The Role of Oral Microbes in Halitosis – A Review

Neema Balan[1], Lakshmi P Das[2], Arulvizhi M[3], Bastian T.S[4], Selvamani. M[5]

[1]PG student, [2]PG student, [3]PG student, [4]Professor and HOD, [5]Professor, Department of Oral Pathology and Microbiology, Mahe Institute of Dental Sciences and Hospital, Mahe

ABSTRACT

Halitosis or malodour is a common complaint that usually causes social embarrassment, irrespective of socioeconomic status. Halitosis can be a genuine halitosis or pseudo halitosis. Pseudo halitosis occur as a part of obsessive compulsory disorders and hypochondria where the condition is quite imaginary and is known as halitophobia. Genuine halitosis can be oral or extra oral. It is well known that majority of the cases of halitosis results from the microbial activity of the oral cavity. This review aims at discussing the role of various oral microbes in developing halitosis.

Key words: *Halitosis, Halitophobia, Oral Halitosis, Bacterial Putrefaction, Volatile Sulphur Compounds*

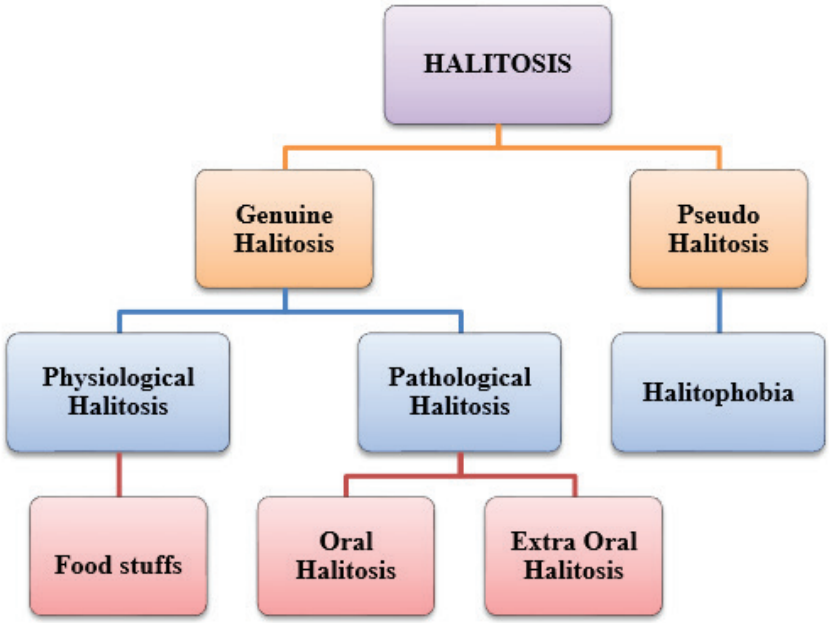
INTRODUCTION

Halitosis is a general term used to describe an unpleasant or offensive odour emanating from the oral cavity[1]. The origin of halitosis could also be related both to systemic and oral conditions, but an outsized percentage of cases, about 85%, are generally associated with an oral cause[2].Oral halitosis is the specific term used to define halitosis with oral origin[1].Gingivitis and Periodontitis accounts for approximately 60% of the oral factors and the poor hygiene of tongue accounts for the other 40%. Systemic or extra–oral conditions may also produce volatile compounds that are eliminated through exhaled air, contributing to halitosis[4]. Halitosis is a medical term, first coined by the Listerine Company in 1921, used to describe unpleasant breath, regardless of its sources, oral or non-oral[5]. Various synonyms like oral malodor, fetor ex ore, bromopnea and bad breath are used at instances to describe halitosis[4].The term 'Halitosis' was derived from the Latin word "halitus" meaning, "breath" and the Greek word "osis" meaning, "a condition, action or pathological process". In simple words, halitosis means "Bad Breath"[6].

Corresponding Author,
Dr. Neema Balan
Second year PG student
Department of oral pathology & microbiology
Mahe Institute of Dental Sciences and Hospital,
Mahe(U.T of Pondicherry). Pin- 673310.
Mob: 9562536050
email-ullasneema80@gmail.com

Classification

The first step in classifying 'Halitosis' is to distinguish whether it is a 'genuine halitosis' or a 'pseudo halitosis'. Genuine halitosis is the real problem of malodour which can be assessed by various methods where as pseudo halitosis is a false assumption of patient that he or she has a problem of bad breath (Halitophobia). Genuine halitosis can be further classified as physiological and pathological halitosis[1]. Physiological halitosis otherwise known as transient halitosis or morning breath, mainly originates in the tongue. It is due to normal nocturnal hyposalivation and hence self limiting[1, 7]. Pathological halitosis in nearly 85% of cases occurs due to oral causes[2, 7]. Oral halitosis occurs mainly due to periodontal diseases. Extra oral halitosis is caused due to other systemic conditions[7, 8]. Persons with halitophobia interpret other people's behaviour, such as covering the nose, averting the face or stepping back, as an indication of their own bad breath, and such behaviours convince the patients that they have offensive oral malodor. Most often these gestures are incidental and misinterpreted by pseudo halitosis patients[9].



Etiology

Etiology of halitosis can be a simple transient one like in physiological halitosis or may be due to certain food items, habits like smoking or alcoholism, drugs or due to oral and systemic diseases[7, 10]. These factors can be listed as follows:

Oral diseases • Food impaction • Acute necrotising ulcerative gingivitis • Acute gingivitis • Adult and aggressive periodontitis • Pericoronitis • Dry socket • Xerostomia • Oral ulceration • Post oral surgical procedures • Oral malignancy	Respiratory disease • Foreign body • Sinusitis • Tonsillitis • Malignancy • Bronchiectasis **Volatile foodstuffs** • Garlic & Onions (contains a chemical named Allicin that will turn into sulphur compounds) • Spiced foods
Systemic causes • Acute febrile illness • Respiratory tract infection (usually upper) • *Helicobacter pylori* infection (?) • Pharyngo-oesophageal diverticulum • Gastro-oesophageal reflux disease • Pyloric stenosis or duodenal obstruction • Hepatic failure (fetor hepaticus) • Renal failure (end stage) • Diabetic ketoacidosis • Leukaemias • Trimethylaminuria • Hypermethioninaemia • Menstruation (menstrual breath)	Drugs and chemicals • Alcohol • Tobacco • Betel • Solvent misuse • Chloral hydrate • Nitrites and nitrates • Dimethyl sulphoxide • Disulphiram • Some cytotoxic agents • Phenothiazines • Amphetamines

PATHOGENESIS

Any oral site during which microbial accumulation and putrefaction can occur could also be an origin for oral malodor. The most common intraoral sites of malodor production are the tongue, interdental area, and subgingival area. The other foci may include faulty dental restoration sites, sites of food impaction, abscesses and Caries which are sufficiently large to allow entrapment of food particles[11]. Oral production of malodorous substances is most ordinarily related to byproducts of bacterial metabolic degradation. These products result from microbial fermentation of proteins, peptides, and mucins found in saliva, blood, gingival crevicular fluid, lysed neutrophils, desquamated epithelial cells, and any residual food retained on the oral surfaces[12].

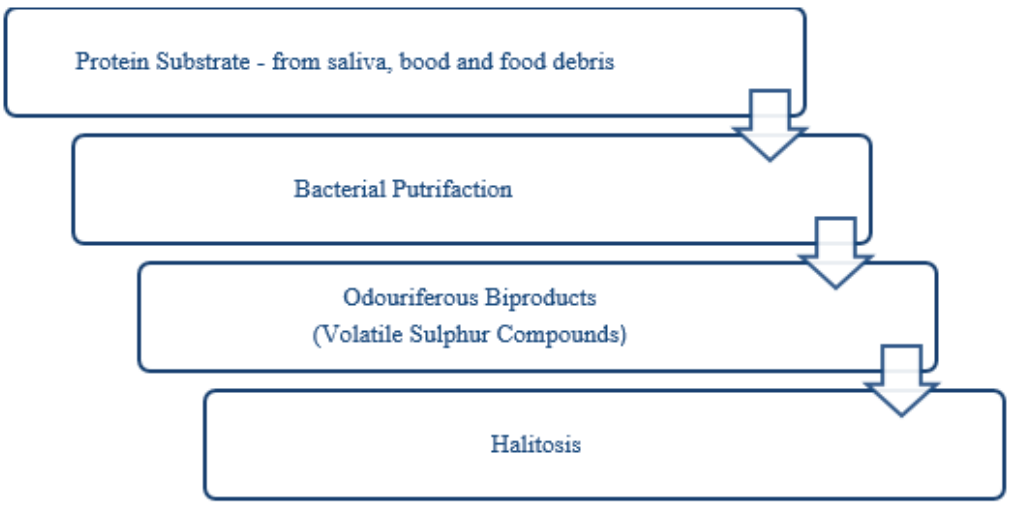
Volatile sulphur compounds (VSCs) are most common odouriferous substances identified and includes hydrogen sulphide, methyl mercaptan, and dimethyl sulphide accounting for roughly 90% of VSCs. Gram-negative anaerobic species found within the subgingival plaque, produce a various range of malodorous compounds as byproducts of their metabolism, including VSCs and short-chain organic acids like pentanoic acid , butanoic acid , putrescine, and skatole. The putrefaction of amino acids within the mouth may be a physiological process; however, it's enhanced by other modifying factors, like periodontal diseases, circumstances resulting in dry mouth, and other systemic conditions[12].

Deep periodontal pockets exhibits low oxygen tension that leads to low pH and activation of the decarboxylation of amino acids to cadaverine and putrescine, two malodorous diamines. Periodontal diseases, in particular, Acute Necrotizing Ulcerative Gingivitis (ANUG), severe periodontitis, pericoronitis, dry socket, and other oral infections and ulcers have been classically associated with oral malodour[12].

The tongue may be a major site of oral malodor production. The papillary structure of the dorsum represents a particular niche within the mouth, offering an outsized area that favors the buildup of oral debris and microorganisms[13].

Dentures are another important explanation for oral malodor, particularly if they are worn overnight. Usually the odor features a somewhat sweet but unpleasant character and is quickly identifiable, particularly if the dentures are placed in a bag and smelled after several minutes[11].

Disease, pathologic condition or malfunction of oral tissues can also result in malodor[4]. Lack of oral cleansing in subjects with xerostomia (dryness of the mouth) has the potential to cause or enhance malodour[10].



Flow chart:

MICROORGANISMS INVOLVED

The oral microorganisms most likely to cause oral malodors are Gram-negative bacteria species and include organisms such as *Prevotella (Bacteroides) melaninogenica, Treponema denticola, Porphyromonas gingivalis, Porphyromonas endodontalis, Prevotella intermedia, Bacteroides loescheii, Enterobacteriaceae, Tannerella forsythensis(Bacteroides forsythus) , Centipeda periodontii, Eikenella corrodens, Fusobacterium nucleatum vincentii, Fusobacterium nucleatum nucleatum, Fusobacterium nucleatum polymorphum and Fusobacterium periodonticum*[10,12].

Gram-positive microorganisms like Streptococcus salivarius even have been found to contribute to malodor production. They can deglycosylate the salivary glycoproteins, therefore helping in exposing the protein core for further denaturation by gram-negative bacteria[14].

DIAGNOSTIC TECHNIQUES[14]

There are various methods to assess halitosis of which most commonly used is the organoleptic measurement. Chair side test for assessing bacterial activity is BANA test and most recent diagnostics include polymerase chain reactions are also mentioned in the literature. Many tests and equipments are used to determine and detect the types of organisms which are probably responsible for bad breath. Some available diagnostic tests and equipments are listed below:

- Organoleptic measurement(sniff test):

Organoleptic measurement may be a sensory test scored on the idea of the examiner's perception of a subject's oral malodor. This is considered to be the gold standard. The test is simple and does not require any specialized equipment. The examiner smells the air exhaled by the subject through a plastic tube or straw inserted in to the patient's mouth. Upon evaluation of the odor, it's given a score (0-5).

- Gas chromatography (GC)
- Saliva incubation test
- Dark field/phase contrast microscopy
- Sulfide monitors (halimeter)
- The electronic nose
- Ninhydrin method of detecting amine compounds
- Halitox system
- Topas (toxicity prescreening assay)
- Zinc oxide and nitrogen chemiluminescence detectors
- Bana tests: Chairside test that is used to determine the proteolytic activity of certain oral anaerobes that contribute to oral malodor
- Perio 2000 diamond probe system
- Polymerization Chain Reactions (PCR) for identifying non- cultivable microorganisms[13]

TREATMENT

Treatment algorithm for oral malodor is a step-by-step problem-solving procedure and well described by Newman (1996). Before starting the treatment, a clinician must first determine the actual source of malodor. The simplest way to distinguish oral from non-oral origin is to compare the smell from mouth and nose (Rosenberg 1996). If the origin is from nasal or if the patients have the potential medical etiology, they must be referred to a physician for further evaluation and treatment[15].

The odor generated from the oral cavity often requires a dental treatment. If the patients still suffer from oral malodor after maintaining good oral hygiene, rinsing or gargling with an effective mouthwash may be advised[15]. Halitosis is associated with specific bacteria; therefore, it may be amenable to treat them by specific and nonspecific antimicrobial therapies. Individuals exhibiting halitophobia requires counseling thereby educating them that their problem is psychological through an explanation of their results of diagnostic assessment[1].

CONCLUSION

It is essential to identify the exact cause of halitosis before proceeding in to the treatment. Exact microbial species should be identified and treated. Step - wise diagnostic procedures will definitely help in identification and treatment of halitosis that ultimately

increase personnel confidence of the individual, thereby rescuing them from social embarrassment.

CONFLICTS OF INTEREST: There are no conflicts of interest

ETHICAL CLEARANCE: Not required as this article is a review article.

SOURCE OF FUNDING: Not required as this article is a review article.

REFERENCES

1. Sanz M, Roldan S, Herrera D. Fundamentals of breath malodour. J Contemp Dent Pract. 2001 Nov 15;2(4):1-7.
2. Cortelli JR, Barbosa MD, Westphal MA. Halitosis: a review of associated factors and therapeutic approach. Brazilian oral research. 2008 Aug; 22:44-54.
3. Rösing CK, Loesche W. Halitosis: an overview of epidemiology, etiology and clinical management. Brazilian oral research. 2011 Oct; 25(5):466-71.
4. Armstrong BL, Sensat ML, Stoltenberg JL. Halitosis: a review of current literature. American Dental Hygienists' Association. 2010 Mar 1;84(2):65-74.
5. Rayman S, Almas K. Halitosis among racially diverse populations: an update. International journal of dental hygiene. 2008 Feb; 6(1):2-7.
6. Veeresha KL, Bansal M, Bansal V. Halitosis: A frequently ignored social condition. Journal of International Society of Preventive & Community Dentistry. 2011 Jan; 1(1):9.
7. Scully C, Greenman J. Halitology (breath odour: aetiopathogenesis and management). Oral diseases. 2012 May; 18(4):333-45.
8. Murata T, Yamaga T, Iida T, Miyazaki H, Yaegaki K. Classification and examination of halitosis. International dental journal. 2002 Jun; 52(S5P1):181-6.
9. Yaegaki K, Coil JM. Examination, classification, and treatment of halitosis; clinical perspectives. Journal-canadian dental association. 2000 May; 66(5):257-61.
10. Porter SR, Scully C. Oral malodour (halitosis). Bmj. 2006 Sep 21; 333(7569):632-5.
11. Krespi YP, Shrime MG, Kacker A. The relationship between oral malodor and volatile sulfur compound–producing bacteria. Otolaryngology—Head and Neck Surgery. 2006 Nov; 135(5):671-6.
12. Saini R, Saini S, Saini SR. Halitosis: An oral microbial faction. Chronicles of Young Scientists. 2010 Oct 1; 1(4):36.
13. Abdul-Rahman GY, Al-Adole RJ. Isolation and Identification of Microorganisms from Patients with Halitosis. Rafidain Journal of Science. 2018 Dec 1; 27(4):33-9.
14. Panicker K, Devi R, Honibald EN, Prasad AK. Oral malodor: a review. Journal of Indian Academy of Dental Specialist Researchers. 2015 Jul 1; 2(2):49-54.
15. Morita M, Wang HL. Association between oral malodor and adult periodontitis: a review. Journal of clinical periodontology. 2001 Sep; 28(9):813-9.
16. Haraszthy VI, Zambon JJ, Sreenivasan PK, Zambon MM, Gerber D, Rego R, Parker C. Identification of oral bacterial species associated with halitosis. The Journal of the American Dental Association. 2007 Aug 1; 138(8):1113-20.