

Oral Malodor: A Clinical Appraisal: Mechanism, Diagnosis & Therapy.

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Abstract: This article appraises the olfactory/gustatory mechanism, provides working concepts of different kinds of oral malodor, deconstructs OM deriving from direct-oral, and indirect non-oral causes, lists common causes of both, and reviews clinical measurement, diagnosis, management and treatment.

Key words: Cacogeusia, Fetor ex ore; halitosis, Halimeter, ozostomia, stomatodysodia, volatile sulfur compounds

I. Introduction and background:

Oral malodor, from time immemorial, is among the most common causes of social embarrassment and personal shame among all people worldwide. Much misunderstanding about different types of OM exists, and consequently frequently clinical frustrations or disappointments arise when therapies fail to improve the condition. **Aim:** This article appraises olfactory/gustatory mechanisms, classifies different types of oral malodors, reviews clinical diagnostics and hopefully suggests successful principles of management, therapeutic strategies and pragmatic therapies.

What is OM? OM exists when the breath stinks. Most are **caused by** breakdown products deriving mainly from sulfur-containing amino-acids. Yet not all OMs are the same, and they have different causes. **What causes OM?** Generally OM is detected when metabolic or microbial breakdown products, using enzymes[like protease, sulfatases or lipases, produce odoriferous molecules called volatile sulfur compounds (VSC's) like mercaptan, hydrogen sulphide etc], which are present in exhaled air. VSC's are derived from cysteine/cysteine and methionine residues and other S-containing metabolites. Sulfinic and sulfonic acids participate in dimerization of inter/intra molecular disulfide linkages in proteins, and when these are broken down, VSC's are released. Various other metabolic products like urea, ketones or bilirubin and others, yield unique fragrances, but these are not as common or prevalent as VSCs.

II. Mechanism of Smell and Taste

These two sensory modalities are interlinked, and both must be healthy, active and working to realize optimal function. [1,2] Olfactory sensations are mediated through the first cranial nerve (CN-I) olfactory receptor hair-like structures, with central-nervous-system links via the nucleus of the medullary *tractus solitarius*, the *ventral posterior nucleus of the thalamus*, and the parietal lobe localizing in the *post-central gyrus*.

Taste buds connect to various cranial nerves with olfactory and taste sensations receiving co-stimuli not only from CN-I, but also from CN-V, CN-VII, CN-IX, and CN-X input. **Normal healthy function of the CNS is mandatory for healthy function of smell and taste.** Taste buds are prevalent and scattered in various locations of the oro-pharyngeal mucosae and connect to the oro-pharyngeal cavity via taste pores. A total of about 10 000 taste buds with pores are found scattered throughout mucosae of the lips, cheeks, larynx, epiglottis, superior one third of the esophagus, and are most concentrated on the dorsal and sides of the tongue, and the soft palate. Olfactory stimuli are triggered by a combination of a physical molecular fit and/or vibration from the stimulating molecules. [1-3] A synapse at the base of the pores connects to the CN-sensory nerve fibres cited. For the receptors to function, gustatory stimulants must be sapid, and olfactory molecules must be volatile and capable of penetrating and/or dissolving in the liquid covering the neural receptor. Olfactory stimulants can be detected in as little as 1 part in 12 million in Mankind, and as low as 1part in 50 million for dogs, pigs and other animals. Taste is strongly moderated by mucus blocked mucosae, usually prevalent with naso-pharyngeal infections like the common cold or influenza. Substances, which do not ionize easily or are insoluble in saliva, are notorious for being odorless and tasteless. Both olfactory and gustatory mechanisms are inter dependant and function in unison to render optimal subjective sensations.[1,2,3.]

Types of Oral Malodour according to site and etiology: [4]

OM has **NON-ORAL** and **ORAL causes**, and different names of OM imply different causes and sources.

I. NON-ORAL causes and OM types:

Mainly three types of **Halitosis**: i) *physiological*, ii) *pathological* and iii) *psychological*.

- i) **Physiological halitosis**: is caused by dietary foods and drink, like garlic, onions, curries and spices such as cumin, mace, coriander, cinnamon, or tumeric. It is short lived, temporary and easily reversible.
- ii) **Pathological halitosis** is caused by systemic disease. *Diabetes mellitus* often produces ketones and a sweetish odour. Diabetic control is essential to eliminate this *ketosis*. *Kidney disease* may produce an ammoniacal smell, and *liver disease* has a musty odour. *Gastritis* with mucosal pathology (like ulcers or neoplasia) may present with OM with a fetid foul odor. These pathological malodours must be addressed by medical physicians to cure the underlying disease. These are more persistent and reversal, although challenging is feasible, but depends on treating the underlying physiological cause. *Early loss of smell (anosmia)* may indicate early onset Alzheimer's, as the CNS connections become less functional.
- iii) **Psychological halitosis** more accurately called *delusional cacosomia*. This OM is subjectively, but falsely, perceived by patients who may have a brain dysfunction or tumor. Taste and smell changes frequently occur with people who are suffering from an intra-cranial neoplasia, either as a primary lesion, a metastasis, or from cancer therapy. [6]. Objective measures of VSC's with a machine (as ppb with an Halimeter) will provide measures that are below threshold detection by healthy people. *Psychological halitosis* demands immediate urgent further investigation. In epilepsy, *psychological halitosis/delusional cacosomia* may be perceived as an **aura**, which is a subjective warning sign that a seizure is about to occur. The **aura** may be any smell but commonly burning rubber, smoke, or a pungent aroma. Once the CNS pathways are dysfunctional subjective reporting of OM remains nigh impossible to eliminate.

Other NON-ORAL causes and OM Types [4]

- i) **Ozostomia**: OM from causes above the carina. (The carina is the bronchial cartilage that divides the respiratory tree into upper respiratory tract URT and lower respiratory tract LRT) URT infections like pharyngitis, tonsillitis, tonsoliths, rhinitis or sinusitis often cause *ozostomia*. Blocked and runny noses frequently among children will produce typical ozostomia smells. This is also a pathological halitosis. [12]
- ii) **Stomatodysodia**: OM caused from the lungs below the carina. Tobacco addiction/abuse is the main cause of *stomatodysodia*, but also infective bronchitis, bronchiectasis, lung abscess, tuberculosis, pleurisy, and/or pneumonia, by viruses and/or microbes contribute and may be responsible. This is also a pathological halitosis.

II. ORAL causes and OM types:

Oral types are called **fetor ex ore FEO** and **fetor oris FO**. FEO and FO are the same.

By far the commonest type of OM is fetor ex ore or FEO. Over 90 percent of Oral malodour has an oro-dental origin. Consequently it is important to render a mouth totally pathology free before investigating for non-oral causes.[4]

Not all biofilms are the same. Mature climax ecosystems in biofilms, are laced with Gram-negative bacteria, which areas powerfully equipped with sulfatases and are major contributor to oral VSC compound found in FEO.[7]

FEO's are caused by odoriferous bacterial biofilms from effects of stagnated microbes with pathology of the mouth affecting teeth, gums and tongue. These conditions and biofilm stagnation areas include the situation below in **Table 1:-**

TABLE 1

- Gingivitis/Periodontitis
- Pericoronitis/Peri-implantitis
- Dead spaces of stagnation on implants
- Caries/Tooth Decay with/without cavitation
- Dorsum of Tongue Pathology
- Interdental areas
- ANUG/NUG (trench mouth)
- Post-extraction, dry socket
- Plaque & Calculus (Biofilm and Calcified Biofilm)
- Poor Oral Hygiene with stagnation areas
- Inadequate brushing & flossing
- Reduced salivary flow
- Faulty fillings like overhangs or spaces

- Dental materials
- Cements with Eugenol, oil of Cajeput,
- Pulp dressings with Creosote or Kri3 (para-mono-chlor-phenol)
- Fixed bridgework with unsanitary pontics
- Appliances: Orthodontic and Prosthodontic
- Inadequate Denture hygiene
- Oral Medicine Mucosal Conditions.
- Ulcerations, Abrasions, Wounds
- Neoplasias
- Hemorrhagic Diatheses
- Fractures and Healing oral wounds; post-operative
- Other local oro-pharyngeal pathologies

Table 1: Oral Sources as causes of FEO.

Any oral condition that is associated with blood, necrosis, pus, mucus, bacteria or food remnants will cause FEO unless eliminated. For this reason personal oral hygiene practices are essential in the elimination of FEO. ***FEOs can be eliminated through correct identification of the cause and successful elimination of the source.*** For example successful treatment of NUG reduces the ppb VSC count from over 1000ppb VSC to below 50ppb or less, which is within the range of normal

What to do to assist in managing OM?

Measure VSC's

The human nose may only detect VSC's at about 80ppb or more. An artificial nose, by way of an instrument is needed for precise quantification of VSC's in the exhaled air. The Halimeter is an instrument which is reliable, robust and easily available in the USA for accurate measures of VSC's.[5, 11, 16]

The Halimeter VSC records accurately as parts per billion, all VSC's in exhaled air. Recordings which register below 80ppb, ***but subjectively reported as severe***, OM should seriously be investigated further. A CNS lesion, neoplasia or other expanding CNS entity could be responsible for dysfunctional central exaggerated interpretation of objectively recorded low levels of measured VSC's. Often this symptom is the earliest indication of brain tumors. This is because disrupted CNS physiology renders the taste/olfactory brain connections dysfunctional with persistent subjective false interpretations of OM. Objective VSC measures in these cases are invaluable for indicating further special investigations.

A cruder device called The Tanita Breath Checker [18] (which indicates with spots the presence of malodor) is also available, but this is not a reliable tool for accurate clinical assessment and use. When delusional cacosmia [psychological halitosis] may be present in people with non-oral lesions leading to false perception of OM, a precise numerical measure is indicated for serious consideration. .

Management of OM as FEO:

Management of OM, which in the main is FEO, demands that a dentist does a full comprehensive dental exam. When therapy renders the mouth, tongue, gingivae and teeth healthy and disease free, OM should markedly improve to below subjective threshold levels. Objective reporting by a spouse, family or friends should also be investigated, as the phenomenon of accommodation may occur subjectively and the OM is only noticed by third persons. Accurate measures and records of VSC measures must be kept for comparisons to assess improvement deriving from Therapies.

A mouth with healthy gums and decay-free teeth rarely emanates OM.

Poor oral hygiene and inadequate home plaque control is the major cause of OM. Improved oral hygiene with tooth-brushing and flossing improves most OM. The central mission of improved oral hygiene is to reduce the oral bacterial count, especially gram-negative bacteria. Any disinfectant, antimicrobial substance or molecule with sanitary activity and achieves microbial elimination or reduction, will provide noticeable improvement of FEO. Hypertonic saline mouthwashes, disinfectant solutions (like those containing chlorhexidine, cetyl-pyrimidine, or volatile oils) all improve FEO VSC counts through bacteriostasis. [8-16]

Improved home care including daily brushing, flossing and tongue scraping, combined with regular visits to the dentist for professional cleaning will cure most OM.

Medical conditions manifesting in the mouth like ANUG, allergies or other pathologies demand proper management by medical/dental specialties, and the general dentist will refer these cases for the correct management and therapy.

General therapeutic comments of OM

Removing the fundamental cause is essential for treating or improving all OM. The different types of OM demand different management according to the cause. This applies specifically to sufferers of diabetes who may exhibit 'ketone breath'; also liver or kidney disease must be attended to eliminate their unique pathological non-oral halitosis. For ozostomia and stomatodysodia, targeted therapy to the respiratory causes renders positive reduction in OM. This may include single or combination-use of antimicrobials, antibiotics, mucolytics, antihistamines and inhalants. For FEO elimination or at least marked reduction of bacteria stagnation areas are essential to improving FEO.

Masking oral stench with aromatic substances like flavored chewing-gum, perfumed pastilles or scented 'dragees' does not eliminate the smell. The same applies to aerosol mouth-sprays, oral fresheners and fragrances. Most contain vaporized oils that taste and smell pleasant, but do not address the causes of the OM. Mouth washes alone may temporarily mask the smell, and although some of these oral rinses assist in controlling infection, and can reduce the oral microbial count, they do not cure, eliminate or prevent OM recurrence.

OM detection often is not subjective as people accommodate to their own OM.

Intimate and other family or social contacts may notice OM and inform the sufferer.

Outlined below are therapeutic modalities called upon to moderate OM. **See Table 2.**

TABLE 2

- **Local chemical/antibacterial methods**
 - Mechanical debridement
 - Toothbrushing and inter-dental flossing: improved oral hygiene techniques.
 - Scaling, Root-planing and Tongue scraping
 - Prosthesis-Denture hygiene
 - Avoidance of foods, odoriferous fluids, and medications
 - Correction of anatomical abnormalities; eliminate biofilm stagnation
- **Medical management of systemic disease**
 - Psychological: Imipramine
 - Systemic antibacterial methods
 - Salivary stimulation/substitutes
 - Nasal mucus-control methods
 - Upper Respiratory Tract Infection clearance
 - Lower Respiratory Tract Infection clearance
- **Specialized antibiotics, antimicrobials and disinfectants**
 - Penicillin
 - Metronidazole
 - Mebendazole
 - Florazole
 - Elyzol
 - Tetracycline: Actisite:Minocycline
 - Dentamycin
 - Doxycycline: Atridox; Spiramycin/Rovamycin;
 - Clindamycin; Azithromycin; Clindamycin; Erythromycin
 - Ciprofloxacin
 - Bactrim (S)
 - Biocides
 - Chlorhexidine
 - Periochip
 - Cepacol
 - Phenolics

Table 2: Generic therapeutic adjuncts to manage OM.

III. Concluding remarks

OM is prevalent globally in all cultures, and is regularly ascribed as an undesirable personal characteristic. FEO is most common and an enormous industry claiming cures for OM has flowered. Most solutions used eschew defining the cause and effects are cosmetic, that is they are temporary, mask the malodor and do not remove or cure the cause. Oral malodor clinics exist in selected areas, but are rare. Consultation with oral health care workers (oral hygienists, dentists, dental-specialists) should be the first approach, and referrals

with specialists indicated followed up. Defining the cause, determining the type and targeting therapy is essential for curing OM.

Author's statement: The author has no conflicts of interest or commitment.

References, Sources and Further Reading:

- [1]. Ganong WF (2003) Review of Medical Physiology. 21st ed. P 191-194. New York: Lange Medical Books.
- [2]. Schiffman SS (2003) Taste and smell in disease. (First of two parts) New England Jnl of Medicine. 308;21: 1275-1279.
- [3]. Turin L (1996). "A spectroscopic mechanism for primary olfactory reception". Chem. Senses 21 (6): 773-91. doi:10.1093/chemse/21.6.773. PMID 8985605. and Turin L (2002)
- [4]. Web, www.physiol.ucl.ac.uk/research/turin_1/chemical_senses_complete.pdf. Vibration Theory In: Burr, Chandler (2003). The Emperor of Scent: A Story of Perfume, Obsession, and the Last Mystery of the Senses. New York: Random House. ISBN 0-375-50797-3.
- [5]. Touyz L. Z. G. (1993) Oral Malodor. Canadian Dental Jnl 59(7)607- 610.
- [6]. Halimeter (2013) Halimeter.com. © 2013 Interscan Corporation • ADDRESS: 4590 Ish Drive #110 • Simi Valley, CA 93063.Tel: (800) 458-6153 (US & Canada) • PHONE: (818) 882-2331 • FAX: (818) 341-0642 • E-MAIL: info@halimeter.com
- [7]. Ripamonti CI, LaVerde N, Farina G, Garassino MC.(2010). In: Nutrition and the Cancer Patient. Eds: Del Fabbro E et al. Ch 13 Oral complications. P133-148. Oxford Univ Press.
- [8]. Chan E.C.S., Siboo R., Touyz L.Z.G., Qiu A, Klitorinos A (1993) A successful method for quantifying viable oral anaerobic spirochetes. Oral Microbiology and Immunology; 8(2); 80-83.
- [9]. Nanchani S (2002) In: Antibiotic & Antimicrobial Use in Dentistry. Oral Malodor 9:127-143.
- [10]. Yaegaki K, Coil JM. Examination, classification, and treatment of halitosis; clinical perspectives. J Can Dent Assoc. 2000 May;66(5):257-61. Review.
- [11]. Scully C, Porter SP, Greenman J. What to do about halitosis. Br Med Jnl. 1994;308:217-218.
- [12]. Rosenberg M, Kulkarni GV, Bosy A, McCulloch CAG. Reproducibility and sensitivity of Oral Malodor measurements with a portable Sulfide Monitor. J Periodontol 1991a;70:1436-40.
- [13]. Amir E, Shimonov R, Rosenberg M. Halitosis in Children. J Pediatr 1999; 134:338-43.
- [14]. Ermis B, Aslan T, Beder L, Unalacak M. A randomized placebo controlled Trial of Mebendazole for Halitosis. Arch Pedr Adolesc Med 2002; 156:995-998.
- [15]. Schwarcz J. Smelly pee and asparagus challenge science. Montreal Gazette Apr 19 2008.p111.
- [16]. Rosenberg M. The Science of Bad Breath. Scientific American 2002. 286:72-79.
- [17]. Furne J et al. Comparison of Volatile Sulfur Compound Concentrations measured with A Sulfide vs a Gas Chromatography. 2002. J Dent Res 81(2): 140-143.
- [18]. Silwood etal 2001; Suarez2000; Loesch&Kazor 2002; Tonzetich 1994;Yoshimura etal 2000.
- [19]. Tanita (2013) www.tanita.com. Breathalert. Accessed 26-10-2013.