Relevancy of Concept of *Oja* with Neuropeptides: A Brief Discussion

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Abstract: The vital force to keep normal physiology working in equilibrium with reference to Tridosha is termed as Oja in Ayurveda. It is required for every single physiological action. Its defined swaroopa proves its physical existence. Based on characteristics, importance, actions and effects, it is related with collective forms of all neuropeptides. Neuropeptides small protein molecules present in every neuron. Minute screening of central control of every physiological action further strengthens the claim of similarity between Oja and Neuropeptides (all collectively). Detailed effects of non-functioning or irregular functioning of neuropeptides leaves similar effects as mentioned for kshaya.of Oja which may lead to emaciation of body and death even. Previous correlations with immunity, albumin, vitamins etc. have restricted approaches with greater scopes of objections.

Keywords: Oja, Neuropeptides, Kshaya, Hridaya, Mahat, Visharana, Vyapada, Weakness.....

The online dictionary describes *Vital force* or *power* as a hypothetical force, being important cause for evolution and development of living organism[1]. It is specified to force independent of physical and chemical forces[1]. Literally, the word *Oja* or *Ojas* stands for vital force/energy or vitality or vigour[2] in *Ayurveda*, but its physical existence in terms of appearance is detailed in *swarupa* (attributes). It is referred to representative essence of *Vital power* from *Rasa* to *Dhatu*[3,4]. *Oja* is associated with every system and activity of human beings. This vital power is reported for imparting a firm integrity to the muscle, improves the voice, complexion and helps external and internal sense organs to perform their natural functions. Actually it controls all acts of vitality[3,4]. *Sushruta Sutrasthana* (*S.Su.*) 15/23 recorded Oja as soft, shiny, oleaginous, cooling, white, firm (*sthira*) and sweet[3,4]. It is upmost basis of life[3,4]. The whole body is permeated with *Ojas*, and diminution in its natural quantity leads to the gradual emaciation of organism[3,4]. *S. Su.* 15/25 reveals that injury, persistent wasting disease, anger, grief, depression or anxiety, fatigue and hunger are the causes behind the loss of this strength-giving principle of the body[3,4]. *Oja* is transformed in to strength which radiates from the heart and circulates in whole body[3,4].

Number of efforts are made in modern science to correlate *Oja* with vitamins, albumin, internal secretions, immunity etc., but the diversified ambits and descriptions of *Oja* were observed differing from these terms in one or other aspect/s. Still for global recognition and in depth study needs some close association with medical terminology which is best suited with all aspects of *Oja* cited in *Ayurveda*. Attributed countenances and actions of *Neuropeptides* brings them closer to *Oja*. Belzung et. al. (2011) defined *Neuropeptides* as, 'small protein-like molecules produced and released by neurons through the regulated secretory route and acting on neural substrates[6]'. It is diversified class of signaling molecules[7]. *Neuropeptides* change the chemistry of every cell inside a body[8], so they control almost every physiological function[7]. Many of peptide hormones are grouped under this category based on structural and function similarities.

Attributes of *Oja*[5,52] and its relation with Characteristics of Neuropeptides

Attributes of *Oja* are noted in *Charak Chikitsasthana* 24/31and *Charak Sutrasthana* 17/73-75 as:

1. ***Ghrita Sadrisha Shuklavarna*** (White with reddish and yellow touch): Neuropeptides are combinations of amino acids in short sequences[9,10]. Amino acids have spectral colours[11]. It is ordering of amino acids that make the absolute colours for peptides[11]. Opiate peptides share the sequence of *Tyrosine-Glycine-Glycine-Phenylalanine-Methionine/Leucine*[9]. They share the colours in sequence as Green-Yellow-Yellow-Green-Green/Green[11]. The mixing of these colours give light yellow with red tinge, a colour near to colour of clarified butter (ghrita). The work on sequencing of amino acids for number of neuropeptides are yet to be done. After revelation of sequence or synthesis of neuropeptides only, detailed colour-patterns of group-wise neuropeptides is possible.

2. ***Guru*** (Heaviness): Peptides are capable of formation of building block by covalent bonding, ligand-receptor interactions, template-directed assembly and non-specific co-assembly[12]. Such capacity provides the properties of heaviness for diversified neuropeptides as distinguished groups of peptides are observed in different neuropeptides.
3. ***Sita*** (Cold): Amino acids attach to each other by peptide bonds through the process of condensation[13]. Energy is consumed during this attachment. Requirement of energy is phenomenon of endothermic reaction and endothermic reaction gives feeling of coolness[15].
4. ***Mridu*** (Softness): Neuropeptides are short sequences of amino acids[9]. The hydrogen bonding and folding of secondary, tertiary and quaternary structure determines the structure of peptides[16]. Dietary fatty acids alter the concentration of neuropeptides[17]. It shows the association of neuropeptides with fatty acids. Even number of neuropeptides are formed by adipose tissue[18]. So, they are soft.
5. ***Slakshna*** (Smoothness): Fatty acid association of neuropeptides make them smooth.
6. ***Bahala*** (Density): Density means mass and volume ratio. Neuropeptides are located in small, clear dense core vesicles from Golgi network[19]. They are organic molecules. They have certain molecular weight and they also cover space. So, they have densities. But the densities depend upon the structures of neuropeptides.
7. ***Madhura*** (Sweetness): Peptides are also having taste varying from sweet, umami to bitter[20,21,22,25]. The taste cells for sweet, bitter and umami follows the same intracellular signaling pathway[23]. Sweet molecules activate phospholipase C to generate inositol triphosphate which causes the release of calcium from endoplasmic reticulum. This calcium activates TRPM5 channel and induces cellular depolarization. This activates the afferent neurons via release of ATP[21,22]. This also masks the pathway of bitterness[24]. *Alanine, Glutamine, Glycine* and *Serine* are sweet amino acids[25]. Sequencing and number of neuropeptides with involvement of either of these sweet amino acids will give perception of sweetness. However, intensity depends upon the unit of these amino acids in sequences.
8. ***Sthira*** (Stability): Neuropeptides are produced after processing of precursor proteins and their action depends upon the site and receptors of contact[26]. Their long lasting action on nervous system and other organs suggest about their stability[27].
8. ***Prasanna*** (Clearness): Peptides are short chains of amino acids[19]. Combinations of specific amino acids in defined pattern designates the particular neuropeptide. They are clear without any mixing of other compounds.
9. ***Pichchhila*** (Sliminess): Banks and Kastin (1985) have discussed the reasons behind the passage of blood-brain barrier (BBB) by neuropeptides[28]. They reported the lipophilicity, charge, molecular weight and protein binding as physico-chemical characteristics enabling the neuropeptides to cross BBB[28]. Lipophilic compounds are composed of lipids, glycolipids, glycoprotein or exopolysaccharides[29]. They all are slimy.
10. ***Snigdha*** (Unctuousness): Lipophilic compounds are unctuous.

Heart As Major Place for *Oja* Significance of Heart for Neuropeptides

Charaka Sutrasthana 30/7-8 cites the importance of heart for *Oja* as vessels carry it throughout the body. Due to this reason, it is also called as *Mahat* and vessels are called as *Mahaphala*[30].

As mentioned for *Oja*, similar pathway for neurotransmitter can be apprehended as blood is source of nutrients viz., glucose, fatty acids and amino acids[31]. Sodium is important for working of neuropeptides because, absorption of dipeptides and tripeptides is indirectly Na^+ dependent[32]. Na,K-ATPase in capillary endothelium plays an important role to bring sodium to brain through blood[32]. Dipeptides and tripeptides are also carried to site. So, heart works as the source of neuropeptides and sodium too. Other than this, natriuretic peptides viz., atrial natriuretic peptide (ANP) and brain natriuretic peptides (BNP) are also produced in heart. BNP is brought to brain through this pathway.

Karma of *Oja*[3,4] and its Association with Actions of Neuropeptides

1. *Oja* is instrumental in maintaining the equilibrium of *Vata-Pitta-Kapha* through various bodily function. Immune system plays an important role in this. Neuropeptides mediate regulatory functions of almost every organ inside the body[34]. Diversified neuropeptides control feeding behavior, blood pressure, water balance, metabolism of glucose and others, neuroprotection, immunomodulation etc. The hypothalamus-pituitary-adrenal axis regulates the immune system. Corticotrophin releasing factor, adrenocorticotrophic hormone, alpha-melanocyte stimulating hormone and beta-endorphins are neuropeptides working as immuneregulators[35]. A detailed exploration is still required.
2. Destruction of *Oja* brings the emaciation and death. Same way, the working of immune system, neuroprotection and various other physiological controls are directly related with neuropeptides. Any mal-functioning or non-functioning of various neuropeptides may bring relevant physiological alteration leading to death.
3. *Oja* is related to gratifying every component of body. Similarly, neuropeptides are also associated with every components of body through nervous system and nerves. Neuropeptides are neuronal signaling molecules localized within peripheral and central nervous system. They are also incorporated with sympathetic, cholinergic, noncholinergic, adrenergic and nonadrenergic nerves[36].
4. *Oja* regularizes all *Dhatus*. Correspondingly neuropeptides are also affiliated to regularization of plasma, blood, muscle, fats, bones, nervous system and reproductive system via different pathways.
5. All physiological functions are controlled by *Oja*. Involvement of neurons in every physiological action gives the automatic place to neuropeptides equivalently as marked in *Ayurveda* for *Oja*.
6. All sensory organs, mind, intellect and ego are result of *Oja*. A sensory system involves sensory neurons and neuron are associated with neuropeptides. Intelligence is connected with learning, memory, innovation and behavioural flexibility[37]. They are linked to various parts of nervous system viz., hippocampus, medial temporal lobes, thalamus, hypothalamus etc. All of them are related to neuropeptides.

   Mind is faculty of consciousness while ego is between consciousness and unconsciousness[38]. Both are governed by lots of mental functions based on memories and their processing. Memories and their processing are connected with brain and neurons, so with neuropeptides.
7. Feeling of happiness and sorrow are due to *Oja*. The amygdala is responsible for emotion and related processing through prefrontal, anterior temporal areas and central autonomic structures[39]. Emotional arousal is linked to amygdala neurons. The definition of neuropeptides itself suggest the relationship with neurons as neuropeptides are produced and released by neurons. So, involvement of neuropeptides with emotion is quite apparent.
8. Superiority of voice and speech are due to *Oja*. Central nervous system control of voice is described[40]. Organizational framework of functional and structural brain networks is agnate to quality of voice[41]. Neuropeptides are basis behind both i.e., functioning of CNS and implications of brain networks.
9. Concisely *Oja* is basis of life. As complete physiology is dependent on neuropeptides, so it can be taken as basis of life.

Deformity of *Oja*[51] and Relation with Neuropeptides' Irregularity

Sushruta Sutrasthana 15/24-28 highlights three deformities of *Oja* as:

The ***Vishrana*** means weakness or laxness[42] of *Oja*. It gives rise to symptoms as looseness of the bone-joints, numbness of the limbs, dislodgement of the deranged humours from their respective receptacles and suppression of the bodily and intellectual functions.

Neuropeptides have been studied for controlling bone homeostasis viz., calcitonin gene-related peptide (CGRP), neuropeptide Y (NRY), substance P (SP), vasoactive intestinal peptide (VIP) and tyrosine hydroxylase

(TH)[43,44]. Neuropeptides and their receptors also regulate the functions of osteoblasts and osteoclasts. These ways they regulate remodeling of bone and remodeling is very much related with looseness.

Numbness is said to be result of nervous system malfunction. Disturbance or weakness or laxness in sensational functioning results to numbness. Neuropeptides are directly related with neurons and indirectly with neurotransmitters. Derangement in receptacles invites mal-functioning or non-functioning as specific receptors of individual neuropeptide determines the appropriate functioning. They are also related with every normal physiological functioning and intellectual exposition.

The meaning of ***Vyapad*** stands for spitefulness. It gives rise to symptoms as numbness and heaviness of the limbs, dropsy due to the action of the deranged bodily vayu, discoloured or changed complexion, feeling of malaise, drowsiness and somnolence.

Sensational malfunctioning is directly related to the improper functioning of neuropeptides. Catabolism of neuropeptides have been shown for increased interstitial fluid in rat stomach[46]. Functions of keratinocytes, mast cells, dermal microvascular endothelial cells, infiltrating immune cells and langerhans cells are modulated by neuropeptides released from sensory nerves of dermis and epidermis[47]. Any derangement is responsible for health of skin including inflammation, wrinkles, changed coloration etc. Drowsiness is associated with neuropeptide Y, leptin, hypocretin-1 and ghrelin levels in plasma[48].

Kshaya brings fainting, loss of flesh, stupor, delirium and ultimately death. Abnormalities of concentration of neuropeptides also results in degenerative diseases[49]. Neuropeptides are involved in homeostatic systems i.e., normal physiological functions of the body. Associated with neurotransmitters, they also regularize immune system. Loss or degradation in neuropeptides brings all abnormalities of related physiology[50].

Conclusion: Based on evidences and relevancy of characteristics, actions, places and deformities, neuropeptides reveal the semblance with *Oja*. Both of them work to fuel every system of the body to maintain the equilibrium of *Tridosha*. Any irregularity from normal course of existence causes connected alterations. A detailed logical search at further minute level is option for work ahead.

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