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Matric Number: 18/mhs02/040

Department: NURSING

Course Code: PHS212

Topic: PATHWAY INVOLVED IN TASTE

The tongue contains small bumps called papillae, within or near which taste buds are situated. In the tongue's taste buds, the taste receptors receive sensory input via two important mechanisms – depolarization and neurotransmitter release. Intake of salty foods leads more sodium ions to enter the receptor, causing the said mechanisms. The same is true with intake of sour foods (hydrogen ions) and sweet foods (sugar molecules), both of which result to the closing of K⁺ channels upon their entry.

From the axons of the taste receptors, the sensory information is transferred to the three taste pathways via the branches of cranial nerves VII, IX and X. The chorda tympani of CN VII (facial nerve) carries the taste sensory input from the tongue's anterior two-thirds. Then, the rest of the taste sensations from the throat, palate and posterior tongue are transmitted by the branches of CN IX (glossopharyngeal nerve) and CN X (vagus nerve). From these cranial nerves, taste sensory input travels through the nerve fiber synapses to the solitary tract, the ventral posteromedial thalamic nuclei, and the thalamus. In these three locations, there are clustered neurons which respond to the same taste (sweet, sour, salty or bitter). The thalamus relays the information to the primary gustatory cortex located in the somatosensory cortex. The primary gustatory cortex is where the perception of a particular taste is processed.

The neural taste pathway will undergo scrutiny from the perspective of starting within the tongue and moving away from it towards the brain. The three nerves associated with taste are the facial nerve (cranial nerve VII), which provides fibers to the anterior two-thirds of the tongue, the glossopharyngeal nerve (cranial nerve IX), which provides fibers to the posterior third of the tongue, and the vagus nerve (cranial nerve X), which provides fibers to the epiglottis region. Taste fibers categorize as special visceral afferent (SVA).

The branch of the facial nerve that innervates the anterior two-thirds of the tongue is the chorda tympani nerve. Another branch of the facial nerve, called the greater petrosal nerve, supplies innervation to taste buds of the soft palate. The cell bodies of the facial nerve associated with taste occur within the geniculate ganglion. Its central processes enter the brainstem at the pontomedullary junction and travel caudally to the medulla oblongata, where they synapse at the nucleus solitarius.

The cell bodies of the glossopharyngeal nerve associated with taste are in the inferior ganglion of the glossopharyngeal nerve (petrosal ganglion). The central processes of the glossopharyngeal nerve travel through the jugular foramen, enter the brainstem at the level of the rostral medulla, and eventually synapse at the nucleus solitarius.

The cell bodies of the vagus nerve associated with taste exist in the nodose ganglion. Its central processes travel through the jugular foramen, to the medulla, and also synapse at the nucleus solitarius.

At this point, fibers from all three of these nerves have synapsed at the nucleus solitarius.

Specifically, the synapse occurs in the rostral part of the nucleus solitarius known as the gustatory region of the nucleus.

[1] The caudal area of the nucleus solitarius receives cardio-respiratory information, and it is known as the visceral region.

Next, the second-order fibers ascend ipsilaterally to the parvocellular division of the ventral posteromedial nucleus (VPMpc) of the thalamus, where the next synapse occurs.

The third order fibers travel ipsilaterally through the posterior limb of the internal capsule to terminate in the frontal operculum, anterior insular cortex, and in the rostral part of the Brodmann area 3B.

[2] The overall function of these third-order fibers is to provide discriminatory taste sensations.

Additionally, there are secondary fibers that travel from the gustatory cortex to the posterolateral portion of the orbitofrontal cortex (OFC). This area is where the integration of taste and smell takes place, as well as the phenomenon of food reward.

[3] The description of food reward is the enjoyment of a particular food at the time in which an individual is eating it.