

DIAGNOSTIC VALUE OF HALITOSIS EXAMINATION METHODS

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This manuscript is cited as:

Aydin M, Bollen CM, Özen ME. Diagnostic Value of Halitosis Examination Methods. Compend Contin Educ Dent. 2016 37(3):174-178

ABSTRACT

There are many methods and modified protocols to examine halitosis. Chemical and enzymatic tests determine presence of the bacterial species, their metabolic products or enzymes in the mouth while halitometers perfectly quantify gases but do not halitosis. The examinations by the human nose (self assessment, feedback or organoleptic examination by an examiner) directly target to detect halitosis, however, organoleptic examination alone is not

enough for exact diagnosis when the individual has no complaint from halitosis. The underlying reasons for a patient to seek for a consult concerning halitosis are usually self-assessment and other people assessment (feedbacks) even they are less correlated with oral odorous gas measurements.

Which examination method is more decisive and summative for haltosis, yet, has not been clearly reviewed. This paper revalues the examination methods of halitosis.

INTRODUCTION

Halitosis is etiologically classified from type 0-5; physiologic, oral, airway, gastroesophageal, blood-borne and subjective halitosis respectively.¹

Halitosis measurement methods, should cover each of the three malodor sources: the mouth, nose cavity and breath.

SELF OR OTHER PEOPLE ASSESSMENTS

Asking the patient for level of his own halitosis is the simplest way to have idea what about will be faced with or how the patient is impressed by the halitosis. However there is no statistically significant correlation between self assessment and measurable halitosis levels by objective measurement methods.^{2,3} The latter is due to the fact that patients with halitosis, may not be aware of this situation or become inured to their own malodor over time⁴; since olfactory desensitization in objective halitosis patients can cause “false-negative” results while self assessing of halitosis.^{5,6} Although, psychopathological factors can be reason of misdiagnosis (false positive) in halitosis diagnosis are observed.⁷

There are controversy reports available: subjective opinion correlated well with objective evaluation of halitosis.^{8,9,10,11,12,13} Significant associations between self-reported oral malodor, socio-demographic or medical history and oral hygiene variables were also found.⁹ Actually, self-assessment is indeedly the

primary diagnostic criterium for halitosis because it is the reason for patients to forward halitosis examination. The initial contact with a patient commonly stems from a complaint of halitosis identified by another person or suspected by the patient himself. Therefore, Despite other people rarely dare to give reaction as usually tend to hide the patients halitosis with a paternalistic approach¹⁴, the most descriptive question of the anamnesis and the most convincing tool to determine the result of a halitosis treatment is self or other people’s assesment that covers the three sources of malodor.

Eventually, if a person complains from halitosis by self assessment, than he is (at least Type 5) halitosis patient.

ORGANOLEPTIC TESTS

Studies argue that organoleptic assessments (sniffing patients’ breath and scoring level of malodor by examiner) are regarded as gold standard for measuring halitosis and are significantly related to VSCs^{15,16,17} and amines.^{18,19} However, volatiles that can be detected by human olfactory system are restricted. For instance human nose is less sensitive to ammonia,²⁰ but ammonia is a part of halitosis.^{14,21} The latter, nonstandard preparation and test protocols for organoleptic measurement have been used, even the scale used for scoring of malodor, often are changed.

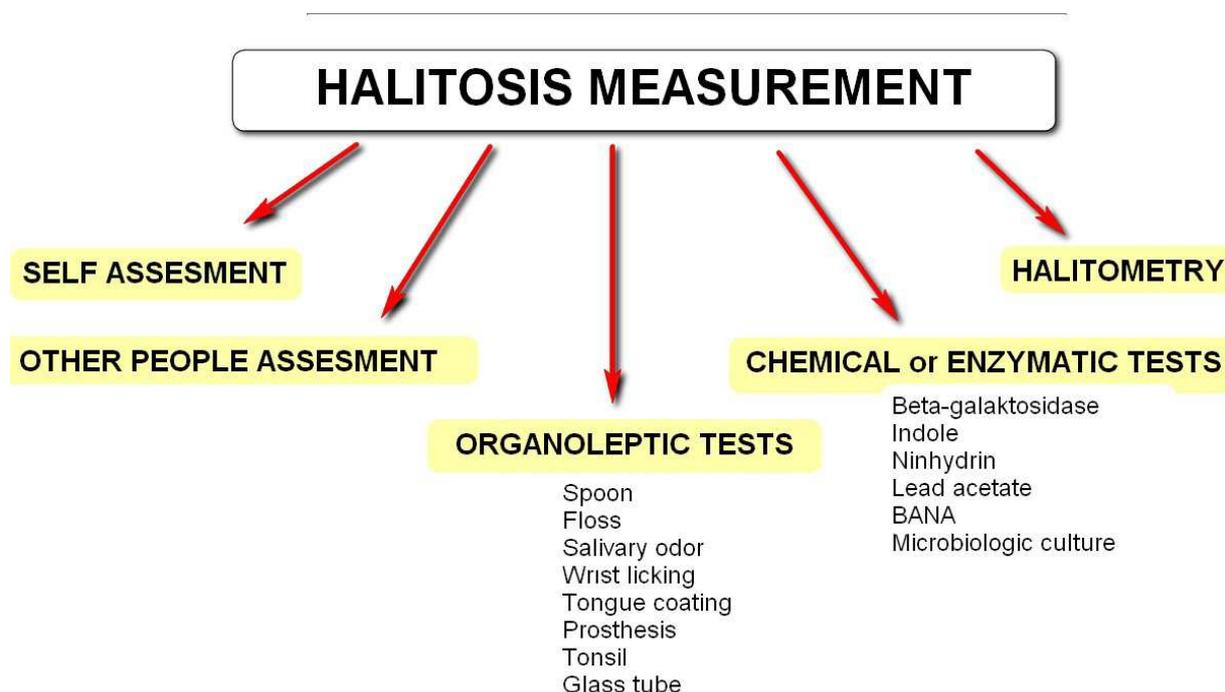


Fig.1 Direct methods of halitosis examination require human olfactor system (organoleptic, self or other people assesment) or gas detector (halitometer), while indirect methods consist of chemical, microbiological tests search bacteria or their products in the mouth.

Before organoleptic measurement, antibiotics are ceased before at least 3 weeks²² or some others proscribe 4, or 8 weeks.^{2,23} Some investigators proscribe patients drink, eat, chew, rinse, smoke for at least two hours,^{24,25,26} some for 4, but some proscribe odorous foods for 24, or 48 hours before the appointment. Some allow a restricted oral hygiene (tooth brushing without using toothpaste) before 2, or 3 hours, while some prohibit even drinking water within 1 h before-appointment. Some practitioners prefer to examine their patients in the morning, while some others afternoon or evening.²⁷ Pre-mesurement protocol is not truly standardized so far.

To ask individuals to stay fast for hours and not clean their mouth is a challenge to start (or exacerbate) halitosis

with a previously described mechanism for morning breath.¹ Even people with no halitosis will have malodor in their mouth according to such preconditions.

Organoleptic measurement protocols available in the literature are also variable. A tube is inserted into the patient's mouth and having the person exhale,^{2,23} or without using a tube²⁴ or the patient counts loudly to 10 while breath is evaluated by examiner.¹⁴

Lips are kept closed for 30 seconds,²⁶ 60seconds,²⁸ 2²⁷ or 3 minutes,²⁹ afterwards, oral air is assessed by the examiner from 5-15 cm²⁹ or 5-10 cm²⁷ or 10 cm.^{30,31} Holding breath awhile, then expiring by the mouth from 20 cm to examiner (some use a pipette) as another method.²¹

Modified methods of organoleptic assessments have been widely applied. A

spoon is sniffed 5cm away 5 seconds after scrape the dorsum of tongue (**Spoon test**).²⁵ A piece of unwaxed floss is sniffed 3cm away through the interdental regions of teeth (**Floss test**).¹⁴ The subject spits out 1-2ml of saliva into a glass tube³² or 0.7-0.8 ml of saliva to petri dish,³³ afterward, incubated at 37 °C for 5 minutes, then evaluated 4 cm away (**Salivary odor test**), some don't incubate.³⁴ A **Glass rod** (15x0.5cm) **test** consists of sniffing it 2.5cm away after inserted into the saliva sample and stirred thrice.³⁴ All above tests are categorized as organoleptic.³⁵ **Wrist licking test**: consists of sniffing the wrist from a distance 3cm after licking and waited for five²⁴ or 10seconds.¹⁴ A 2x2cm gauze (some use scrapper, periodontal probe or dental floss) is applied on dorsoposterior surface of the tongue and drawn anteriorly for 2-3cm then immediately evaluated (**Tongue coating test**).²⁹ The prosthesis odor (if the patient wears removable denture), can be scored (**Prosthesis test**).¹⁴ **Tonsil test**: is subjectively assessing odor of tonsil.³⁶

It is known that, some odorants (indole, methylamine, and cadaverine) do not increase malodor when added to bulk saliva²⁴ whereas they are resolved in the dental plaque³⁷ since they become detectable when saliva is dried or agitated.^{15,38} Some of organoleptic tests (floss, spoon, gauze, wrist licking) are usually found false positive even the person with no pathologic halitosis. Thereby, their diagnostic values are questionable.

The severity of odor sniffed by examiner is usually numerically scored from less to extremely strong. Some investigators use a 3-point scale,²⁸ 4-point,^{26,34,39} 5-point,^{23,40} 6-point,¹⁵ 10-point¹⁵ or even half-

scores are used rarely. Nonstandardized scaling of organoleptic scoring will obviously cause misinterpretation of findings.

Dislike or even shame is experienced by 50% of patients¹ may also be a disadvantage (n=283). To decrease such unpleasant situations, individual is asked to breathe inside a plastic bag, afterwards the examiner sniffs from the bag.²¹ Sometimes privacy screen is used to hide the direct-sniffing contact from the patients who assume that they have undergone a specific malodor examination instead.²³ Some examiners place non-transparent wall with a hole to separate patients.⁴¹ Syringe method is recommended to obtain higher degree of privacy for the patient.^{22,42} A questionnaire by the author, asked to dental practitioners (n=151) "do you smell breath of your halitosis patients?". Totally 133 practitioners (88%) rejected to smell patients breath, due to find it repulsive.

Unpredictable factors (age, gender, individual odor memory of examiner, time of day, temperature and humidity of room air, etc) affect scoring organoleptic scoring, this makes the organoleptic assessment incredible.. Therefore it is not reproducible,^{15,43} and is extremely subjective, emotional, instinctive, learnable, intuitive and also indexed to the socioeconomic background or examiner's experiences; lacking an international calibration⁴⁴ and standardization.

CHEMICAL AND ENZYMATIC TESTS

Some studies^{45,46} hypothesized, a potential relationship between halitosis and particular bacterial species can be found,

contraversy studies found no obvious association between halitosis and specific bacteria.⁴⁷ Dividing bacteria as odorigenic or not, is over simplification. Actually, every bacterium is odorigenic.^{48,49} Despite to this, there are some tests colorimetrically indicate oral bacteria or their products in the mouth. **β -galactosidase test** detects an enzyme that may be related with odorigenic bacteria present in the medium. Although β -galactosidase activity have been found correlated with malodor.⁵⁰ however can even be associated with physiologic halitosis, which is not necessarily associated with oral problems,⁵¹ nor truly reflects halitosis level.⁵² **Indole test** exhibits the presence of indole that is one of the odorus compounds in halitosis.³⁴ No clear correlation was found between odor concentrations and the indole amounts.³⁸ **Ninhydrin test** is simple, rapid, enzymatic test can give information on halitosis related bacterial putrefaction.⁸ **Lead acetate test** is also used for detect sulfurs present in the medium. The saliva taken from a patient is incubated overnight²⁶ or half an hour²⁹ in agar plate containing Pb-acetate (0.02%), the black color exhibits sulfur content. If it had been developed a method to instantly quantify sulfur content, then it would be decisive to estimate VSC content of saliva.

A hydrolase enzyme of hydrolysing benzoyl-*DL*-arginine-naphthylamide (BANA) is present on commercially available test strips. BANA strips turn in blue, indicating positive result, if the particular 3 bacteria: (*Porphyromonas gingivalis*, *Treponema denticola* and *Tanerella forsythia*) present in the medium, having this hydrolase.^{53,54} Specificity and sensitivity of the BANA test is found above 80%, predictability for periodontal disease is

found >83%.⁵⁵ However this three bacteria is not the unique oral species that have BANA hydrolase enzyme. Bacteria identification software⁵⁶ could find 37 more bacteria that can hydrolyse arginine, by using its library. This makes BANA test unreliable.

The above chemical and enzymatic tests target to diagnose only orally originated malodor by searching the presence of bacteria or their products should be stated..

HALITOMETRY

Gas chromatography (GC) is highly sensitive for VSCs but impractical.⁵⁷ GC-based portable device OralChroma, (Abimedical, Japan) is capable of quantify sulfur family gases. Some of other portable halitometers are Halimeter (Interscan, USA), Breathtron (Cosmos, Japan); the Twin Breasor (GC, Japan); Probe/Perio (Diamond, USA), and BB Checker (Taiyo, Japan). Their accuracy is poor when compared to GC.

3481⁵⁸ or 400-700⁵⁹ VOCs are detected in mouth or alveolar air of healthy subjects. Sulphide detectors can not cover all of these gases. There is need new halitometers to detect sulfur, nitrogen and organic based gases (at least H₂S, NH₃, VOC, H₂). Industrial portable gas detectors that are capable of detecting more than 4 gas groups that could potentially be utilized.¹ Sensor systems for monitoring the simple gases with breath test kit (BreathTracker, USA), electronic noses like FF-2A (Shimadzu, Japan), Cyranose 320 (Intopsys, USA), bioelectronic gas sensor to detect sulfur family and trimethyl amine has been developed to measure halitosis.⁶⁰ Some of them use chemical sensor arrays for the

detection of odorant profile (halitoprint) by using an algorithm,⁶¹ covers many gases.

Halitometers are generally used to detect orally originated malodor, rarely used for alveolar or nasal malodors depending on what measurement method was used, so, mentioned halitometers can detect gases but not halitosis, and should be used only for confirmation, comparing similar cases, and monitoring the therapy of halitosis, but not for a diagnostic purpose alone since halitometric readings are of no sense if there is not complaining from halitosis.

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Conclusion

Because referring to a health care professional due to complains of halitosis occurs when the malodor is detected by patients' self assessment and/or feedbacks from other people around forholdet social-environment have a prominent place among all diagnostic tests. Due to self satisfaction, healing of halitosis is confirmed by the patient only the way with self or other people assessments but not other examination methods (halitometer reading or enzymatic activity of the saliva).

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