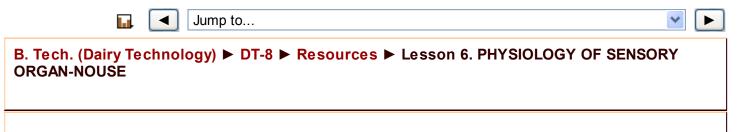
JUDGING OF DAIRY PRODUCTS



Module 2. Requirement of sensory evaluation and physiology of human senses

Lesson 6 PHYSIOLOGY OF SENSORY ORGAN-NOUSE

6.1. Olfactory

Olfaction: The sense of smell nose is the organ of olfaction. Olfaction involves several distinct sensory systems located in nasal cavities. Smell is more primitive than vision, more complex than taste .

Fig. 6.1 Anatomy of the Olfactory system

As shown in Fig.6,1, two nasal cavities are separated by a smooth median septum. The lateral walls of the cavities have a series of folds, approximately horizontal, varying from two to six. The lower fold extends over most of the length of the nasal cavity. The two above this called "conchae" are smaller protruded into the cavities to provide 3 channels the inferior, median and superior meatus. Each meatus is confluent with a large common meatus, which communicates with an olfactory cleft above the superior concha and the septum.

These spaces are all connected by very narrow passage with the posterior naris (chaoana) and with the pharynx. The upper & lower nasal passages are mere slits of 1-2mm. The deeper part of the nasal cavity contains a pseudo-stratified columnar epithelium containing ciliated cells, whose cilia beat toward the choana. The cavity also contains alvelo-tubular glands with mucifous cells. Air entering nasal cavity is warmed and humidified by passage -over the surfaces. The olfactory region or olfactory epithelium, is yellow-pigmented area about the size of a postage stamp, located in the upper part of the nasal cavity and above turminate bones. Olfactory cells (10-20 million in man) through which odors are detected, are located in this area. Each olfactory cell terminates a number of hair like projections or extensions of the cell wall, called cilia, which extend into the mucous lining of the olfactory epithelium.

Nerve endings from the first cranial nerve called olfactory nerve, make contact with nerve fibers from the olfactory cells by way of "olfactory bulb" which is just above the odor-detecting area & separated from it by the perforated ciribriform plate. The nose is

innervated with fibers from the fifth cranial nerve, which sense pain.

The simplified drawing of a section of the olfactory epithelium shows olfactory cells with their terminal hairs and nerve fibers, which serve the area. The overall physiological design for odor perception schematically outlined below.

6.2 Important Aspects of Odor Perception are

- The prospective odor material must be volatile.
- The odor-laden air must reach the olfactory receptors.
- The differences in diffusion rates may be a factor in stimulation.
- The odor must dissolve in aqueous mucus and then diffuse through it.

There is, of course, a critical concentration below which there will be no identifiable - sensation.

The exact definition of a threshold appears more difficult in this case than with other senses.

It is estimated that normal inspiration the fraction of inspired air passing the olfactory slit is at least 5% and at the most 10%, about 2% of the total odors molecules reach the olfactory epithelium in normal breathing.

Normally, most of the inhaled air follows past the olfactory area but does not impinge directly upon it, as chiefly eddy currents reach smell.

The odoriferous substance must be sniffed of whiffed rather slowly, but strongly while respiration is slowed, have stopped.

While exhalation there is no appreciate smell sensation.

However, in the act of swallowing, a slight vacuum is formed in the nasal cavity and as food starts down the esophagus, a small gust of odor-laden air from the food is drawn up in the olfactory area.

6.3 Odor Detection/Perception

The basic requirements are:

- A substance must be volatile, and the molecules must make contact with receptors.
- The volatility of a substance depends on its molecular weight and molecular bonding properties. The upper limit for "smell ability" is usually a molecular weight of about

300. Heavy molecular weight substance like proteins starches, fat and many sugars are too heavy to be odorous.

- Molecular bonds vary with the chemical compounds and temperature.
- Compounds that are more volatile are derived from liquids than from solids. Increase in temperature increases volatility of both states.
- Odoriferous substances, must be adsorbed/adhered to the chemo-receptors, i.e. it should be soluble to some extent in the membrane constituents, which consists of lipids, proteins and water.

To perceive an odor, information is picked up as electrical impulses by the nerves to the brain, where message is decoded.

Man has capacity to distinguish/perceive odors. 3-4 yr. Children: rated many odors as pleasant, which they later considered unpleasant. Odor preferences are developed after the age of 5. Odorous material diffuses over 20 million receptors to trigger the olfactory reaction. The molecules/unit time, rather than total no. of molecules, appear to determine the character of odor. With training odors can be recognized at very low concentrations and several odors can be distinguished.

6.4 Adaptation

Perception of a constant odor diminishes with the elapse of time is known as adaptation. It results in decline in sensitivity, increase in threshold. The rate of adaptation is a function of the stimulus intensity. As the adaptation occurs there may be a progressive change in the nature of odor. Fatigue for one odor may even raise the threshold for others.

6.5 Odor Stimuli

Odor is the property of a substance/s that is perceived in the human and higher vertebrates, by inhalation in the nasal or oral cavity, that makes an impression upon the olfactory area of the body, & that during and as a result of such inhalation, it does not cause or result in choking, irritation, cooling, warmth, drying, wetting or other functions foreign to the olfactory area. Impure odors are defined as those in which other senses in addition t the olfactory are excited.

Smell is not only a part of the esthetic pleasure in foods but it also has a protective mechanism. Spoiled foods often have typical and easily recognizable odors, which cause man to reject them. Fresh Fruits-vegetables-most attractive feature-odor/aroma Add herbs/species-to produce special desirable smells. Standards for odor in food-not universal Decomposed fish-enjoyed by millions, 'ripe cheese' not appreciated by many people, 'curry' smell must be a cultivated taste.

Volatility or vapor pressure is not proportional to its odor. Musk-low volatility but powerful odorant, "Water-high vapor pressure but is odorless.

Low carbon alcohol (methyl & ethyl alcohol are particularly insoluble in fats and have very milk odors while the C4 to C6 alcohol are water and fat soluble and are having strongly odors. However, ethyl alcohol [C6], though lipid soluble is water insoluble and has no odor.

Organic compounds generally elicit odors, but the relation of composition to odor is extremely variable. Compounds of very different chemical composition may have quite similar odors while compounds of similar composition may be different in odor.

In concentrated solutions, many compounds have an unpleasant or repugnant odor but in dilute solutions, the odor may be very pleasant. E.g. H2S

6.6 Theories of Olfaction

Approximately 50 different theories have evolved in the last century. Four theories are noteworthy due to their relative longevity of existence and / or supporting evidences.

1. Amoore's Stereo chemical Theory

The theory proposes that olfactory receptors are sensitive to the size, shape and the electronic status of the odorant molecule. Based somewhat on the lock an essential concept of enzymology, it was expressed that all odor sensations are based on a combination of limited number of primary odors and specific nerve receptors site cavities.

The internal dimensions and / or electrical of each nerve cavity were complementary to the molecular morphology of the primary odorant.

This theory is based on nerve impulse electrical conduction. It has been reported that nerve fiber (axon) membranes were composed of a lipid double layer with adsorbed protein on the inner and outer surfaces of axon. In the resting state, there was an excess of sodium and chloride ion on the outer surface and an excess of potassium ions on the inner surface of the axon.

Davies suggested that the relatively bulky, awkward and rather rigid molecules of the odorant (upon contact of axon) tended to penetrate and disorient the double layer of lipid, if only temporarily. This in turn resulted in holes in the axon surface, which permitted ionic changes to occur, and thus initiated a nerve impulse to the brain (odor perception).

2. Wright's Vibrational Theory

It has been suggested that the odor stimulus be conveyed at long range from the source to the nose or antenna by propagated electromagnetic radiation, as by ultraviolet or more likely infrared lengths. This was further modified by Wright, suggesting that the odors of the given chemicals are a function of their 'intrinsic molecular vibration frequencies, within the far infrared region of the electromagnetic spectrum (100-700 cm-I).

3. Beet's Profile-Functional Group Theory

Beets stated that two molecular attributes were important in determining the characteristic odor: 1] the form and bulk of the molecule and the nature and disposition of the functional groups of the molecule.

Thus, theories of olfaction can be listed as follows:

- Vibrational Theory: based on correlation between infrared or raman spectra and odor quality.
- Molecular Size Theory: based on the ability of specific odoriferous molecules to fit or fill a corresponding receptor sites.
- Molecular Shape Theory: based on the degree of fit into postulated receptor sites.
- Molecular Interaction Theories: dependent upon vapor pressure, solubility and other bulk characteristics of the volatile compounds.

6.7 Olfactory Abnormalities

- Cryptosmia : obstruction in nasal passages.
- Anosmia: temporary / permanent loss of smelling capacity.
- Hemianosmia or Hyperosmia : excessive response.
- Merosmia: loss of only certain odors.
- Heterosmia / Parosmia : false odor perceived.
- Autosmia : odor sensation in absence of odor stimuli.
- Cacosmia : persistent perception of unpleasant odors.

Anosmia may be due to mechanical or central injury, or it may be functional. It has been reported that some individuals subject to migraine headaches had hyperosmia and that individuals with anosmia usually have defective taste sensitivity.

6.8 Odor Intensities

The ratio of the olfactory threshold determined after sifting undiluted substance to the

threshold determined after sniffing the diluents is termed as the order intensity. The threshold found after smelling the undiluted substance were much higher than those obtained after some structural isomers differed odor intensity measured thus increases as the concentration of the undiluted substances in increase, but not after a certain point. Roughly odor intensity is proportional to the square root of the concentration of the solution.

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