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E-Mail: carolyn@praxis2practice.com **Website:** https://praxis2practice.com/ | https://oirf.com/

*An exclusive translated **article for Praxis2Practice Supporters**, published November 2026 by Praxis2Practice Consulting . . .*

Earwax Provides The Diagnosis

Also In Cancer: Cerumen As A Reliable And Inexpensive Biomarker

By Martina Schneider, HP

From an article in CO'med, Volume 32, July 2026
Translation & redaction by: Carolyn L. Winsor, P2P Consulting

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AI Digital and online translation assistance utilized.

Sometimes sticky, sometimes crumbly and in any case informative: earwax. As a natural component of the outer ear, it is providing more and more scientists with valuable indications about diseases. An additional advantage for patients is that cerumen samples are easy to obtain.

In earwax (cerumen), secretions from the sebaceous and sweat glands in the outer ear canal mix with dead skin cells, dirt particles and hairs. The result is a high-fat substance in which mainly hydrocarbons, wax esters, triglycerides, cholesterol and fatty acids are combined.

This glandular secretion keeps the skin of the ear canal supple and protects the inside of the ear from bacteria or fungi. Even small insects usually have no chance of penetrating the body through the ear. Cerumen also cleans the ear by transporting dust particles, dead skin cells and hair outside. Whether a person needs a lot or a little earwax for this depends on the individual. The amount increases with age.

On average, a person produces 1.5 kg of cerumen in the course of his or her life. In Europeans and North Africans, it is usually yellowish to orange and sticky in consistency, in Asians it is rather grayish and dry.

Viscous Mass

If the lower jaw is moved when speaking or eating, the earwax slowly pushes itself towards the auricle in order to be gradually transported out of the ear: Now it can be easily removed with a soft cloth. However, if the glands produce (too) much wax, which is then no longer easily transported, a plug can form. This often also occurs when an attempt is made to clean the ear with a cotton swab – and cerumen is pressed into the ear. Viscous mass accumulates, hardens and blocks the ear canal. Completely or partially. With increasing age, the earwax becomes drier and drains only slowly. In addition, the hairs in the ear canal become coarser and can further hinder its removal. The following applies to all ages: hearing aids, headphones worn in the ear or earplugs to protect against noise, dust or water can be reasons for earwax to accumulate in the ear canal.

Even the consistency and color of earwax can provide information about skin diseases and the general condition of a person:

- **Gray and dry:** Indication of dermatitis. This is a collective term for inflammatory skin reactions that are not contagious and manifest themselves through redness, itching, scaling or blisters. Dermatitis is based on a disturbed skin barrier, usually triggered by external stimuli.
- **Red color:** It indicates an injury to the ear canal or eardrum due to the admixture of fresh blood.
- **Unpleasant odor:** This can be a sign of a bacterial infection or inflammation. In addition, a liquid and purulent consistency of the earwax is noticeable.
- **Cerumen obturans** (commonly known as earwax impaction)**:** An earwax plug that is too large causes hearing impairment that, if left untreated and eventually becomes chronic, can lead to hearing loss and even increase the risk of dementia.

Cancer And Precancerous Lesions

Researchers are increasingly focusing on cerumen because it is increasingly proving its worth in the diagnosis of diseases. In addition, in contrast to blood, sputum or bodily fluids, it is easy, non-invasive and hardly risky to obtain earwax samples.

With the new Cerumenogram test, cancer and its precursors can be reliably detected with the help of earwax. ***Nelson Roberto Antoniosi Filho*** developed the test with his team at the Federal University of Goiás Goiânia in Brazil. In malignant diseases, the cell metabolism changes, resulting in volatile organic components that accumulate and can be detected in the cerumen. [1]

In a large study, scientists examined more than 700 people using the new test procedure. Among them were cancer patients, people with benign tumors or cell changes, as well as healthy people. The Cerumenogram test reliably detected cancer and also identified precursors such as dysplasia. It is also possible to monitor the course of the disease. In a patient with prostate cancer, the test showed a recurrence, which was later confirmed by imaging techniques. In addition, inflammatory metabolic changes and dysplasia left conspicuous patterns in the cerumen that benign tumors or metaplasms did not show. Accordingly, the new Cerumenogram test succeeds in differentiating between high and low cancer risks. This is a major advantage over previous methods. Biopsies or biotherapy procedures that are often required are usually invasive, complex, risky and expensive.

Filho summarizes what a Cerumenogram does:

- It can save lives because it recognizes the premalignant cells even before the onset of cancer and thus records oncological risks. The Cerumenogram is a new type of screening method.
- It shows that mitochondrial disorders in premalignant cells – such as hypermetabolic inflammation or dysplasia – produce the same VOC biomarkers (volatile organic compounds) as malignant cells. These are different from those of benign lesions. This opens up new possibilities for risk management and early intervention.
- It compares the results of the Cerumenogram with those of established imaging methods and thus proves the correspondence with clinical findings. At the same time, it represents a non-invasive and more cost-effective method.
- It is used to monitor the response to treatment and remission of cancer. And it assists in evaluating the effectiveness of the treatment and the return of cells to a "normal state".
- It confirms metabolic evidence of malignancy and, in addition to imaging procedures and biopsies, can help with decision-making in everyday clinical practice.
- It supports the development of therapies that specifically target the metabolites that are increasingly produced in malignant diseases.

In 2019, Filho and a team had already examined cerumen samples from 52 patients with lymphoma, carcinoma or leukemia and 50 healthy volunteers using a method that detects volatile organic compounds (VOCs). Here, 27 VOCs were identified as diagnostic markers for cancer. The cancer status could be predicted with an accuracy of 100%. However, it was not possible to distinguish between the types of cancer with this method, which for the scientists is an indication that these VOCs generally indicate malignant cells.

Another study has shown that metabolic disorders can be detected with the help of earwax analysis as early as the pre-malignant stage, therefore already when cells show dysplastic changes (changes that can lead to cancer but are not yet malignant). This could enable much earlier intervention. In addition, the scientists are concerned with the question of whether metabolic changes associated with neurodegenerative diseases such as Parkinson's disease and Alzheimer's disease can be detected in earwax.

Biomarkers For Stress
What does earwax have to do with stress? A lot! This is because earwax is able to store stress hormones, so it can also act as a biomarker here. Stress hormones, in turn, can influence the production of earwax. Chronic stress leads to significantly more stress hormones, especially cortisol, being released. A high cortisol level stimulates the sebaceous and sweat glands in the ear canal to produce more cerumen. Its consistency, in turn, can also change due to stress-related physical conditions. Sputum and cerumen: Both are reliable and inexpensive biomarkers that can be used to measure long-term cortisol levels. They also serve as early detection.

Morbus Parkinson
In the early stages of Parkinson's disease, those affected often exude a body odor that is perceived as musky, oily or animal-like. This odor also adheres to the cerumen and is related to increased sebum production. Increased sebum production often occurs in Parkinson's patients. The composition of the lipids of the sebum changes and produces the striking odor. Likewise, the volatile organic compounds such as ethylbenzene, 4-ethyltoluene, pentanal and 2-pentadecyl-1,3-dioxolane change, so that cerumen also becomes a biomarker here. Chinese researchers are currently working on developing cerumen analyses in neurology as a simple screening tool.

Diabetes Mellitus
Volatile metabolites also occur in Type 1 and Type 2 diabetes mellitus: Researchers examined cerumen samples from 26 diabetes patients using gas chromatography and mass spectrometry. For comparison, volatile substances from samples from 33 healthy individuals were available. The most important biomarkers were ethanol, acetone, methoxy acetone, hydroxyurea, lsobutyraldehyde and acetic acid. Methoxy acetone alone was sufficient to clearly distinguish between Type 1 and Type 2 diabetes. For the scientists, the method thus has great potential for gentle and at the same time reliable diabetes screenings. [2]

Ménière's Disease
The Cerumenogram provides valuable services in Ménière's disease, a disease of the inner ear that has no typical biomarkers in blood or urine and has so far been diagnosed by exclusion procedure. Ménière's disease is a chronic, usually unilateral inner ear disease characterized by seizure-like vertigo, often with a tendency to fall, fluctuating hearing loss, tinnitus and a feeling of pressure in the ear because fluid (endolymph) accumulates in the inner ear. A new approach in diagnosis is the analysis of earwax with modern physical methods such as gas chromatography, coupled with mass spectrometry. Researchers found significantly fewer different chemical compounds in the cerumen samples of patients with Ménière's disease than in the samples of healthy people. They also identified three fatty acids that reliably separate sick from healthy: The average values of cis-9-hexadecenic acid, cis-10-heptadecenic acid and cis-9-octadecenoic acid are higher in healthy people than in sick people.

Maple Syrup Disease

The characteristic sweet smell of maple syrup has given the disease its name: People who suffer from the autosomal recessive inherited disease cannot properly break down certain amino acids. The cause is a defect in the so-called 2-keto acid dehydrogenase complex. As a result, the breakdown of the amino acids leucine, isoleucine and valine accumulates. These substances accumulate in the blood. In addition, SotoIon is produced: a substance that comes from the leucine metabolism. It is responsible for the typical sweet smell of urine, which is reminiscent of maple syrup. Earwax also helps here: Especially in newborns, this clear odor in the earwax can be an important indication of the genetic disease in the first days of life.

Martina Schneider

Keywords: Maple syrup disease, biomarkers, cerumen, Cerumenogram test, cancer diagnosis, earwax

The Author



Martina Schneider, HP

Martina Schneider is a naturopath, wingwave® coach, Reiki master/teacher and NLP master (DVNLP). She also works as an author and freelance editor.

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Website: https://praxis2practice.com/ | https://oirf.com/
Email: carolyn@praxis2practice.com