



Lecture Text “Taste & smell”

LO2-A-B-2

“Know basics in physiology of taste/smell, be aware of how different conditions affect taste/smell and of possible clients’ food intake needs with respect to taste/smell deterioration, and detect these needs in collaboration with health professionals”



Co-funded by the
Erasmus+ Programme
of the European Union

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AGREEMENT NUMBER – 621707-EPP-1-2020-1-BE-EPPKA2-SSA

1. Physiology of taste & smell

Taste and smell belong to the group of sensory organs and can be summarized as chemical senses. Accordingly, they perceive stimuli from the external environment and thus certain chemical substances from food and air and assign them to a sensation.

Olfactory and gustatory sense have the basic purpose in and respectively contribute to the processes of food intake and digestion.

1.1. Olfactory sense - Sense of smell

General Aspects

Even though the sense of smell is relatively poorly developed in humans compared to many other mammals, humans can perceive a wide range of sensations, at least significantly more than it is possible with the sense of taste. Thus, humans can distinguish approximately up to or even above 10,000 scents/ odor qualities, although a classification into verbally distinguishable scent categories is relatively limited. Unlike the sense of taste, there is no strict classification into specific basic qualities; rather, similar olfactory sensations are bundled into odor classes and characterized by specific representative odors. Consequently, the following qualities are considered odor classes:

- floral,
- ethereal,
- musky,
- camphor,
- sweaty,
- foul and
- pungent.

Functions

The sense of smell comprises various functions. It serves as a near and far sense and is used in particular for the assessment of food. For example, while pleasant odors trigger saliva and gastric juice secretion, unpleasant odors warn of potentially spoiled food. In addition, it has a strong emotional component and an important social function thus playing a role in social relationships and communication.

Olfactory Process

The olfactory mucosa, also called olfactory epithelium, is located in the roof of the nasal cavity, i.e. the upper nasal cavity. Scents that are inhaled from outside through the nose or absorbed through the oropharynx (the mouth throat zone) when eating reach as chemical signals the olfactory mucosa, where the olfactory sensory cells are located. Scents are subsequently dissolved in nasal mucus and bind to olfactory receptors located in the olfactory sensory cells. By converting the chemical signals of the scent into electrical signals, they are transmitted to the brain via the olfactory bulb. The actual olfactory perception ultimately arises through processing in the brain.

Pungent, spicy and burning scents (e.g. acid or ammonia vapors...), as an exception, are not perceived via the olfactory sensory cells in the way described, but by stimulating free nerve endings.

The odor thresholds for different scents are sometimes very different, so the smell of rotten eggs from hydrogen sulfide is already perceived at a lower concentration than, for example, the smell of rose oil.

Tasting is strongly related to the sense of smell, so that the range/variety of taste perceptions only arises through the sense of smell.

1.2. Gustatory sense - Sense of taste

General Aspects

5 qualities of taste can be roughly distinguished with the gustatory sense:

- Sweet (i.e. sugar or other carbohydrates)
- Sour (Food with free H^+ ions, i.e. acidic solutions such as vinegar)
- Salty (i.e. dishes with salt)
- Bitter (Foods that contain a lot of bitter substances) and
- Umami (Foods that contain glutamic or aspartic acid e.g. meat, soy sauce). This taste quality is mainly found in protein-rich foods and often denotes the specific “meaty” flavor quality.

Functions

On the one hand, the sense of taste provides information about food, especially with regard to the digestibility/enjoyability of food, and thus has a protective or warning function, as spoiled or bitter-tasting food is often harmful or poisonous. On the other hand, tasting substances controls/stimulates reflex mechanisms of the upper gastrointestinal tract such as saliva and gastric juice secretion.

Gustatory Process

Flavor substances/molecules ingested with food are dissolved in saliva to get to those sensory cells on the tongue where they can be tasted. Once there, similar to the olfactory process, the chemical signal is converted into an electrical signal and thus transmitted via the nerves to the brain, where the stimulus is processed.

However, what does the taste process and the taste-sensing cells look like in a physiological sense, i.e. how are they roughly structured?

The taste papillae are located on the tongue, these are numerous small elevations under the mucous membrane that significantly increase the surface of the tongue and thus provide a larger area for perceiving the different taste qualities. There are numerous taste buds in the walls of the papillae, which are considered the functional basic unit of the sense of taste and thus represent the actual taste organ with the sensory cells. The taste substances dissolved in the saliva reach the specific taste sensory cells via the opening in the taste buds, whereby receptors are activated. Depending on the taste quality, the stimulus is received and transmitted on via different mechanisms.

In addition to the taste sensors described, the sense of smell and free nerve endings are also significantly involved in the taste process. Thus, the sensation of eating spicy food is not a taste, but a pain sensation (e.g. chili).

Overall, each taste quality can be tasted/perceived anywhere, i.e. at any point on the tongue, with varying degrees of sensitivity at different areas. Thus, there are regions of the tongue in which the respective taste qualities are tasted more strongly.

The sensitivity to the individual taste qualities and thus the taste thresholds are relatively different, with being lowest for bitter taste sensations. This can be described as physiologically meaningful, since toxins are often associated with a bitter taste and these in turn can show toxic effects even at a low concentration.

The subjective evaluation of food is basically inhere, but can be influenced by learning processes in the course of life as well.

2. Pathology of taste & smell

2.1. Types/ Differentiation of common disturbances

Disturbances of the sense of smell

➔ **Disturbances of olfactory perception/ sensation generally referred to as dysosmia**

Quantitative Dysosmia:

- Anosmia: complete loss of the sense of smell/smell perception, insensitivity to scents (partial or total; depending on whether only one specific odor quality or all odor qualities are affected)
- Hyposmia: reduced odor perception, decreased sense of smell

Qualitative Dysosmia:

- Parosmia: altered odor sensation/ perception or odor illusion
 - Cacosmia: unpleasant odor sensation - unpleasant sensory illusions in the context of the sense of smell (e.g. in pregnancy, due to brain tumors...)
- Phantosmia: olfactory hallucination

Disturbances of the sense of taste

➔ **Disturbance of taste perception/ sensation generally referred to as dysgeusia:**

Quantitative Dysgeusia

- Ageusia: absence of the sense of taste, lack of perception of taste (qualities) (partial or total; depending on whether only one or all taste qualities are affected)
- Hypogeusia: reduced/ diminished taste perception,
- Hypergeusia: more intense/increased taste perception

Qualitative Dysgeusia

- Parageusia: altered taste perception
- Phantogeusia: taste perception without taste stimulus

It is also important to remember that disorders of the sense of taste are often associated with disorders of the sense of smell.

2.2. Common reasons for taste & smell disorders

The causes of smell and taste disorders can be described as very diverse, so that only a rough insight into possible causes can be given here.

Smell:

The causes of olfactory disorders include, for example, factors such as damage to the nasal cavity or the central nervous system, e.g. due to accidents or impacts against the head (up to a fracture of the base of the skull), viral infections such as the flu virus (which can cause e.g. hyposmia & cacosmia), also neurodegenerative diseases such as Alzheimer's and Parkinson's disease can be associated with it and entail, for example, anosmia as a possible first sign. Altered perception of normal into unpleasant odors can be caused by specific situations such as pregnancy, but also by epilepsy or a brain tumor. Olfactory hallucinations can, for example, occur as a possible symptom of schizophrenia.

Taste:

A taste disorder can also have numerous underlying causes. In principle, these can be divided into 3 levels:

- 1) Damage to the taste buds, e.g., due to medications, infections, or radiation therapies.
- 2) Damage/injury to certain relevant cranial nerves, e.g. after operations or skull fractures.
- 3) Disturbances in the area of processing, e.g. in the case of trauma, brain tumors, psychoses.

In addition to cranial trauma and nerve diseases, diseases or problems in the ear, nose and throat area, e.g. due to accidents, operations or tumors/ radiation, can be named as frequent causes. Medications/ medication-related side effects or drugs can also impair taste sensations (e.g. cocaine, penicillin).

In addition, the aging process also plays a role in taste perception, so that the sensitivity to flavors decreases in the course of life (hypogeusia).