

HALITOSIS – A Social Malady

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Abstract: Halitosis is a common and universal affliction suffered by many people irrespective of age, sex, and social status. Halitosis is estimated to be the third most frequent reason for seeking dental aid, following tooth decay and periodontal disease. It is one of the biggest proscriptions in the society. Halitosis may be an important factor in social communication therefore; it 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. Causes of halitosis include certain foods, poor oral health care, dry mouth, deep carious lesions, periodontal disease, oral infections, peri-implant disease, pericoronitis, mucosal ulcerations, tongue coating, tobacco products and medical conditions. The present review was to describe the etiological factors, and the therapeutic approaches related to halitosis.

Key words: halitosis, tongue coating, volatile Sulphur compounds, halimeter, triclosan

I. Introduction:

Halitosis is one of the most personal and often embarrassing problems commonly faced by millions of people. It is one of the society's oldest and most troublesome social maladies, which can lead to a significant amount of social disharmony and embarrassment and has been recorded in literature for thousands of years.¹ The other terminologies used for bad breath is halitosis, fetor oris, ozostomia, or stomatodysodia.

In 90% of cases the causes of halitosis are located in the mouth and can be attributed to deep carious lesions, periodontal disease, oral infections, periimplant disease, pericoronitis, mucosal ulcerations, impacted food or debris, factors causing decreased salivary flow rate and mainly, tongue coating.²

Halitosis may be an important factor in social communication therefore; it 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.³ Sufferers often make desperate attempts to mask their oral malodour with mints and chewing gum, compulsive brushing, and repeatedly rinsing with mouthwashes.⁴

II. Historical Background:

Odours are essential clues in the creation and conservation of social bonds, as they are loaded with cultural values. Hindus consider the mouth as a body's entry door and therefore insist that it be kept clean namely before prayers. During Christianity devils supreme malignant odour smelt of sulfur, and it was presumed that sins produced more or less bad smell. Islamic literature recommended the use of siwak which contains sodium bicarbonate and tannic acid that exert beneficial effects on oral health for fetid breath. The problem is discussed at length in the Jewish Talmud and has been described by Greek and Roman writers.⁵ Other folk cures include parsley, cloves, guava peels, and eggshells.⁶ Since the 1960s, the preeminent researcher in this field has been Tonzetich. He and coworkers established that oral malodour is associated with the presence of volatile sulfur compounds, primarily hydrogen sulfide and methylmercaptan.^{7,8}

III. Etiology Of Halitosis:

Oral malodour has complex etiology. Extrinsic causes include tobacco, alcohol and certain foods such as onions, garlic and certain spices.⁹ Oral odour can be affected by the intake of food and drinks, which can either dry the mouth, such as alcohol-containing liquids and cigarettes. Moreover, 'morning breath' is related to the decreased saliva production and secretion resulting in the transient desiccation of the mouth.¹⁰

Tongue coating:

Tongue coating is accumulation of desquamated and exfoliated or ready to exfoliate epithelial cells inter-mingled with blood cells, food remnants and bacteria. Under magnification, the tongue was compared to the "surface of the moon after a rain shower."¹¹ Researchers reported that a single epithelial cell in the oral cavity can harbor up to 25 bacteria, whereas 1 epithelial cell on the dorsum of the tongue can harbor up to 100 bacteria.¹² The dorsum of the tongue and its bacteria has been the subject of several studies.^{13, 14, 15}

According to a study of the topographic distribution of bacterial types on the tongue surface, the dorsal posterior to the circumvallate papillae consistently carried the highest load of all bacterial groups.¹⁶ Several

investigations have identified the dorsal posterior surface of the tongue as the primary contributor to bad breath in healthy people.¹⁷

Yaegaki and Sanada using gas chromatography methods found that VSC production is reduced by one-half when the tongue coating is removed with small spoon.¹⁸ The examination of the composition of the microbiota in tongue biofilm suggested that the major species of H₂S-producing bacteria were Veillonella, Actinomyces, and Prevotella.¹⁹

Hess et al proposed a mathematical model in which each papilla is cluster of strands protruding perpendicularly from the tongue. The biofilm metabolizes oxygen gradually.²⁰ Researchers have suggested that various glycosidases, such as the β-galactosidase produced by Gram-positive oral bacteria, cleave carbohydrate side-chains of salivary glycoproteins and contribute to VSC-production by Gram-negative oral bacteria.²¹ Masuo et al quantified β-galactosidase activity in the saliva of subjects complaining of halitosis, and reported a positive correlation between enzymatic activity in whole saliva and OLS and VSC concentrations.²²

Saliva:

Saliva plays a central role in the formation of oral malodour. Periodontal pockets can cause food debris to accumulate and the rate of foul-odour production to increase.²³ Medications may cause xerostomia and result in oral malodour, especially those with anticholinergic activity.²⁴ In any individual, bad breath levels during the day are inversely related to saliva flow.²⁵ When saliva flow is low, bad breath rises.

Bacteria / Microorganisms:

Malodor producers are members of the oral microbial ecosystem, which is regulated by numerous interactions among the inhabitants. The principal bacteria that are implicated in the creation of oral malodour include *Fusobacterium nucleatum*, *Prevotella intermedia*, and *Tannerella forsythensis*. *Prophyromonas gingivalis* and *Treponema denticola*.²⁶ 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.²⁷ These bacteria proteolyse the sulphur-containing amino acids from the proteins in the saliva, shed epithelium, food debris, gingival crevicular fluid, interdental plaque, and postnasal drip thereby releasing the VSCs.²⁸ Bacterial strains forming large amounts of H₂S from L-cysteine were found in the genera *Peptostreptococcus*, *Eubacterium*, *Salenomonas*, *Centipeda*, *Bacteroides*, and *Fusobacterium*, and CH₃SH from L-methionine was formed by some members of the genera *Fusobacterium*, *Bacteroides*, *Prophyromonas*, and *Eubacterium*.²⁹

Awano et al detected the presence of *T. forsythensis*, *P. gingivalis*, *Aggregatibacter actinomycetemcomitans*, and *P. intermedia* by PCR in the saliva of patients complaining of halitosis.³⁰ Gram-positive oral bacteria, primarily streptococci, may also promote VSC production by Gram-negative bacteria.³¹

Periodontal disease:

It has been demonstrated under exaggerated conditions in the experimental gingivitis model, where discontinuation of tooth brushing resulted in bad breath before the development of clinical gingivitis.³² As the bacterial plaque matures the oxygen level drops to zero favouring reduced conditions and production of odiferous volatiles.³³ The fetid odour characteristic of acute necrotizing ulcerative gingivitis is an extreme example of malodour from periodontal pathogens.³⁴

Extra oral causes:

Pathologic oral malodour also can originate from non-oral causes, like diabetic ketosis and acidosis, uremia and regurgitations, hepatic and renal failure, and certain types of cancer, such as leukemia. Bad breath, from the nasal passages have the telltale odour can be smelt most strongly from the nose, rather than the mouth. In some cases, craniofacial anomalies, such as cleft palate, may be involved.³⁵ A typical nasal malodor usually has a slightly cheesy odour and differs appreciably from other types of bad breath.³⁶ Halitosis of upper respiratory tract may be due to chronic sinusitis, nasal obstruction, nasopharyngeal abscess and carcinoma of the larynx and halitosis of lower respiratory tract may be because of bronchitis, bronchiectasis, pneumonia, pulmonary abscess and carcinoma of the lungs.³⁷

Extraoral halitosis might also be a manifestation of a serious systemic disease, such as hiatus hernia, hepatic cirrhosis or diabetes mellitus.³⁸ Tangerman A, Winkel EG provided evidence that dimethylsulfide (CH₃SCH₃) is the main contributor to extra-oral or blood-borne halitosis, due to a hitherto unknown metabolic disorder.³⁹

In premenopausal women elevated VSC were found in mouth air during mid-cycle and around menstruation.⁴⁰ Bacteria feed on this blood creating odorous volatile sulfur particles. Social habits and behaviors which could increase the risk of suffering halitosis, like alcohol and tobacco consumption.⁴¹

Liquor consumption reduces saliva production, resulting in dry mouth. A study by Suzuki N et al, found an association between daily alcohol consumption and strong malodour, especially related to periodontal disease.⁴¹ Few studies in the literature have highlighted the links between halitosis and emotions, e.g. anxiety.⁴² The relation between anxiety and halitosis have been analyzed with clinical observations suggesting that anxious situations may increase VSC concentration thus causing halitosis.⁴³

Medications:

Medications that are taken for a long duration time contribute to bad breath and taste disorders like medications include antihistamines, tricyclic antidepressants, diuretics, anti-hypertensives and analgesics.²⁴ Disulfuram, is a drug used in treating alcoholics, which is metabolized to carbon disulfide. Dimethyl sulphoxide is prescribed for patients suffering from interstitial cystitis.⁴⁴ It is metabolised and reduced to dimethyl sulfide, giving off the garlic –like odour of dimethyl sulphide. Cysteamine is used in patients with nephropathic cystinosis and can be metabolised to dimethyl sulphide. Certain drugs can also alter the sense of taste and smell causing subjective halitosis or may diminish saliva production thereby stimulating oral putrefaction and thus oral malodour.³⁷

Certain foods including garlic, onion and some spices are absorbed from the intestine, possibly metabolized in the liver released into the bloodstream and excreted via the lungs and other routes. For garlic it was found that halitosis may be oral or gut origin.⁴⁵ This was explained by assuming a rapid metabolism of these thiols by gut mucosa and liver tissue.⁴⁶ Onions does contain large concentrations of propyl mercaptan. The gut component of onion halitosis consisted of methyl propyl mercaptan.⁴⁷

In the fish odor syndrome oxidation of trimethylamine to the odorless trimethylamine N- Oxide is impaired, leading to elevated trimethylamine levels in blood urine sweat and breath.⁴⁸

IV. Diagnosis:

Complaints of bad breath should be taken seriously by the dental practitioner, whether they are justified or not.⁴⁹ Depending on the origin, different smells may be distinguished like rotten eggs, sweet, rotten apples or fish.⁵⁰

Certain questions like who noticed the bad breath- patient himself or others? Under which circumstances was the bad breath experienced? Only in the morning, after meals, after lying down, all these should be evaluated. Halitosis after meals or lying down may be indicative of regurgitation oesophagitis.⁵¹

The patient should be instructed to refrain from drinking, eating, chewing, rinsing, gargling, and smoking for at least two hours prior to the appointment. Malodour examinations should not be performed on patients taking antibiotics.⁴⁹

Organoleptic test:

Organoleptic measurements are considered to be the gold standard for measuring and assessing bad breath.⁵² The offensiveness of the odour can be measured on Rosenberg scale from 0 to 5, which is as follows: 0 = no odour; 1 = barely noticeable odour; 2 = slight but clearly noticeable odour; 3 = moderate odour; 4 = strong offensive odour; and 5 = extremely foul odour; with a score ≥ 2 equalling halitosis.⁵³ Hedonic scale in which a score of +2 = like very much; +1 = like; 0 = do not like or dislike; -1 = dislike; and -2 = dislike very much.⁵⁴ In whole mouth breath assessment, the subjects are instructed to breathe out through the mouth at the distance of approximately 10cm from the nose of the judge who is blinded.⁵⁵

Spoon test is evaluated at the distance of approximately 5 cm from examiners nose.⁵ The dental floss odour test determines the presence of interdental plaque odour.⁵

In saliva odour test, the subject expectorates approximately 1 -2 ml of saliva into a petri dish which is covered immediately, incubated at 37 °C for 5 minutes and then is presented for odour evaluation at a distance of 4cm from the examiners nose.⁵⁶ Lick the wrist, wait about five seconds while the saliva dries then it has to be smelt.⁵⁷

Sulfide meter:

The sulfide meter records a score based on VSC levels in parts per billion (ppb) based on electrochemical and voltametric sensors. There are three categories of scores: Normal = 80 ppb to 160 ppb; Weak = 160 ppb to 250 ppb; and Strong = > 250 ppb. “Weak” signifies malodour at a close distance, and “Strong” signifies malodour at a greater distance. This method is repeated three times, and the mean of the scores is taken.⁵³

Gas chromatography:

GC measures the amount and type of specific VSC and volatile organic compounds (VOCs) in mouth air. Samples of oral cavity breath are collected in a multi-laminate bag. The VOCs are extracted from breath

samples onto sorbant traps. VOCs are identified by computer-based libraries and quantified by their amounts compared with an internal standard.⁵⁸

Portable gas chromatography:

A portable GC device can be used to measure the VSCs in the breath and identify three causal components, like hydrogen sulfide, methyl mercaptan, and dimethyl sulfide.⁵⁹ To measure, a syringe (without the needle) is placed deep into the oral cavity. Then, the plunger is slowly withdrawn, inserted, and withdrawn again before the syringe is removed from the mouth. Then, the sample is injected into the machine where measurements start automatically.⁵⁹

The BANA Test

Bacteria that produce bad breath can be detected by performing BANA (benzoyl-D, L-arginine-naphthylamide) test. When sample of patient's saliva that contains these bacteria is placed in the BANA testing compound, they cause it to break down. As a result, the testing compound changes color. A study by Kozlovsky A et al suggested that the BANA test together with volatile sulphide determination provides quantitative data contributing to the overall association with odour judge estimation.⁶⁰

Zinc oxide and nitrogen chemiluminescence detectors:

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These chemiluminescence detectors permit the precise measurement of nitrogen compounds such as indole & cadaverine in organic matrices. This helps to determine whether these nitrogen compounds are present in mouth air.⁶¹

Electronic nose:

The electronic nose is a handheld instrument that has the ability to “smell” and produce unique fingerprints for odours.⁵³ The mouth-air gas from a patient is first trapped in a tube for 30 seconds and then driven up a sensor section with pure nitrogen. An estimated VSC concentration and organoleptic score is calculated.⁶²

Halimeter

It is a specialized type of sulfide monitor and it produces a mean by which tester can quantify degrees of bad breath in parts per billion (ppb). The examination should preferably be done after at least 4 hours of fasting and after keeping the mouth closed for 3 minutes. The mouth air is aspirated by inserting a drinking straw fixed on the flexible tube of the instrument. This straw is kept about 2cm behind the lips, without touching any surface and while the subject keeps the mouth slightly open and breathes normally.⁶³

Bacteriological analysis:

Bacteriologic analysis from the biofilm and scraped specimens obtained from the dorsum of the tongue or other oral sites can identify the VSC-producing bacteria.⁸³ Kazor and colleagues associated halitosis with *Solobacterium. moorei*, identifying it in one of five subjects without halitosis and in three of six subjects with halitosis.⁶⁴ Newer methods, however, such as the direct amplification of microbial nucleic acids (also called broad-range polymerase chain reaction), can identify both cultivable and non-cultivable microorganisms.⁶⁵ This is important because non-cultivable bacterial species are more numerous than cultivable bacterial species.⁶⁶

Dark Field or Phase- Contrast Microscopy:

Gingivitis and periodontitis are typically associated with a higher incidence of motile organisms and spirochetes. These can be seen directly with the help of microscope.⁶⁷

Indices to check the severity of oral malodour:

Used to measure the tongue coating which aids in malodour. Winkel tongue coating index divides the tongue into 6 sextants, 3 anterior and 3 posterior part of tongue. Scoring criteria is as follows, 0- no coating, 1 presence of light coating, 2 presence of distinct coating. Results obtained by adding all the 6 scores.⁶⁸ Miyazaki index was used to entire tongue as well as score per area (anterior and posterior to sulcus terminalis, each region further divided into left and right side) is given. The score ranged from 0-3. Scoring criteria 0-no coating, 1-<1/3rd, 2-<2/3rd, 3->2/3rd of the surface coated.⁶⁹

V. Treatment:

The treatment of halitosis should aim at the elimination of its cause. Hence, the first step is to identify the etiology. Since diagnosis is imprecise and the vast majority of cases of halitosis are of oral origin elimination of the most prevalent intraoral causes makes therapeutic sense.⁷⁰ Common therapeutic approaches should be considered a) reduction of intra-oral bacterial load, b) to reduce the availability of protein nutrients for bacteria, since the microbes responsible for converting VSC are proteolytic, c) removal of the tongue coating, and d) periodontal assessment and treatment.

For the general case of non-systemic oral malodour, treatment often begins with proper oral hygiene at home. This procedure will reduce the amount of VOCs and microorganisms in the mouth.⁷¹ Emphasis has been placed on tongue cleaning to reduce the amount of coating on the back of the tongue. A recent study examined tooth brushing and tongue scraping reduces microflora, and toothbrushing alone demonstrated the least reduction.⁷²

A study by Casemiro LA et al compared the effectiveness of a new manual toothbrush that has a tongue scraper on the back of its head and a commercial tongue scraper. The evaluated methods were equally effective in the improving breath odour and reducing the facultative aerobic and anaerobic microbiota on tongue surface of the studied population.⁷³

Carvalho MD et al demonstrated the beneficial impact of mouthrinses on morning breath even in the absence of mechanical plaque control. In a cross-over trial on college students, the VSC formation was inhibited in descending order, 0.2% chlorhexidine, 0.12% chlorhexidine, triclosan and essential oils and cetylpyridinium chloride.⁷⁴

Chlorhexidine has the ability to remain active in the oral cavity up to 12 hours due to its ability to adsorb to mucosal and dental surfaces. Oral mouthwashes containing zinc have also been listed as VSC reducers which acts for three hours.⁷⁵

Several toothpastes have demonstrated antimicrobial and anti-halitosis effectiveness even with the use of regular commercial toothpastes.⁷⁶ Essential oils containing mouthwash present in market is Listerine. It has been found only relatively effective against oral malodour (25% reduction vs. 10% for placebo).⁷⁷

Shinada K et al showed that a mouthwash containing ClO₂ improved morning bad breath and reduced the concentrations of H₂S, CH₃SH and (CH₃) in healthy subjects. Moreover ClO₂ mouthwash used over a 7-day period was effective in reducing.⁷⁸

Triclosan a broad spectrum antibacterial agent has been found to be effective against most oral bacteria and has a good compatibility with other compounds used for oral home care.⁷⁹

Lodhia P et al have shown significant effectiveness of green tea in reducing oral malodor because of its disinfectant and deodorant activities, although effect was maintained for a very short duration. Green tea was found even more effective than sugarless chewing gum and mint in reducing volatile sulphur compounds.⁸⁰

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