



Rasadhatu Review from Ayurvedic and Modern Perspective

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ABSTRACT

Ayurveda being the science of life upholds the theory that *dosha*, *dhatu* and *mala* are at the *mula* of *sharira*. They form the integral foundation of the human body and are responsible for its existence. Ayurveda describes that the normal functions of these along with *agni* and *mana* maintains *swastha* and their imbalance contribute to *vyadhi*.

The word *Dhatu* means to support, not only body but also mind and life. *Dhatus* constitute the material substrate of the body. In modern terminology, it can be called as body tissues. *Dhatus* are structural and nutritional factors of body. *Rasa dhatu* is the first *dhatu* to be formed from *aahar rasa*. It is transparent extract and carries nutrients to all the other *dhatus* in the body. It is the most crucial *dhatu* for the healthy growth of remaining *dhatus*. *Rasa dhatu* circulates from the *hrudaya* through *rasavaha strotas*. It provides nutrition to each cell of the body, thereby giving a feeling of satisfaction. The detailed description regarding *Rasa dhatu* is found in Ayurvedic texts.

This article is proposed to make a correlation of *rasa dhatu* with modern prospective to have a clearer view about the *rasa dhatu*. The basic material required for the study has been collected from the Ayurvedic classics with the available commentaries, as well as text books of contemporary modern medical science and e-journals.

From this conceptual study it is concluded that *rasa dhatu* is responsible for vitality of life and can be correlated with Extracellular fluid of the body.

Key Words: *Aahara rasa*, *Chyle*, *Extracellular Fluid*, *Rasa dhatu*

INTRODUCTION

Ayurveda the science of life upholds the theory that *satva* (mind), *aatma* (soul) and *sharir* (body) are the three pillars of life¹. As roots of tree are responsible for holding the tree likewise *dosha*, *dhatu* and *mala* hold the body². The word *dhatu* is derived from Sanskrit word '*dhru*' which means

dharana i.e. holding the body³. Moreover *dhatu* also functions in developing and sustaining body. Among the seven *dhatus* explained by Ayurveda, *rasadhatu* is the first to get produced and nourished from *aahar rasa*. *Purush* is evolved from *rasadhatu*⁴. Thus healthy status of *rasadhatu* indicates healthy *sharir*. Being the first *dhatu* it ultimately nourishes the remaining six *dhatus*. The



“*apara oja*” which is formed during the metabolism of each *dhatu* manifests in the form of the essence of *dhatu* is also circulated throughout the body through *rasa* indicating its relation with *Rasa dhatu*⁵.

According to *aashraya-aashrayi bhava rasa dhatu* is *aashraya* for *kapha dosha*⁶. The *kapha* and *rasa dhatu* are similar in qualities as both have *jalamahabhuta* dominance.

Equilibrium of *dosha*, *dhatu* and proper excretion of *mala* determine the healthy status of an individual. Any condition which affects in altering this equilibrium leads to manifestation of *vyadhi* (disease). Hence the detailed study of *dhatu*s is necessary for maintenance of health, understanding the *samprapti* (pathogenesis) of disease and deciding the line of treatment.

Modern physiology describes that body fluids are the major component of the body. Body fluid is mainly divided into intracellular and extracellular fluid⁷. The functions of body fluid are to transport the nutrients, carry away the cellular waste products and maintain homeostasis.

In many research papers *rasa dhatu* is compared with plasma and lymph due to similarity in properties and functions of these body components.

This article is an attempt to understand *rasa dhatu* from Ayurvedic aspect along with its modern perspective.

AIMS AND OBJECTIVES

To understand the concept of *rasadhatu* from Ayurvedic and modern perspective.

MATERIALS

For this conceptual study classical Ayurvedic text, modern physiological texts along with information from e-journals is referred.

REVIEW OF LITERATURE

A. Conceptual study of *Rasadhatu*

Rasa Nirukti:-

Rasa nirukti is ‘*rasagatu*’ which means moving. The fluid substance present in body which is circulated constantly is known as *rasa dhatu*⁸.

The dictionary meaning of ‘*rasa*’ is taste, to relish, to perceive, to feel, to desire⁹.

Synonyms:-

Adyadhatu (first *dhatu*)¹⁰, *Aharaparinama dhatu* (transformed from food)¹¹, *Saumya dhatu*

Formation and metabolism of rasa dhatu:-

Ingested food gets digested by *jatharagni* and gets converted into *aahar-rasa*. Formation of ultrafine *rasadhatu* takes place in *rasavaha srotas* from *aahar-rasa*. Here the *rasadhatvagni* acts on *aahar-rasa* (essence of digested food) and transforms it into *sthayi rasadhatu*, *asthayi raktaposhakansh*. The *upadhatu*s *raja* and *stanya* are also formed at the same time¹². *Kapha* is formed as the *mala* of *rasa dhatu*.

Time span for formation of Rasa dhatu:-

The complete formation of *rasa dhatu* takes time period of *ek ahoratra*¹³ (24 hours).

Quantity of Rasa dhatu:-

Rasa dhatu is a *drava dhatu* (in liquid form). The quantity of *rasadhatu* is measured by *anjali*



praman and is said to be nine *anjali* in *swastha* individuals ¹⁴.

Panchabhautika constitution and properties:-

The attributes of *rasa dhatu* are *drava* (liquidity), *sara* (fluidity), *manda* (dull), *snigdha* (unctuous) *pichchila* (viscous) ,*sheeta* (cold) and *soumya* (mild) reflecting its *jalamahabhuta* predominance¹⁵.

Types of rasa:-

Rasa is of two types ¹⁶.

1. Poshya (Sthaayi) rasa: - Fully formed *rasa dhatu* is known as *poshya rasa*. It is also called as *Sthaayi rasa dhatu*.

2. Poshak rasa:-

The *rasa* which nourishes is called *poshak rasa*. The essence of the digested food formed in the gut and coming to the heart to be distributed all over the body is called *poshak rasa*. It is also called as *anna rasa* (essence of food). *Poshak* and *Poshya rasa* flow in same channels hence cannot be identified separately.

Location of rasa dhatu:-

Rasavahasrotas:- *Srotas* are the channels through which circulation of transforming *dhatu* (*parimanaapdyaman Dhatu*) takes place. It also acts as shelter for that particular *dhatu*. *Rasa dhatu* is located in *rasavaha strotas*. The *mula sthana* of *rasavaha strotas* is *hrudya* and its associated ten *dhamanias* ¹⁷. According to Acharya Sushruta *hrudya* and *rasavahi dhamanis* are *mulasthana* of *rasavaha strotas* ¹⁸.

Circulation of rasa dhatu:-

The prime function of *rasa dhatu* is *preenana*. For accomplishing this function it has to be circulated

throughout the body. *Vyan vayu* is located in the *hrudya* and is responsible for the circulation of *rasa dhatu*. The circulation of *rasa* in upward, downward and lateral directions is suggested by the words *archi*, *jala* and *shabda santanvat* ¹⁹.

According to Acharya Sushruta the four *tiryaga damini* further divide and re-divide to form capillary network and through this network *rasa dhatu* is circulated ²⁰.

Functions of rasa dhatu ²¹:-

- The prime function of *rasa dhatu* is *Preenana*. The Sanskrit meaning of *preenana* is *aapyaayanam* or *trupti* which means to satisfy or gratify. *Rasa dhatu* gratifies all *dhatu*s as well as *indriya*.

- The functions of *prakrut rasa dhatu* are explained depending on the age of the person. In *balya awastha* the function of *rasa dhatu* is *vardhana* (growth and development of *dhatu*) while in *madhya awastha*; it is responsible for *dharana / jeevana*. (Stabilizing and maintaining the *dhatu*) Whereas in *vardhakyawastha* its function is *yapana* (preventing the total deterioration of *dhatu*)

- Irrespective of age it also function as *tarpana* (nourishment of body), *snehana* (oleation/ lubrication) and *avashtambhana* (sustaining the body)

- *Raktapushti* function of *rasa dhatu* can be understood by the fact that *rakta poshakansh* are formed during *rasa dhatu* formation.

- It is also responsible for *tushti* (satiety)

Rasa dhatu and Oja:-



Oja is the purest, finest essence formed from all seven *dhatu*. Just like *ghruta* is present in a dormant form in *milk*, *oja* is present in every tissue of the body in the dormant form and is manifested as supreme quality after its proper metabolism²². This *oja* is circulated all over the body with *rasa dhatu* and *rakta dhatu* through *ojovaha sira*²³. These channels originate from the *hrudya*. The *para oja* is located in the *hrudya*. The *apara oja* which is formed during the metabolism of each *dhatu* manifests in the form of the essence of *dhatu*.

Causes of vitiation²⁴:-

Vitiation of *rasavahasrotas* occurs due to *aahariya hetu* like *atiguru, atisnigdha, atisheet* and *atimatra aahara*. *Manas hetu* like *atichintan*.

Rasa pradhoshaj vikaar²⁵:-

The principal cause of all the diseases is *agnimandya*. This directly affects the formation of *rasa dhatu*. Vitiation of *rasa dhatu* may lead to various diseases ranging from *ashraddha, pandu roga, jwara, sthauilya, karshya, klaibya*, etc.

B. CONCEPTUAL STUDY OF EXTRA CELLULAR FLUID (ECF)²⁶:-

Water is the principal fluid medium for cells. Total body fluid is divided into intracellular (ICF) and extracellular fluid (ECF). ICF contributes about 2/3rd part of total body fluid. ECF contributes the remaining 1/3rd part of total body fluid. ECF denotes all body fluid outside the cell. ECF comprises of three compartments namely interstitial fluid with lymph, intravascular fluid i.e. plasma and transcellular fluid. The fluid which is present in the interstitial space is known as

interstitial fluid or tissue fluid. Interstitial fluid flowing in lymphatics is called as lymph. Plasma is the fluid which is present in the blood vessels. The fluid present in the epithelial lined spaces is known as transcellular fluid.

Volume: - The volume of extracellular fluid in a young adult male of 70 kg is 20% of body weight i.e. about fourteen liters. Eleven liters is interstitial fluid and the remaining three liters is plasma.

Composition:-

Substances in the ECF include dissolved gases, nutrients and electrolytes all needed to maintain life. The ECF also contains materials secreted from cells in soluble form, but which quickly coalesces into fibers (e.g. collagen, reticular, and elastic fibers) or precipitates out into a solid or semisolid form (e.g. proteoglycans which form the bulk of cartilage, and the components of bone). These and many other substances occur, especially in association with various proteoglycans to form the extracellular matrix or the "filler" substance between the cells throughout the body. These substances occur in the extracellular space, and are therefore all bathed or soaked in ECF.

Functions:-

Extracellular fluid provides internal environment for the cell.

The extracellular fluid provides the medium for the exchange of substances between the ECF and the cells.

Cells can survive, grow and perform their functions as the necessary constituents are present in this internal environment.



Interstitial fluid:-

Interstitial fluid is the body fluid between blood vessels and cells, containing nutrients from capillaries by diffusion and holding waste products discharged out by cells due to metabolism. Plasma and interstitial fluid are very similar because water, ions, and small solutes are continuously exchanged between them across the walls of capillaries, through pores and capillary clefts.

*Composition*²⁷ :-Interstitial fluid consists of a water as a solvent containing various solutes like sugars, salts, fatty acids, amino acids, coenzymes, hormones, neurotransmitters, white blood cells and cell waste-products. This solution accounts for 26% of the water in the human body. The composition of interstitial fluid depends upon the exchanges between the cells in the biological tissue and the blood. This means that tissue fluid has a different composition in different tissues and in different areas of the body.

The composition of interstitial fluid and plasma are almost similar except presence of red blood cells in plasma. The ionic composition of the interstitial fluid and blood plasma slightly differs depending on concentration of cations and anions between the two fluid compartments.

Functions:-

It provide the medium which supplies all the immediate requirements of the cell.

It is great reservoir of water, salts and nutrients

*Plasma*²⁸:- Blood plasma is a straw coloured liquid component of blood in which the formed

elements of the blood are suspended. It contributes about 55% of the body's total blood volume.

Composition: - It is mostly water (up to 95% by volume) and contains important dissolved proteins (6–8%). The protein includes serum albumins, globulins, and fibrinogen. Glucose, clotting factors, electrolytes (Na⁺, Ca²⁺, Mg²⁺, HCO₃⁻, Cl⁻, etc.), hormones, carbon dioxide and oxygen are also present.

Functions:-

Albumins are abundant in plasma. The main function of albumin is to maintain the osmotic pressure of blood.

Among the globulins, immunoglobins are important for the immune system.

Fibrinogens are one of the main blood clotting factors which helps in hemostasis.

Plasma transports hormones and other compounds throughout the body.

*Lymph*²⁹:-

Lymph is clear, watery appearing fluid found in lymphatic vessels. Lymphatic vessels present in the villi of small intestine are known as lacteals. They are filled with milky white fluid, chyle. The extracellular fluid collects into lymph capillaries is called as lymph. The lymphatic vessels carry it back to the blood.

Composition: - it contains water, mostly lymphocytes, proteins (including antibodies), lipid, carbohydrates and electrolytes.

Functions:-

Lymph returns coarse proteins and drains excess interstitial fluid to the blood stream.



It helps in transporting lipids from the digestive system (beginning in the lacteals) to the blood via chylomicrons.

It is also responsible for immune responses against particular microbes or abnormal cells through T lymphocytes and B lymphocytes.

*Transcellular fluid*³⁰:-

Transcellular fluid is formed from the transport activities of cells, and is the smallest component of extracellular fluid. These fluids are contained within epithelial lined spaces. Examples of this fluid are cerebrospinal fluid, aqueous humor in the eye, serous fluid in the serous membranes lining body cavities, perilymph and endolymph in the inner ear and synovial fluid etc.

Composition: - Transcellular fluid's composition is dependent on its location. Usually some of the electrolytes present in the transcellular fluid are sodium ions, chloride ions, and bicarbonate ions.

Function: - As it is a specialized type of extracellular fluid its function varies depending on its composition and location where it is present.

DISCUSSION

The word *rasa* is used in Ayurveda in many contexts like *Garbharasa* denotes vitality in embryonic life. This is transformed into unctuous body fluids. It is known as '*sharira rasa*' in later life leading to the formation of *oja*.

Madhur, amla, lavana, katu, tikta and *kashyaya* are the six *rasa* (taste) of *aahar*.

Parad (mercury) is also known as *rasa*. The branch of Ayurveda related to the study of *parad* (*rasa*) is known as *Rasashastra*.

Rasa dhatu is the first *dhatu* among the seven *dhatu*s explained in Ayurveda. Present article is related to this *rasa dhatu*.

Rasa dhatu is first to be formed from *aahar*. Two types of *rasa dhatu* are formed after *aahar* under goes digestive and metabolic changes by *jatahagni* and *dhatvagni* respectively. These two types of *rasa* namely *sthayi* and *Poshak rasa dhatu*. The *poshak rasa dhatu* is also known as *aahar rasa*. *Sthayi* (*poshya*) *rasa dhatu* is fully formed *rasadhathu*.

Poshak rasa dhatu can be correlated with chyle which is milky bodily fluid. It is formed in the intestine as end product of digested fatty food and taken up by lymph vessels specifically known as lacteals. Finally it enters into the heart and circulates throughout the body. Chyle contains nutritious portion required for the tissues.

The existence of *purusha* depends upon *rasa*. The quality of *rasa* is directly responsible for the quality of other tissues, promoting health, immunity and longevity as its properties. Therefore, one should protect and maintain the quality and quantity of *rasa dhatu* with utmost care. It can be achieved through proper diet and lifestyle. *Vyana vayu* located in heart is responsible for *rasasanvahana*, which includes *rasa, rakta* and *aahar rasa* circulation.

In human body among the two types of body fluids, extracellular body fluid (ECF) may be compared with *poshya rasa dhatu*. The main



composition of ECF is water it is about 97%. This can be compared with *jala mahabhoot pradhanya* of *rasa*.

According to *nirukti* of *rasa dhatu* it is constantly circulated throughout the body. Plasma and lymph which are the compartments of ECF are also constantly circulated through circulatory and lymphatic system respectively. This can be considered as the similarity between *rasa dhatu* and ECF.

Main organ of circulatory and lymphatic system is heart. The *moolsthan* of *rasavaha srotas* is *hrydya*. This denotes the similarity in location of *rasa dhatu* and ECF.

Plasma is straw color while lymph is clear colorless fluid which may be compared with the *shweta varna* of *rasadhatu*.

The principal function of *rasa dhatu* is '*preenan*'. All the cells of the body are surrounded by the interstitial fluid. The interstitial fluid bathes the cells and helps in providing nourishment to the cells. Glucose, proteins and other micronutrients are transported to the cell by various processes which include diffusion, facilitated diffusion, osmosis, active transport, etc. After receiving their micro nutrients the cells become gratified and efficient to perform their functions. This can be correlated with *preenan* function of *rasa dhatu*.

Transcellular fluid's main function is to lubricate cavities formed by the epithelial cells. Sometime it acts as an electrolyte transporter. This function of transcellular fluid corresponds to *snehana* and *tarpan* properties of *rasa dhatu*.

From literary review, *oja* and *rasa dhatu* are similar in properties. One of the cardinal functions of *oja* is *vyadhikshmatva*. *Rasa dhatu* is medium of circulation for *apara oja* to carry out its function of immunity. The immunoglobins and lymphocytes (B and T Lymphocytes) which are present in plasma and lymph respectively are responsible for immunity.

Acharya Vagbhat states that *rasa* is similar to *kapha dosha*. *Rasa dhatu* is one of the *ashraya sthana* for *kapha dosha*. Among the sub types of *kapha Shleshak, tarpak, avalambak* are usually compared with synovial fluid, cerebro spinal fluid and pleural fluid along with pericardial fluid respectively. These fluids are examples of transcellular fluid. They provide lubrication, nourishment and drain waste product from these areas. They also reflect the *snehan, tarpan, preenan* and *avasthambhana* function of *rasa dhatu*.

CONCLUSION

- The vitality of *rasa dhatu* is clearly explained in Ayurvedic classical texts.
 - Out of the two types of *rasa dhatu*, *poshya rasa* may be correlated with Extra cellular fluid as there are similarity in their properties, location and functions.
 - *Poshak rasa* may be correlated with chyle as it supplies essential nutrients.
 - *Rasa dhatu* provides medium for circulation of *apara oja*.
 - Sub types of *kapha* (*Shleshak, tarpak, avalambak*) may be compared
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synovial fluid, cerebro spinal fluid and pleural
fluid along with pericardial fluid.



REFERENCES

1. Vd. Trikamji Jadhavaji Acharya, Charak Samhita of Agnivesha, elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Sutrasthan 1, Deerghajeevitiya Adhyaya, Verse 46, Edition reprint, Chaukhamba, Varanasi, 2011, pg 11.
2. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri. Gayadasacharya on Sutrasthana 15, Doshdhatumala kshaya vrudhi vidnyaniyam, Verse 3, VIth edition Chaukhamba Orientalia, Varanasi, 1997, pg 67.
3. Pt. Bhisagacharya hari shastri Paradkar, Ashtang hruday of Vagbhata, commentary by Arundutta and Hemadri, Sutrasthana 1 Aayushkamiya aadhaya, Verse 13, Collected by Dr. Anna moreshwar Kunte and Krishnamchandra shastri navre, Edition reprint, Krishnadas Academy, Varanasi, 2000, pg 10.
4. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri. Gayadasacharya on Sutrasthana 14, Shonitavarnaniya adhyaya, Verse 12, VIth edition Chaukhamba Orientalia, Varanasi, 1997, pg 62.
5. Vd. Jadhavaji Trikamji Acharya, Charak Samhita of Agnivesha, elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Sutrasthan 30, Arthedashamahamuliya adhyaya, Verse 8, Edition reprint, Chaukhamba, Varanasi, 2011, pg 185.
6. Pt. Bhisagacharya hari shastri Paradkar, Ashtang hruday of Vagbhata, commentary by Arundutta and Hemadri, Sutrasthana 11 Doshadi vidnyaniya aadhaya, Verse 26, Collected by Dr. Anna moreshwar Kunte and Krishnamchandra shastri navre, Edition reprint, Krishnadas Academy, Varanasi, 2000, pg 186.
7. Guyton and Hall, Text book of medical Physiology, XIIth Edition, Chapter I, Functional organization of the Human body and control of the Internal Environment, Elsevier publication, Reprint 2011, pg 03.
8. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri. Gayadasacharya on Sutrasthana 14, Shonitavarnaniya adhyaya, Verse 13, VIth edition Chaukhamba Orientalia, Varanasi, 1997, pg 62.
9. Vaman Shivram Apte, The practical English Sanskrit dictionary, Bharatiya Grantha Niketan, New Delhi, 2007, pg 796.
10. Pt. Bhisagacharya hari shastri Paradkar, Ashtang hruday of Vagbhata, commentary by Arundutta and Hemadri, Sutrasthana 13 Doshopakramaniya aadhaya, Verse 25, Collected by Dr. Anna moreshwar Kunte and



Krishnamchandra shastri navre, Edition reprint, Krishnadas Acadamy, Varanasi, 2000, pg 216.

11. Vd. Jadhavaji Trikamji Acharya, Charak Samhita of Agnivesha, elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Nidansthan 1, Jwarnidanam adhyaya, Verse 23, Edition reprint, Chaukhamba, Varanasi, 2011, pg 200.

12. Vd. Jadhavaji Trikamji Acharya, Charak Samhita of Agnivesha, elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Sutrasthan 28, Vividhashitapitiya adhyaya, Verse 4, edition reprint, Chaukhamba, Varanasi, 2011, pg 175

13. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri. Gayadasacharya on Sutrasthana 14, Shonitavarnaniya adhyaya, Verse 15, Edited by VI th edition Chaukhamba Orientalia, Varanasi, 1997, pg 62.

14. Vd. Jadhavaji Trikamji Acharya, Charak Samhita of Agnivesha, elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Sharir Sthana 7, Sharirsankhyasharir adhyaya, Verse 15, Edition reprint, Chaukhamba, Varanasi, 2011, pg 339.

15. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of

Shri. Gayadasacharya on Sutrasthana 14, Shonitavarnaniya adhyaya, Verse 3, VI th edition Chaukhamba Orientalia, Varanasi, 1997, pg 59.

16. Vd. Jadhavaji Trikamji Acharya, Charak Samhita of Agnivesha, elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Sutrasthan 28, Vividhashitapitiya adhyaya, Verse 3, Edition reprint, Chaukhamba, Varanasi, 2011, pg 175.

17. Vd. Jadhavaji Trikamji Acharya, Charak Samhita of Agnivesha, elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Viman Sthana 5, Strotoviman adhyaya, Verse 8, Edition reprint, Chaukhamba, Varanasi, 2011, pg 250-251.

18. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri. Gayadasacharya on Sharirasthan 9, Dhamanivyakaraniya adhyaya, Verse 12, VI th edition Chaukhamba Orientalia, Varanasi, 1997, 386.

19. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri. Gayadasacharya on Sutrasthana 14, Shonitavarnaniya adhyaya, Verse 19, VI th edition Chaukhamba Orientalia, Varanasi, 1997, pg 63.

20. Vd. Jadhavaji Trikamji Acharya, Sushruta Samhita of Sushruta,



- Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri.Gayadasacharya on Sharirasthan 9,Dhamanivyakaraniya adhyaya,Verse 8,9,VI th edition Chaukhamba Orientalia,Varanasi,1997, pg 385.
21. Vd. Jadhavaji Trikamji Acharya,SushrutaSamhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri.Gayadasacharya on Sutrasthan 14,Shonitavarnaniya adhyaya,Verse 3,VI th edition Chaukhamba Orientalia,Varanasi,1997, pg 59.
22. Vd. Jadhavaji Trikamji Acharya,SushrutaSamhita of Sushruta, Nibandhasangraha Commentary of Shri Dalhanacharya Nyaychandrika Panjika of Shri.Gayadasacharya on Sutrasthan 15,Doshdhatumala kshaya vrudhhi vidnyaniyam,Verse 19, VI th edition, Chaukhamba Orientalia,Varanasi, 1997, pg 71.
23. Vd. Jadhavaji Trikamji Acharya,Charak Samhita of Agnivesha,elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta,Sutrasthan 30, Arthedashamahamuliya adhyaya ,Verse 8, Edition reprint,Chaukhamba, Varanasi,2011, pg 185.
24. Vd. Jadhavaji Trikamji Acharya,Charak Samhita of Agnivesha,elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta, Viman Sthana 5, Strotoviman adhyaya ,Verse 13, Edition reprint,Chaukhamba,Varanasi,2011, pg 251.
25. Vd. Jadhavaji Trikamji Acharya, Charak Samhita of Agnivesha,elaborated by Charak and Dridhabala with Ayurved dipika vyakha by Chakrapanidatta,Sutrasthan 28, Vividhashitapitiya adhyaya ,Verse 9-10, Edition reprint,Chaukhamba, Varanasi,2011, pg 179.
26. Dr. C. C. Chatterjee,Human Physiology Volume I, Chapter V,Body fluid,lymph, lymphnode(Lymph glande),spleen and reticulo endothelial system, Medical allied agency,Kolkata, 2011, pg 188.
27. Widmaier, Eric P, Hershel Raff, Kevin T,Strang,Vander's Human physiology: The mechanism of body Function, Body fluid Compartment, 14th Edition, Mcgraw-hill,New york, 2016, pg 400-401.
28. Tortora gerard J, Derrickson Bryan, Principles of Anatomy and physiology, Chapter 19, The cardiovascular system: The Blood,XIth edition,John wiley and sons,2006, pg 669.
29. Sujit K Chaudhuri, Concise medical physiology, Chapter 13, Lymphatic circulation,New central book agency (P)Ltd,Kolkata, Revised reprint 2011, pg 263.
30. Guyton and Hall, Text book of medical Physiology, XIIth Edition, Chapter 25,The Body fluid compartments: Extra cellular and intra cellular fluid: Edema, Elsevier publication, Reprint 2011, pg 286.