Summary

Olfaction known as the **Sense of Smell** is a very important property for evaluation of food products either for acceptance or rejection, either for liking or disliking as well as for imitation flavoured products development. Though it rates next to taste in its depthness of study, but the food cannot be accepted upon if the smell is not desirable. The sense of smell is mediated by specialised sensory cells of the nasal cavity. The odour responsible compounds binds to specific sites of olfactory receptors and transmission of signal to the brain reveal the type of odour, its liking, its comparison to the concept etc. Olfaction along with the taste is a form of chemoreception. The chemicals themselves activate the olfactory system and can be sensed at very low concentrations. Further, as a result of stimulation by chemical compounds in the respiratory tract leads to specificity in odour recognition. Smell forms as one of the sensory sensations of flavour besides the taste and tactile properties. The importance of odours in food industry refers to the acceptance of the various food products since odour can attract or repel consumers. The original or normal odour of the ingredients used or sources used add to the positive strength of the product. But the processing effect, by products wastage eminated off odours leads to environmental pollution and health hazards. At times, modification of odours is attempted to overcome or mask the undesirable odour character, thereby malodours intensity is reduced. Some of the masking agents such as vanillin, citrus compounds mask the odd odour with their powerful strength. The nose can distinguish among hundreds of substances, even in minute quantities. Odour can be defined phenomenologically through the nasal cavity action as well physiologically through the response of the nasal cavity action. Odour is the property of a substance or substances 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 which is distinct from hearing, tasting or feeling. It does not cause as a result of choking, cooling, warmth, drying, wetting which are the attributes involved by other sensory organ. On the other hand, physiologically, odour is the sensation perceived from the responses of the olfactory nerve or first cranial nerve. The three elements of odour are intensity, type and variety. The type of odour refers to the source say fruity, spicy, aromatic odour etc. and the intensity speaks of the depthness of perception or the concentration. While the variety makes a difference, may be a mixture of odours, may be the unripened, ripened or senescence of particular fruit odour, sweetish, acidic or stages of foul odours. Ultimately, the variety has a greater impact on the liking or disliking or rejection decisions. During inhalation phase, smell is perceived, while during exhalation phase olfaction contributes to flavour. The olfactory system is the only human sense that by passes the thalamus and connects directly to the forebrain which is called frontal lobe.

Considering the anatomy of nose, the 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

folds above this called chonche are smaller and protrude into the cavities. It provides three channels called the inferior, median and superior meatus. The upper and lower nasal passages are mere slits, nowhere wider than 1-2 mm. In normal inspiration, the fraction of inspired air passing the olfactory slit is 5-10%. For small rates of flow, the number of molecules striking the olfactory region is small because so many are being absorbed by the mucous membranes. At higher rates of flow also the number of molecules striking the olfactory region is small since small part of molecules in the olfactory slit can diffuse to the walls. Therefore about 2% of odourous molecules reach the olfactory epithelium in normal breath. With the injection or by blast techniques it may raise to 4%. Olfactory sensitivity is directly proportional to special area in the nose, specifically the olfactory epithelium. Humans have about 1.6 square inches of olfactory epithelium. The area in the nasal cavity near the septum is reserved for the olfactory mucous membrane where olfactory receptor cells are located. In humans, there are about 10 million olfactory cells each of which has 350 different receptors type composing the mucus membrane. Each of the 350 receptors types is characteristic of only one type of odourant.

The deeper part of the nasal cavity contains a pseudo stratified columnar epithelium which contains ciliated cells. These cells are hair-like projections that contain olfactory receptor proteins. These proteins carry out the transduction of odourants into electrical signals for neural processing. The cavity also contains many alveoli-tubular glands with mucous cells. During normal breathing, air does not reach easily the olfactory cleft and upon expiration air normally passes along the lower routes. Therefore direction of projection of odouriferous molecules by sniffing draws up the air up into the olfactory cleft. In addition to the olfactory neurons, epithelium contains basal cells, supporting cells and olfactory cells. It is estimated that man has 10-20 million such receptors. Each olfactory receptor cell is a primary sensory bipolar neuron. The olfactory neurons are unique because they are generated throughout the life by the underlying basal cells. New receptor cells are generated approximately every 30 to 60 days. The olfactory epithelium as well as the rest of the nasal surface is innervated by bare nerve fibres from the trigeminal nerve.

The process of odour perception starts from the sniffing of odorous material which through air currents reaches the olfactory receptors followed by binding. This through cranial nerves reaches olfactory bulb in the brain, then signal transmission reveal the odour. The odourous material must be volatile and should reach the olfactory cleft thereby receptors. The odour must dissolve in an aqueous mucous and diffuse through it. The mucous overlying the epithelium contains mucopolysaccharides salts, enzymes and antibodies. Thus mucous acts as a solvent for odour molecules. It flows constantly and is replaced every 10 minutes.

Olfactory sensory neurons project axons to the brain within the olfactory nerve. These nerve fibres, having myelin sheaths, pass to the olfactory bulb of the brain through perforations in the cribriform plate, which in turn projects olfactory cortex and other areas. The axons from the olfactory receptors converge in the outer layer of the olfactory bulb into small structures of less than 50μm in diameter called glomeruli. Mitral cells located in the inner layer of the

olfactory bulb, form synapses with the axons of the sensory neurons with in glomeruli and send the information about the odour to other parts of the olfactory system where multiple signals may be processed to form a synthesized olfactory perception. A large degree of convergence occurs, with twenty five thousands axons synapsing on say twenty five mitral cell, with each of these mitral cells projecting to multiple glomeruli. The mitral cells leave the olfactory bulb in the lateral olfactory tract. These synapses on five major regions of the cerebrum ie. anterior olfactory nucleus, the olfactory tubercle, the amygdala, the piriform cortex and the entorhinal cortex. The piriform cortex projects to the medial dorsal nucleus of the thalamus, then projects to the orbitofrontal cortex. The orbitofrontal cortex mediates conscious perception of the odour. The 3-layered piriform cortex projects to a number of thalamic and hypothalamic nuclei, the hippocampus, amygdala and the orbitofronal cortex. But its function is not well understood. The entorhinal cortex projects to the amygdala and is involved in emotional and autonomic responses to odour. It also projects to the hippocampus and is involved in motivation and memory. This is possibly due to the olfactory systems close anatomical ties to the limbic system and hippocampus, areas of the brain that have long been known to be involved in emotion and memory respectively.

This process is influenced by the inhibhition and excitation of mitral cells, neuromodulators such as acetylcholine, serotonin and norepinephirine. Infact inputs from the two nostrils have separate inputs to the brain with the result for humans to experience perceptual competition in the olfactory sense.

Further, the perceived odours undergo coding in brain prior to the signal to give a final decision of the odour experience. It is possible to find the spatial coding through which brain is able to distinguish specific odours as well as temporal coding which is important. Thus the process of coding is of great concern, however, still being researched. When the odourant is detected by receptors, the receptors break the odourant down and then the brain puts the odourant back together for identification and perception. The odourant binds to receptors which recognise only a specific functional group or feature of the odourant. Thus the chemical nature of the odourant plays the role in perception. After binding the odourant, the receptor is activated and will send a signal to glomeruli. Each glomerulus receives signals from multiple receptors and detects similar odourant features. All the signals from glomeruli will be sent to the brain, where the combination of glomeruli activation will encode the different chemical features of the odourant. Then the brain will put the pieces of the activation pattern back together in order to identify the odourant.

In humans, the sense of olfaction is stronger in females than the males. In females, the sense of olfaction is strongest around the time of ovulation and during the phase of menstrual cycle. Humans can also detect individuals that are blood related kins from olfaction. Mothers can identify by body odour their biological children. As the age advances, the number of olfactory neurons steadily decreases thereby the sense of smell gets reduced. Loss of smell has

been linked to inadequate nutritional intake, reduced social pleasure and decreased psychological wellbeing.

The **abnormalities** of olfaction also play a role in the process of perception of odour. The dysfunction can result from pathologic processes at any level along the olfactory pathway. The most common causes of primary olfactory defects are aging, narrow nasal passage, sinus problem, upper respiratory tract viral infections and head trauma. Inflammatory processes cause a large portion of olfactory defects. These may include rhinosinositis, allergies, cough, cold. The central neural involved infection diseases include viral infections, sarcoidisis, mucosal edema and polyp formation. Endocrine disturbances of hypothyroidism, hypoadrenalism, diabetic mellitus may affect olfactory function. The toxicity of inhaled or systemic drugs can contribute to olfactory dysfunction.