International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

The Function of Bodhaka Kapha in Taste Perception: A Comparative Analysis with Salivary and Gustatory Mechanisms

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Abstract: ***Ayurveda delineates the Dosha as three essential principles that function in the external environment while also influencing human nature, hence governing all physiological processes. The Dosha executes several physiological duties throughout the body. Consequently, they are referred to as the functional unit of the body. The deficiency or lack of any single Dosha is insufficient for the fulfilment of life, as Kapha, Pitta, and Vata govern Srushti (Creation), Sthiti (Maintenance), and Laya (Destruction) of all beings. Kapha is the Dosha responsible for the formation of beings and serves as the foundation of the entire universe. The phrase Kapha is formed from the words Ka, meaning water, and Pha, meaning flourishes, occurring concurrently. Kapha is the unifying principle of the body. This is constituted by the supremacy of Aap and Prithvi Mahabhuta. Kapha is functionally categorized into five types-Avalambaka, Kledaka, Bodhaka, Tarpaka, and Sleshaka - due to its attributes such as Snigdhatva, Mritsna, and Gurutva. Bodhaka kapha is one of the Kapha kinds, primarily responsible for the Bodhanakarma of Rasa (Taste Perception) and the fragmentation of ingested food. Bodhaka kapha is situated near the base of the tongue and the neck. The perception of taste is facilitated by the aqueous nature of the gustatory sense organ. Modern science posits that taste is a chemical experience. Saliva, with its solvent properties, dissolves solid food particles, allowing the resultant compounds to activate the taste buds. The activated taste buds identify the flavor. Taste is diminished when the mouth is desiccated, as things can only be perceived when dissolved. This article intends to examine the parallels between saliva and Bodhaka Kapha from both contemporary and traditional perspectives***

Keywords: Dosha, Kapha, Bodhaka Kapha, Rasa Bodhana, saliva, division, gustatory perception

1. Introduction

Sarira is a living body. The different constituents of the body are grouped into three principal categories, namely Dosha, Dhatu and Mala. Ayurveda considers no entity other than these three constitutional elements of the living body.[1] Vata-Pitta-Kapha Doshas, Rasa Rakta-Mamsa-Meda-Asthi-Majja-Sukra Dhatus and Purisha-Mutra-Sweda Malas are like roots of living body. As roots are vital to trees, amongst other organs such as the stem and branches, these Dosha-Dhatu-Mala are essential to the human body[2]. Ayurveda describes the Doshas as three fundamental principles operating in outer nature, but also penetrating our human nature and thus regulating all physiological processes[3]. These three Doshas are made up of five elements: Vata comprises air and space, Pitta comprises fire and water, and Kapha comprises water and earth. The Balance of these entities represents the healthy state, and an imbalance will cause various diseases[4]. Kapha Dosha is one of the body's functional units. Kapha is functionally subdivided into five types, i.e. Avalambaka, Kledaka, Bodhaka, Tarpaka and Sleshaka Kapha[5]. Bodhaka is located at the base of the tongue and throat[6]. It is responsible for the perception of taste because the gustatory sense organ is watery in nature[7]. Ayurveda has described six different tastes (Rasas)[8]. Jala is the Yoni of Rasas, i.e.Rasa percepts when it dissolves in water or saliva[9].

Saliva: It is excreted from three pairs of major salivary glands and several minor salivary glands into the oral cavity. The majority of saliva is produced by the major salivary glands, including the parotid, submaxillary (or submandibular), and sublingual glands, which are located beyond the oral mucosa, with their ducts terminating in the oral cavity. Seventy percent of total salivary secretion is produced by the submandibular glands, twenty-five percent by the parotid glands, and five percent by the sublingual glands. The secretion of the parotid gland is abundant in salivary amylase, an enzyme that hydrolyzes starch, but relatively deficient in mucin. In contrast, the sublingual and submaxillary glands, especially the sublingual gland, are characterized by a high mucin content but a low enzyme concentration.

Saliva consists of 99.5% water and 0.5% solutes.Solutes comprise ions such as sodium, potassium, chloride, bicarbonate, and phosphate. Dissolved gasses and other chemical compounds, including urea, uric acid, mucus, immunoglobulin A, lysozyme (a bacteriolytic enzyme), and salivary amylase (a digesting enzyme that acts on starch), can also be identified. Saliva's water content serves as a solvent for food particles, enabling their detection by gustatory receptors, thereby initiating the digestive process. Chloride ions in saliva trigger salivary amylase, an enzyme that initiates starch degradation.

Total volume – 1200-1500 ml within a 24-hour period. A significant percentage of this 24-hour volume is excreted during lunch, when the secretion rate peaks.

Consistency- Slightly turbid, attributable to the presence of cells and mucus.

Reaction- Typically somewhat acidic (pH 6.02-7.05). Upon standing or boiling, it releases CO2 and attains an alkaline state. This alkaline reaction induces the precipitation of salivary components, such tartar on the teeth or calculus within the salivary duct.

The role of salivaSixteen 1. Safeguards the oral cavity lining by maintaining moisture and neutralizing any potential irritants. 2. Facilitates the perception of taste by dissolving and maintaining the ingredients in solution. 3. Lubricates the food, forms it into a bolus, and so aids mastication and deglutition. 4. It stimulates the taste buds to react to sweet, salty, acidic, and bitter compounds. 5. Maintains oral hygiene by ensuring the mouth and teeth are devoid of food particles. Moreover, the antibacterial properties of lysozyme in saliva protect the teeth and surrounding areas from infection. Mucin in saliva safeguards the oral cavity by lubricating the mucous membrane. Proline-rich protein lactoferrin, found in saliva, exhibits antibacterial properties.

Taste Buds:
The papillae on the tongue house taste buds. The receptors for taste sensation are situated in the taste buds, which are found on the tongue, soft palate, pharynx, and epiglottis. A taste bud is a cluster of taste receptor cells situated within the epithelial layer of the papillae. Altered epithelial cells of taste buds are subjected to salivary fluid in the oral cavity.

Situation of taste buds[20] –
The majority of taste buds are located on the tongue's papillae. Taste buds are located in the mucosa of the epiglottis, palate, throat, and the proximal region of the esophagus. Types of papillae: ▪ Circumvallate papillae ▪ Fungiform papillae ▪ Filiform papillae Cellular types within taste buds22 The cells in the taste buds consist of two types: gustatory receptor cells and supporting or sustentacular cells. Taste cells originate from the epithelial cells encircling the taste bud, migrating towards the center as they grow, and ultimately degenerating within approximately 10 days. It is assumed that all cells within the taste bud are sensitive, but at varying stages of development. Gustatory receptor cells establish synaptic connections with sensory nerve fibers. Each gustatory receptor cell terminates in microvilli at the apex near the pore.

Taste transduction: Taste transduction is the mechanism by which taste receptors transform chemical energy into action potentials within the gustatory nerve fibers. Taste receptors are chemoreceptors activated by the presence of saliva. Taste transduction is the mechanism by which taste receptors transform chemical energy into action potentials in the taste nerve fibers. Taste sensation receptors are chemoreceptors activated by chemicals dissolved in saliva within the mouth. Dissolved chemicals interact with the microvilli of taste receptors located within the taste pore. It induces the formation of receptor potential in the receptor cells. This, in turn, is responsible for generating action potentials in the sensory neurons.

Pathway for taste25 – ▪ Receptors – The gustatory receptor cells within flavor buds serve as the receptors for taste experience. Each taste bud is innervated by approximately 50 sensory nerve fibers, with each nerve fiber supplying at least five taste buds via its terminals. The first-order neurons of the taste pathway are located in the nucleus of three distinct cranial nerves within the medulla oblongata. The dendrites of the neurons are disseminated to the taste buds. The fibers originating from taste buds travel to the cranial nerve nucleus via the following nerves: 1. Chorda tympani fibers of the facial nerve, which originate from the anterior two-thirds of the tongue. 2. Glossopharyngeal nerve fibers originate from the posterior one-third of the tongue. 3. Vagal fibers originating from taste buds in various areas. Axons from first-order neurons in the nuclei of these nerves converge in the medulla oblongata and terminate in the nucleus of the tractus solitarius. ▪ Second-order neuron - Second-order neurons reside in the nucleus of the tractus solitarius. Axons of second-order neurons traverse the medial lemniscus and terminate in the posteroventral nucleus of the thalamus. ▪ Third order neuron - Third order neurons reside in the posteroventral nucleus of the thalamus. Axons from third-order neurons extend into the parietal lobe of the cerebral cortex. The taste center, responsible for taste experience, is located in the opercular insular cortex, specifically in the inferior region of the postcentral gyrus, which receives cutaneous sensations from the face. Consequently, the taste fibers lack an independent cerebral projection.

2. Discussion

Dosha, Dhatu, and Mala together constitute the foundation of the body. The equilibrium of these entities signifies a healthy condition, whereas any disruption would lead to numerous ailments. There are five varieties of Kapha: Bodhaka, Sleshaka, Tarpaka, Avalambaka, and Kledaka.Bodhaka Kapha is a subtype of Kapha that informs, reveals, awakens, arouses, or denotes the flavors contained in various things. The primary function of Bodhaka Kapha is RasaBodhana, which refers to the experience of taste.

Rasa Bodhana - the discernment of flavor Taste is a chemical perception. Taste buds comprise sensory receptors (chemoreceptors) located in the papillae of the tongue, as well as the palate, pharynx, and epiglottis. They comprise diminutive sensory nerve terminals of the glossopharyngeal, facial, and vagus nerves. The sensory receptors are activated by substances that penetrate the pores dissolved in saliva. Taste is diminished when the mouth is desiccated, as things can only be perceived when dissolved. Nerve impulses are produced and transmitted by the glossopharyngeal, facial, and vagus nerves before synapsing in the medulla and thalamus. Their destination is the gustatory region in the parietal lobe of the cerebral cortex where taste is perceived. In this context, saliva functions as a facilitator for the perception of taste. This capability allows us to correlate Bodhaka Kapha with saliva.

Bodhaka Kapha- Digestive Function Upon ingestion, food is lubricated and solubilized by saliva. The mucin in saliva lubricates the bolus and aids in swallowing. Saliva contains three digesting enzymes: salivary amylase, maltase, and lingual lipase. It aids in digestion. Kapha present in the oral cavity or saliva, which facilitates the Kledana (softening) of food, might be associated with Bodhaka Kapha.

Bodhaka Kapha - Disease Resistance The continuous production of saliva cleanses the mouth and teeth, removing food particles, desquamated epithelial cells, and foreign substances. Saliva inhibits bacterial proliferation by eliminating substances that could act as culture media for bacterial growth. The enzyme lysozyme in saliva eliminates some bacteria, including Staphylococcus, Streptococcus, and Brucella. The proline-rich proteins and lactoferrin found in saliva exhibit antibacterial properties. This pertains to the Vyadhikshamatva attribute of Bodhaka Kapha. This element allows us to associate Bodhaka Kapha with saliva.

Bodhaka Kapha – Tarpaka Kapha In the Mukha, we may observe the operation of two types of Kapha: Bodhaka Kapha and Tarpaka Kapha (particularly in the Shiras). Tarpaka Kapha primarily facilitates the nutrition of the senses, such as Chakshurindriya and Rasanendriya, while Bodhaka Kapha enhances the perception of taste at the taste bud level; thus, the Kapha that softens food in the oral cavity is exclusively Bodhaka Kapha. The role of Bodhaka Kapha can be associated with saliva, which facilitates digestion by moistening and softening food in the oral cavity, whereas Tarpaka Kapha operates at a higher level within the neurological system and contributes to the perception of taste.

Criteria	Bodhaka Kapha	Saliva
Location	Rasana	Oral cavity
Composition	Sowmya Guna	99.5% water
Main Function	Rasa Bodhana	Appreciation of taste
Other functions	Splitting of ingested food	Moistening and softening the food - helps in digestion

3. Conclusion

The Bodhaka Kapha, located at the base of the tongue and neck, is a type of Kapha. Sowmya possesses properties29. The primary function of Bodhaka Kapha is identified as Rasabodhana, or the feeling of taste. Taste is a chemical perception. Saliva, with its solvent properties, dissolves solid food items, allowing the taste buds to perceive flavor. Kapha, often referred to as Bala, is responsible for Vyadhikshamatva, which pertains to combating infections. In contemporary physiology, Bodhaka Kapha can be associated with saliva, which aids not just in taste perception but also in other functions. Taste perception in physiology requires food molecules to be in solution form for the stimulation of taste buds, a process facilitated by saliva in the mouth. Bodhaka Kapha can be functionally equated to saliva in modern understanding.

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