halitosis to find it just cause for infidelity.[4] Another Roman, Cosmus, became immensely wealthy by producing and selling aromatic pastilles which he claimed would chase away the bad odor from the mouth and turn it into the fragrance of violets.[4] Plutarch (46-120 A.D.) addressed the problem from a different perspective when he wrote about Heiron of Syracuse. When Heiron chastised his wife for not informing him of his bad breath, this intensely diplomatic lady responded that she thought that the breath of all men had the same terrible odor.

Following the publication of Pliny the Younger's *Natural History* (23-79 A.D.) very little literature about oral malodor was written until the 19th century when Joseph Howe, a physician, introduced his well-written and informative book. [5]

Howe had a very keen insight into the problem. He believed that halitosis was the result of sulphuretted hydrogen, which is found in great abundance in the intestinal canal as well as in decayed teeth, dead teeth and inflamed gums. He also postulated that stress, in the form of fear, excitement or tension may sufficiently alter the body systems to produce a disagreeable breath odor. According to Howe, those who were easily excited, easily depressed or given to angry fits of temper, were most likely to suffer from offensive mouth odor.

Although every individual experiences bad breath occasionally, persistent oral malodor affects

at least 50 per cent of the population. Approximately half of these individuals suffer from a severe, chronic problem.[6-8] This paper will discuss the causes of oral malodor and explore potential treatment alternatives.

Those afflicted with oral malodor often feel great embarrassment and discomfort knowing that their breath is unpleasant to those around them. Many of the subjects interviewed for a recent research project confided that they talk with their faces averted, or their hands in front of their mouths, to diminish the impact of their bad breath on those around them. Individuals with real or perceived oral malodor are extremely sensitive to discriminating behavior and usually interpret occurrences such as opening of windows or the placing of a finger across the nose as an indication that their mouth odor is at a socially unacceptable level. Many make desperate attempts to mask the odor through the frequent use of mints and chewing gum, compulsive brushing and repeatedly using flavored mouth rinses.[9]

There is some justification for this seemingly neurotic behavior. Individuals exhibiting serious mouth odor have been overlooked for promotions, and some have seen close relationships come to an end. Others have chosen smoking as a way to mask the odor and become socially more acceptable. Many have become withdrawn and antisocial to avoid the painful embarrassment of close contact.[9]

The principal components of oral malodor are volatile sulfide compounds or VSC's which are primarily hydrogen sulphide, methyl mercaptan and to a lesser extent, dimethyl sulfide and dimethyl disulfide.[10] Various other compounds in mouth air may be offensive, including organic acids such as butyric and propionic,[11] and compounds such as indole, skatole[12] and cadaverine.[13]

Since malodor often originates in the oral cavity, dental professionals have a responsibility to clearly understand the problem and the treatment options. Dental diseases have been strongly implicated as the cause of oral malodor. The condition is often attributed to dental caries,[6,14,15] periodontal diseases,[16,17,18] and oral carcinomas.[19]

Studies have indicated that severe oral malodor may accompany periodontal diseases [20-22] and the intensity of odor increases with the severity of the disease.[6,12,21-2]. However, there is evidence that both periodontally healthy and diseased individuals can exhibit significant malodor levels[24] and that neither malodor nor VSC levels are reliable assessment tests for the presence of periodontitis. [24,25]

When there is no evident dental disease, it is essential to assess the individual for other probable contributing factors. It should be noted that the eugenol- and creosote containing cements can break down and contribute to an unpleasant taste, which can be interpreted by the patient as malodour.[14]

Similarly, a decrease in the flow of saliva during sleep, combined with the reduced activity of tongue and cheek muscles[2] results in stagnation within the oral cavity.[26] This produces an unpleasant taste and odour.[7]

Diet and dietary habits have a major impact on breath odors as well. For instance, onions and garlic,[4,15,26,27] choline[28] and animal fats[29] will all contribute to a foul breath odor. Lack of food[6,27,30] may produce an objectionable odor of ketosis. Individuals who eat infrequently or diet excessively may find that this objectionable odor remains even after brushing.[8]

Hormonal changes during ovulation and menstruation may contribute a "mousy" odor to breath.[27,31] Many of us have experienced the unpleasant after-effects of that extra glass of wine on the breath[29] but are not aware that the systemic intake of drugs such as dimethyl sulfoxide,[32] as well as certain tranquilizers and antihistamines[33] will taint mouth air.

Malodor sufferers who turn to smoking in an effort to mask their halitosis often do not realize that results in its own offensive breath odor[2].

A thorough medical history is mandatory to identify systemic conditions that may contribute to oral malodor. Many systemic diseases, if uncontrolled, cause their own characteristic breath odor. Breath that is fruity, fishy or sharply sulphurous may indicate diabetes[34,35] renal

failure,[28,35] or liver cirrhosis[35,36,37] respectively. Dentists seldom encounter these conditions in an uncontrolled state since most individuals afflicted with oral malodor usually insist on a complete medical examination.

Dentists must also be able to discriminate between the mouth odors related to these conditions and the odor caused by the high concentration of VSC's found in the breath of those individuals with a hiatus hernia.[32] Similarly, although the prevalence of the metabolic disorder trimethylaminuria, is undetermined,[38] the concentration of volatile sulphide compounds in the mouth generally increases in most of these cases. Excess production of trimethylamine results in episodes of foul, fishy-smelling breath.

Foul smelling, calcified material in tonsils called tonsilloliths causes great discomfort to some individuals both by its presence and the pungent odor it emits when squeezed.[39] Even healthy tonsils may harbor a variety of microorganisms capable of odor production.[40]

Sinusitis, polyps and even foreign bodies may be responsible for a predominently nasal odor. Many malodor sufferers undergo a gastroscopy at the advice of their physician due to the popular belief that oral malodor originates in the stomach. However, the stomach only contributes to oral malodor when it is upset and belching or vomiting occurs.[29] Scientific studies show that constipation is not a contributing factor.[26]

Psychogenic halitosis or haliphobia is a condition that affects individual who have no detectable malodor. Sufferers are convinced that their mouth odor is extremely foul, and have an intense fear that their bad breath is offending others.[41,42,43,44] This imaginary halitosis may be accompanied by psychological pathologies.[41] The problem is intensely distressing to these individuals and suicides have been reported as a result of this affliction.[43]

Although oral malodor has multiple etiologies,[14,38] the most common type of oral malodor involves the degradation of protein, peptides and amino acids by microorganisms residing on the tongue and tooth surfaces.[11] The products formed by these bacteria are foul smelling compounds predominantly VSC's.

As many as 82 oral species have been shown to produce fatty acids, hydrogen sulphide and methyl mercaptan from cysteine and methionine.[11,45,46] Since VSC levels may be high in the presence or absence of periodontitis, it is important to determine if odors originating on or in the proximity of the tongue are the principal contributors to oral malodor. The tongue,[47] the subgingival plaque and the mature plaque located on proximal sites all have rough surfaces that may exhibit high levels of anaerobic bacteria.[48-52] Many of these bacteria are capable of producing copious amount of VSC's. The tongue's coating is an accumulation of desquamated epithelial cells, dead leukocytes, food debris[27,53] and bacteria. Because malodorous microorganisms such as *P. gingivalis, Fusobacterium sp., P. intermedius* and *Capnocytophaga sp.* are present in this coating, the surface of the tongue has been implicated as a major contributor to oral mouth odor.[11,53]

The colonization of these bacteria in the oral cavity may be influenced in part by immunoglobulins, including IgA[54] since the presence of IgA in saliva inhibits bacterial attachment through agglutination[54]. It is possible that IgA deficiency may be an underlying cause for the increased numbers of anaerobic bacteria found on the teeth and tongue. Although selective IgA deficiency may be hereditary, occurring in 0.1% of the population[55], there is evidence that this condition can also be acquired. This may be due, in part, to a decreased synthesis or secretion of IgA.[55] Individuals with decreased amounts of IgA suffer from sinopulmonary infections, multiple allergies, arthritis and a variety of autoimmune conditions.[55]

An analysis of self-reported medical conditions suffered by malodor subjects conducted at the University of Toronto (**Table 1**) indicated that a high proportion of these

individuals have one or more IgA related conditions.[24,56] Although this was statistically significant, additional studies are needed to establish if this is a coincidence or the result of a true relationship. If such a relationship can be reproduced in other studies, it would offer an explanation as to why some individuals maintain that they have had oral malodor for as long as they can remember (hereditary deficiency) while others maintain their problems began at a specific time in the past (acquired deficiency).

Table 1:

Medical Conditions Reported by Subjects with Self-Reported Oral Malodor (N=218)

IgA Mediated Conditions	**Number Reporting**	**Per cent**
Allergies	75	34.40
Sinus problems	59	27.06
Skin rashes	46	21.10
Hayfever	42	19.27
Arthritis	26	11.93
Cold sores	24	11.01
Asthma/emphysema/bronchitis	17	7.80
Numerous colds/sore throats	10	4.59
Mononucleosis	1	0.47
Total reporting IgA mediated conditions	155*	71.11
Other Conditions		
Headaches, hypertension, gastro-intestinal problem, depression, thyroid, anemia, heart disease, cancer, hiatus hernia, diabetes, hepatitis	33	15.14
No Conditions	30	13.76

*Out of 155 subjects, reporting immune depressed conditions, 137 subjects had clearly noticeable oral malodor and 18 subjects exhibited little or no detectable mouth odour[56]. Many subjects reported more than one condition.

Various methods are available to reduce oral malodor but they vary greatly in their effectiveness. These methods can be mechanical such as toothbrushing or chemical, such as rinsing with a mouth wash. Rinsing with water will bring relief for 15 minutes[57] but brushing with tooth paste will reduce mouth odor for as long as two hours.[31] Sodium bicarbonate dentifrice appears to be superior to fluoride dentifrice for the reduction of VSC levels.[62] The addition of tongue cleaning with a brush or a special tongue cleaner will reduce VSC levels for a much longer period of time than toothbrushing alone,[52,64] and the unpleasant taste associated with oral malodor is also substantially improved.

Many commercial products claim to effectively eliminate mouth odor, but most of them use a masking approach. Other products have antibacterial mechanisms, but many of these rinses have insufficient strength to control odor for longer than several hours **(Table II).** Products containing sanguinarine have little effect but those containing phenolic oils, cetylpyridinium chloride, benzethomium chloride, sodium bicarbonate[62] or zinc chloride[62,64] produce a noticeable inhibition of VSC levels in mouth air. The two phase oil and water rinse, which removes microorganisms and cell debris through their adsorption to oil drops, is also effective.[65]

Chlorhexidine has produced equally significant reductions in VSC levels and in oral malodor.[24,66] Although chlorine dioxide has become a popular product to use, scientific studies demonstrating its efficacy, or the possible side effects that may result from long term use are lacking. To date, the studies investigating the safety of this product have been based on water purification research. Recently, however, a study on water chlorination indicated that there is evidence of a link between water chlorination and bladder or colon cancer.[71]

Breath Assure's manufacturers claim their product will reduce garlic and other food odors but there are no published data to support their contention. Individuals afflicted with cystinosis have experienced partial relief from the bad breath and mouth odors caused by sulfur-based medication but must take at least 21 capsules of this product per day.[72]

The measurement and analysis of the mouth air is critical to an accurate assessment. A combination of mass spectrometry and gas chromatography would be ideal in that this method would identify the kinds and amounts of gases present in the patient's mouth air even at very low concentrations. However, the costly equipment and labor-intensive, time-consuming analysis required by this method make it impractical for use in a dental office.

The halimeter, although limited by the inability to distinguish between the various compounds, has become a popular instrument for odor assessment. This portable instrument, a modification of the industrial sulphide monitor, provides a rapid and objective result with a quick turn-around time between measurements.[73] The halimeter exhibits different sensitivity to methyl mercaptan and hydrogen sulphide and may register a misleadingly low reading if the predominant VSC is methyl mercaptan. One must also consider the fact that other compounds, not measured by the halimeter, may contribute to the malodorous state of mouth air. Further, the halimeter's sensitivity to ethanols and essential oils[73] may produce a high reading if rinses containing these compounds were used prior to measurement. Over time the halimeter may show a loss of sensitivity to the sulphur compounds. If this occurs, it will likely be necessary to repair or maintain the instrument's electrochemical sensing unit. The most advantageous way of using the halimeter is to compare the baseline and post-treatment readings. A reduction from baseline will provide concrete evidence to the patient that there is an improvement in mouth odor.

TABLE II

Effectiveness of Rinses Used for the Reduction of Oral Malodour

Method	Effectiveness in Reduction of Oral Malodour
Rinsing with water	Effective for 15 minutes[57]
Use of sanguinarine rinses	No detectable decreases have been reported[58]
Essential phenolic oils	Low substantivity and only transient antibacterial effects but measurable reduction[59,60,61,62].
Zinc chloride rinses	Marked reduction of VSC levels over time[63] Ionic zinc inhibits VSC's for 10 hours, reduces odor by 71 per cent[62, 64].
Two phase mouthwash	Oil, water and cetylperidinium chloride, found very effective at full strength[65] (Not available in Canada.)
Chlorhexidine	Substantive antimicrobial agent, effective against both gram negative and gram-positive bacterial species [67,68]. Some unfortunate side effects such as staining[69] and bitter taste[70].
Chlorine dioxide	No research to show efficacy or long term effects. Some caution from a report by the Canadian Cancer Research with respect to chlorine dioxide in the water supply[71].
Cetylpyridinium chloride	Shown to reduce VSC production for three hours[62].

The use of specialized equipment is impressive, but direct sniffing of expelled mouth air is still the most reliable, albeit simple, approach to analyzing breath odor.[73] Referred to as the organoleptic assessment, it is performed by taking a short rapid sniff as the patient breathes out. Nasal air should be organoleptically measured as well. Detection of nasal odors will indicate that the nose or sinuses may be implicated in the patient's bad breath. Organoleptic measurements can be very subjective however, as ability to detect odors can vary between dentists.[8] With some training and practice, the ability to conduct a successful odor analysis can be achieved.

Along with the growing public and media interest in oral malodor, dental professional are becoming more aware of their patients concerns and are actively seeking information in the area of diagnosis and treatment of bad breath. Research activity has increased and more scientific literature is now available. This long standing and greatly distressing problem finally has the attention that it deserves. Dentists and their team should focus on the philosophy of wellness, as well as the patient's quality of life expectations.

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