Frequently asked questions

3.1 Explain the term Gustation.

Gustation is also referred as taste in the human act of experiencing the differential strength by the senses spread over on the tongue, along the soft palate and along the lining of the throat through the taste buds. The sense of taste is through mainly associated with the taste buds, also depends on the gustatory cortex at the back of the brain which processes the taste inputs. The tongue is the sensory organ involved for the taste perception. Therefore the physiology of the tongue, its involvement with the receptors through the cranial nerves makes it more clear to understand the Gustation and its action.

3.2 Describe the structure of gustatory organ.

The main gustatory sensory organ is tongue, but the structure of tongue refers to tongue, papillae and taste buds. The anatomy and physiology of these reflects the structure with their location in the human system. The tongue is covered with thousands of small bumps called papillae and each papillae contain hundreds of taste buds. Taste papillae seen on the tongue as red spots are called fungifoem papillae, because they look like little button mushrooms. There are three other kinds of papillae. They are foliate papilla, circumvallate papillae and non gustatory fillifoem. Taste buds are situated as the collection of cells on these papillae and cannot be seen by the naked eye. As the base of the taste bud, different taste nerve axons invade the bud and ramify extensively. These in the foem of fibre typically synapses with multiple receptor cells within the taste bud. The taste buds are innervated by the facial nerve, with the help of taste receptor cells, senses the taste, through the nerves transmith the signals to the brain which detects the particular taste. The cranial nerves invervate the tongue. These are chorda tympasis nerve, glaxo-pharyngeal nerve and vagus nerve. Which are located at different parts of the tongue? These nerves make connections in the brain stem in the mueleus of the solitary tract before going to the thalamus and then to regions of the frontal lobe. The electrical signals generated in the taste cells are transmitted through these nerves.

3.3 Explain in brief the mechanism of action of receptors involved in taste perception.

The basic taste receptors are of five types known as salt, sweet, sour, bitter and umami. The receptor cells has peg like extensions projecting into human. These contain the sites of sensory transduction. The basal cells differentiate into new receptor cells and are continuously renewed every 10 days. The mechanism of action of these receptors is through transduction. Each receptor has a different manner of sensory transduction which detects the presence of a particular compound and alerts the brain through signalling. Though each taste cell is expected to respond to specific one tastant, but actually it reacts more strongly to one but responds to more than one kind of stimulus. The current thinking is that sweet, amino acid, bitter taste converge on a comman transduction channel. Sensory receptors change the stimulus from one foem of energy

to another. Sensory neurous which deal with specific type of stimulus. The neurous transmit the messages from receptors to all over the body is different organs. Taste receptors respond to chemical stimuli followed by hot, cold and olfactive types.

Normally, G protein coupled receptor is involved for sweet and bitter laster. Later umami taste also responds to the same receptor. Bitter and sweet substances binds into receptor sites which release other substances into the cell. Activation of these receptors is done by their respective taste molecules which would stimulate G proteins and inturn phospholipase C. the activation of phosphotidyl inositol – 4, 5- biphosphate and opens the transient biphosphate and opens the transient receptor potential channel, resulting in the generation of a depolarizing reseptor potential. This transient receptor potential channel are calcium sensitive and thus intracellular messenger would activate the receptor channels by releasing calcium from internal stores. Depolarization would follow and releases the transmitter. Further electrical signals generated in cells are transmitted through cranial nerves to the brain which declares the percepted taste. In the transduction process, the membrane is affected in different ways depending on the taste substans. Sour substances contain hydrogen ions that blocks the channels in the membrane. Salty substances break up into sodium ions which flow through the membrane directly into the cell. Different types of receptors are involved for different taste.

3.4. Tongue, can it be explained.

Tongue is the sensory organ for perception of the taste of foods, compounds which varies with the chemical structure of the compounds. The tongue is covered with thousands of small bumps called papillae. Each papilla contains hundreds of taste buds. There are 2000 – 5000 taste buds which are located on the back and front of the tongue, on the roof, sides and the back of the mouth towards the throat. Taste buds are able to differentiate among different tastes is sweetness, saltiness, sourness, bitterness and umami through interactions with different ions. The taste sensation on the tongue is experienced at different locations of the tongue. Sweet and fatty taste is easily sensed at the tip of the tongue. Salt is tasted at the tip and edge of the tongue, the sour taste is at the edge of the tongue and bitter taste at back of the tongue.

3.5. How papillae are placed on the tongue?

The tongue is covered with thousands of small bumps called papillae. Taste papillae can be seen on the tongue as tittle red dots or raised bumps mainly on the front of the tongue.

3.6.How many types of papillae are present on the tongue and mention them.

There are four types of papillae and are fungiform papillae, foliate papillae, circumvallate papillae and filiform papillae.

3.7. Where exactly gustatory papillae are located and how does it differ in the taste buds.

Fungiform papillae are located on the most anterior part of the tongue and generally contain one to several taste buds per papilla. They are innervated by the chorda tympani branch of the facial (VIIth cranial) nerve. They appear as red spots on the tongue-red because they are richly supplied with blood vessels. The total number of fungiform papillae per human tongue is around 200. Papillae at the front of the tongue have more taste buds.

Foliate papillae are situated on the edge of the tongue slightly anterior of the circum vallate line. They are predominantly sensitive to sour tastes. Innervated by the glossopharyngeal (IXth cranial) nerve. On average 5.4 foliate papillae per side of the tongue, 117 taste buds per foliate papillae, total, 1280 foliate taste buds per tongue are generally present.

Circumvallate papillae are sunken papillae, with a trough separating them from surrounding wall. The taste buds are in tiers within the trough of the papillae. They are situated on the circumvallate line and confer a sour/bitter sensitivity to the posterior 2/3 of the tongue. Innervated by the glossopharyngeal (IXth cranial) nerve. 3-13 circumvallate papillae per tongue with 252 taste buds per papillae, total = 2200 circumvallate taste buds per tongue are generally present.

3.8. What is non- gustatory papillae? Mention the type.

Filiform papillae are mechanical and non-gustatory. It does not contain taste buds. The centre of the tongue has only filiform papillae and hence “taste-blind”.

3.9. Explain the taste receptor cells.

Taste receptor cells are present in taste buds. These receptors is a type which facilitates the sensation of taste. Each taste bud contains 50 – 100 taste receptor cells. The cells contain microvillai which appear to secret substances into the human taste bud. The sensory receptor cells has peg like extensions projecting into human. These contain the sites of sensory transduction. The basal cells differentiate into new receptor cells. These are derived from surrounding epithelium. The cells are continuously renewed every 10 days. The taste receptors are also in the palate and early parts of the digestive system such as larynx and upper esophagus.

3.10. What are cranial nerves?

The cranial nerves are the nerves which relays the information through the transmitter. These cranial nerves innervate the tongue. There are three cranial nerves and are chordatympani nerve, glasso-pharyngal nerve and vagus nerve.

3.11. Describe the cranial nerves function in taste perception.

Chordatympani nerve conducts the signals from the front and sides of the tongue. Glasso-pharyngal nerve conduct signals from the back of the tongue and vagus nerve conducts taste signals from the mouth and the larynx. These nerves makes the first recordings from sensory fibres shows an optimal response to one stimuli, but smaller response to other taste stimuli. These nerves make connections in the brain stem in the nucleus of the solitary tract before going to the thalamus and then to two regions of the frontal lobe. The electrical signals generated in the taste cells are transmitted through these nerves. The lingual nerve called trigeminal nerve is deeply interconnected with chordatympani nerve and it provides all other sensory information from the 2/3 of the tongue. The glossopharyngeal nerve innervates one third of the tongue including circumvallate papillae.

3.12. Give a brief on the taste receptors type involved in basic taste perception.

G-protien – coupled receptor is involved in sweet, bitter and umami tastes. The bitter resceptor was first characterised in 2000 and called TAS2R1. Sweet receptor was characterised in 2001 as TAS1R2. The receptors differ for each of the basic taste and the site of action on the tongue and the brainnerves differ. This is briefly tabulated as below.

3.13. List the parts involved in gustation system.

1.Tongue
2.Papillae – fungiform, foliate, circumvallate
3.Taste buds – on the tongue, epiglottis, soft palate laryngeal and oral pharynx.
4.Receptor cells – basal cells and supporting cells.
5.Receptor types – G protein coupled, PKD211, Task-1 ACCN1, ENac.
6.Cranial nerves – chordatympani, glassopharyngeal and vagus nerves.

3.14. Which is the receptor used for salt?

The saltiness is sensed by the presence of sodium ions. ENac receptor is sodium ions sensing and hence used for salt perception.

3.15. Which receptors are suitable for sourness?

ACCNI and Task 1are used for sourness and it blocks the channels in the membrane .