ISSN 2456-432X SJIF: 4.819 JIF: 0.9127

IJOOAR

INDIAN JOURNAL OF ODYSSEY OF AYURVEDIC RESEARCH

CORRELATIONAL STUDY OF AGNI AND THYOID HORMONES IN THE CONCEPT OF AYURVEDA

1. **Dr.Pragati Vilasrao Patil,**

Reader, Rognidan Department, Sai Ayurved College and Research Centre, Sasure-Vairag, Tal.Barshi, Dist. Solapur.

2. **Dr.Ujavala Vilas Dabade**

Professor, Dept. of Swasthvrita, College of Varanasi

ABSTRACT:

Agni is the most important mahabhoot in the universe which is termed as Tej Mahabhoot responsible for utpatti-sthiti-laya of the prakriti and similarly of purusha too. According to the acharyas if agni is functioning properly person becomes chirangivi and if becomes vikrut person becomes diseased and if agni becomes silent person too becomes silently dead. Similarly thyroid hormones too functions in anabolism and catabolism of body. So we can correlate agni with thyroid hormones.

Key Words- Agni , utpatti-sthiti-laya , thyroid

INTRODUCTION:

Agni which is the cause of bala of purusha is the basic concept of Ayurveda which has described as an important factor of digestion and metabolism in our body. Agni is Cause of Life, Complexion, Health and Nourishment.[1] Agni means pitta which does favourable and unfavourable functions like digestion and indigestion of food, vision and diminished vision, hotness and coldness of body, normal and abnormality in skin tone, fear, anger, happiness etc [2] . All diseases are caused due to Mandagni[3,4]

The Health of individual depends on diet and life style. These two factors play major role. As a result of rapid Modernization, Consumption of baked food, half fried vegetables, occupational status, sleeplessness, lack of exercise, stress, depression, anxiety etc. there is impairment of Digestion and Metabolism which is the cause of one of the life style disorders like Thyroid disorders.

Thyroid hormones secreated from thyroid gland plays major role in metabolism of our body. Hence work of agni can be compared with functions of thyroid hormones. Viceversa disturbance in their functions can be taken as agnidushti and treated accordingly

AIM:

To study the concept of Agni and its corelation with thyroid hormone,

OBJECTIVES:

1. To study the concept of agni from ayurvedic literature.
2. To study the functions of thyroid hormones from modern literature.
3. To study co-orelation between Agni and Thyroid Hormones.

MATERIALS AND METHOD:

Concepts are studied from different classical texts of Ayurveda,Modern literature and newer journals. These concepts are then co-orelated.

LITERATURE REVIEW:

Agni and Pitta Dosha:

Pitta in the body represents the Agni (Jatharagni). This Pitta does normal and abnormal functions like digestion-indigestion, vision diminished vision, normal-abnormal temperature, skin tone, fear, anger, happiness, sadness in its balanced and imbalanced state in body. [8,9]

Concept of Agni In Ayurveda

Concept of Agni is very broad, Agni is represented by Pitta of body. It clearly means that the cause of life is Agni and balanced Agni is key to good health. All the diseases are caused due to Vikrut Agni, it includes Mandagni, Tikshnagni and Vishmagni. The Sanskrit word Agni, implying its correlation with the various digestive juices of the stomach, small intestines and related exocrine glands. Agni maintains the integrity of the body by converting consumed foods into cellular level and body structures, through Pakadi karmas or bio chemical processes, however, when the stages of Ayurveda speak of Agni with respect to a living organism, it has a much broader significance. Foods are converted into various physical, structural and functional constituents with the help of Jatharagni, Bhutagni and Dhatvagni. This biological energy necessary for the mental, emotional and other vital human activities. In Sushrut Samhita it is stated that, Agni is present everywhere, in different forms of energy, it is present in all living and non-living things in different form, Agni is cause of life, responsible for food digestion and responsible for Ras Utpatti. But due to invisibility of it like atom, whole description of Agni is very difficult [10] . Thus, it is clear that this term Agni, can be something far more comprehensive. Agni represents the divine essence or celestial fire present in every atom of the universe.

Types Of Agni:

1. According to Darshana Shastra – Tarka Sangraha[11]

    a. **Nitya Agni**- Paramanu Rupa

    b. **Anitya Agni**- Kaarya Rupa

Jatharagni is one of type of Anitya Agni also known as Audarya Agni and it does the vital function of metabolism of the food taken.

2.According to Bruhatrayee[12] Agni is divided into thirteen subtypes.

Ayurvedic literature mainly has focus on Jatharagni.

a) **Jatharagni:** 1

b) **Panchbhautik Agni**: 5 types.

c) **Dhatvagni**: 7 types.

Agni is innumerable because of its presence in each and every Dhatu Paramanu (cell) of the body. But, enumeration of the number of Agni is varies in various classical Ayurvedic texts, as shown below.

1. Charaka has mentioned about 13 Agnis [13] .

Jatharagni – 1, Bhutagni – 5, Dhatvagni – 7

2. According to Sushruta, five types of Agnis are illustrated, viz. Pachakagni, Ranjakagni, Alochakagni, Sadhakagni and Bhrajakagni.

However, there is an indirect reference of five Bhutagnis underlying in the brief description made to the transformation of food stuff [14]

3. Vagbhata has described different types Agni, viz. – Bhutagnis – 5, Dhatvagni – 7, Dhoshagni – 3 and Malagni – 3 [15] .

4. Sharangadhara has stated five Pittas only (Pachak, Bhrajak, Ranjak, Alochaka and Sadhak) [16] .

5. Bhavamishra has followed Acharya Charaka and Vagbhata[17] .

Jatharagni (Defination): -

Agni is collective energy formed due to the action of Dosh, Dhatu and Mala within the body. The pitta secreted for the assimilation of food represents Jatharagni[18] . - Jatharagni is prime Agni which dwells in the body consists of five elements. After the complete assimilation of taken food, Production of Aahar-Rasa leads to enhancement and mitigation of all SharirBhavas. This activity

is done by Jatharagni[19] . - Jatharagni is invisible, so it can be understood by its activities within the body. The origin and growth of Panchbhautik-sharir is totally depends upon it. So it is also said to be God, Ishwar (Almighty)[20] .

Jatharagni(Location): -

Jatharagni is the prime one amongst all Agni. As per Charak it is located at Grahani where it confines, explore, and metabolize the ingested Chaturvidha-Ahara[21] .

- Grahani is situated inside Sharira between Amashaya and Pakvashaya[22] .
- As per Bhela Samhita, it is stated that Agni is located in the Surya mandala, which is situated in Soma Mandala and Soma Mandala is located at Nabhi (umbilicus)[23] .

Types of Jatharagni as per Dosha: -

Being prime of all Agni, Jatharagni exists in four types as per Tridosh in Panchabhoutik Sharira. 1. Samagni 2. Vishamagni 3. Tikshagni 4. Mandagni - Depending on the predominance of dosha Agni would be seen in various forms.

- Vata prakriti-Vata predominance- Vishamagni-VataVikara
- Pitta prakriti-Pitta predominance -Tikshagni-Pitta vikara
- Kapha prakriti-kapha predominance -Mandagni-Kaphavikara –

Equilibrium of all dosha-samagni-strong immune system.

Bhutagni:

1. Parthivagni
2. Aapyagni
3. Tejasagni
4. Vayavagni
5. Nabhasagni –

These Agni exists in all substance including the food and drug as well. Their workplace is Koshta. It digests Parthivadi food into the components resulting in Bhutgunas like for eg.Murtatva,

Kathinya, Snehata and Mardavata[42] . [23] - After broken down of food, these Agni's reactivate itself in Dhatugat Srotas. Primarily Jatharagni acted on the food we eat and mechanical breakdown occurs then Bhutagnis action took place on it. After that remaining process of digestion occurs in Dhatugat Srotas by Dhatvagni with the assistance of Samanvayu. This complete process is conducted in Pittadhara Kala. [24][7]

Dhatvagn:

Dhatvagni is divided into seven subtypes

1. Rasagni
2. Raktagni
3. Masagni
4. Medogni
5. Asthigni
6. Majjagni
7. Shukragni. -

Digestion involves action of Jatharagni having trace elements called Dhatvagni which helps in conversion of PanchbhautikAhara into the components for normal body function. - This process involves various organs along with Dhatugat Srotas through which nutrients get absorbed and transported to each and every cell of the body after assimilation of food. - These various nutrients nourish entire organs and all the systems of body. To sustain growth food must have all nutritional values with vitamins and minerals. [25]

Types of Agni and its Function [26]

Agni	Function
1.Jatharagni	Jatharagni is the most important one, which digests four types of food and transforms it into Rasa and Mala. Digestion of Ahar-rasa
2.Dhatvagni	The seven Dhatvagni act on the respective Dhatus by which each Dhatu is broken into three parts
3.Bhutagni	Five Bhutagnis act on the respective Bhautika portion of the food and thereby nourish the Bhutas in the body.

Type of Agni and Parikshana

Types of Agni	Parikshana
Jatharagni	Jaran, Abhyavaharan[27]
Sapta-Dhaatvagni	Dhatu Kshaya-VruddhiLakshana[28]
Pancha-Mahabhutagni	Guna- Karma Parikshana

Agni and Kaarya Kaarana Bhava Siddhanta[29]

Ayurveda accepts the theory which concludes that no Kaarya (output) is without Kaarana (cause) is not possible. So, there is reason behind every cause in this universe. Agni plays the role of Kaarana to perform Kaarya's such as Paaka (metabolism), Utsaaha, Kshudha (appetite), Medha, Varnya etc. It is not only Kaarana for these processes, but is a Samvaayi-kaarana means, if it gets disturbed or destroyed those processes also gets hampered. So, we should always give prime importance for nurturing Agni and maintaining its Sama Avasthaa.

Effect of Jatharagni, Bhutagni and Dhatvagni on food

Among all Agni Jatharagni plays an important role, after taking food process of Jatharagni takes place, from which Ahaar Ras formed by Saar Vibhajan. After that, Bhutagni plays important role, due to bhutagni this Ahar Ras is converted into cellular level food which can readily available for body. Then after that Dhatvagni plays important role this Agni is responsible for conversion of this Ahaar Ras into Rasadi dhatu and poshak Ras. From which Uttarottar Dhatu utpatti takes place.

Thyroid Hormones [33]

Thyroid gland secretes three hormones:

1. Tetraiodothyronine or T4 (thyroxine)
2. Tri-iodothyronine or T3
3. Calcitonin.

T4 is otherwise known as thyroxine and it forms about 90% of the total secretion, whereas T3 is only 9% to 10%. Potency and Duration of Action [34] The potency of T3 is four times more than that of T4. T4 acts for longer period than T3. Duration of T4 action is four times more than T3 action. This is because of the difference in the affinity of these hormones to plasma proteins. T3 has less affinity for plasma proteins and combines loosely with them, so that it is released quickly. T4 has more affinity and strongly binds with plasma proteins, so that it is released slowly. Therefore, T3 acts on the target cells immediately and T4 acts slowly.

Half-life [34]

Thyroid hormones have long half-life. T4 has a long half- life of 7 days. Half-life of T3 is varying between 10 and 24 hours.

Rate of Secretion [34]

Thyroxine = 80 to 90 µg/day

Tri-iodothyronine = 4 to 5 µg/day

Reverse T3 = 1 to 2 µg/day.

Plasma Level [34]

Total T3 = 0.12 µg/dL

Total T4 = 8 µg/dL.

Metabolism of Thyroid Hormones [34]

Degradation of thyroid hormones occurs in muscles, liver and kidney.

Test	Abbreviations	Typical ranges
Free Thyroxine	FT4	0.7-1.9 ng/dl
Free Thyroxine	T4	4.6-12 ug/dl
Thyroid hormone binding ratio	THBR	0.9-1.1
Serum Triiodothyronine	T3	80-180 ng/dl
Free Triiodothyronine	FT3	230-619 pg/dl
Serum Thyrotropin	TSH	0.5-6 uU/ml
Serum Thyroglobulin	Tg	0-30 ng/ml
Thyroxine binding globulin	TBG	12-20 ug/dl T4 + 1.8 ugm

DIFFERENCES BETWEEN T3 AND T4

Parameter	T3	T4
Secretion	30 microgram/day	80 microgram/day
Sources	20-25% by gland	70-80% by conversion Solely by gland
Half-life	1 day	7 days
Potency	3-4 times more potent than	Potent
Binding	0.2% in unbound	0.02% in unbound

ACTIONS OF THYROID HORMONES:

Administration of T4 or T3 or the pathologic or iatrogenic absence of these hormones produces general effects on intermediary metabolism and has particular effects on specific organ systems.

1) FETAL DEVELOPMENT:

Thyroid hormones are critically important in fetal development, particularly of the neural and skeletal systems.

2) OXYGEN CONSUMPTION & HEAT PRODUCTION:

The basal metabolic rate increases in hyperthyroidism and decreases in Hypothyroidism. Postnatally, thyroid hormones increase O2 consumption in all tissues except the brain, spleen and testis. Compared to the effect of TSH on thyroid hormone secretion, most thyroid hormone actions on peripheral tissues are induced relatively slowly over a period of hours or days. For example, T4 administration to hypothyroid patients does not increase oxygen consumption until 24-48 hours after its administration. T3 acts more rapidly than T4 but still over a period of hours.

3) CARDIOVASCULAR SYSTEM:

Thyroid hormones have marked Chronotropic and Inotropic effects on the heart. Low cardiac output with bradycardia and slow myocardial contraction and relaxation are characteristic of Hypothyroidism. The reverse occurs in hyperthyroidism. The force of contraction in Hypothyroidism is normal.

4) SYMPATHETIC EFFECTS:

Many thyroid hormone effects, particularly on the cardiovascular system, are similar to those induced by catecholamines. The patients of Hypothyroidism are more sensitive to catecholamines. Thyroid hormones increase the number of catecholamine receptors in heart muscle cells. Hepatocyte receptors are unaffected. Thyroid hormones may also amplify catecholamine action at a post receptor site. Beta adrenergic inhibition reverses some features of clinical hyperthyroidism, such as eyelid retraction and tachycardia. However other thyroid hormone actions e.g. Effect on O2 consumption are not prevented by beta adrenergic blockade. It is clear, therefore, that thyroid hormone action is distinct from catecholamine action.

5) PULMONARY EFFECT:

Thyroid hormones are necessary for normal hypoxic and hypercapnic drive to the respiratory centers.

6) CALCIUM AND PHOSPHORUS:

Excessive hormone removes calcium and phosphorus from bones leading to Osteoporosis. It also increases calcium loss in feaces and urine.

7) HAEMATOPOIESIS:

Thyroid hormones increase Erythropoiesis, possibly because of increase O2 utilization by tissues leading to increased erythropoietin production. Thyroid hormones also increase 2,3-disphosphoglycerate concentrate in erythrocytes, allowing increased O2 dissociation from hemoglobin and thereby increasing O2 availability to the tissues.

8) ENDOCRINE SYSTEM:

Thyroid hormones have a general effect in increasing the metabolism and clearance of various hormones and pharmacologic agents. Thus, administration of thyroid hormones will increase cortisol production and clearance, but the plasma cortisol concentration remains unchanged. Serum prolactin levels are increased in about 40% of patients with primary Hypothyroidism. When present, this abnormality is corrected by treatment thyroid hormone. Insulin requirements in diabetic are frequently increased in hyperthyroidism.

9) CALCIUM AND PHOSPHORUS:

Excessive hormone removes calcium and phosphorus from bones leading to Osteoporosis. It also increases calcium loss in faeces and urine.

10) MUSCULOSKELETAL SYSTEM

Hormones have a potent stimulatory effect on bone turnover increasing both bone formation and resorption. This is associated with increased urinary hydroxyproline excretion. Hypercalcemia is occasionally observed in severe hyperthyroidism. Thyroid hormones increase the rate of muscle relaxation as measured by elucidation of the deep tendon reflexes.

11) PROTEIN METABOLISM:

Thyroxine in physiological doses has a protein and anabolic effect including enhancement or growth of all bodily tissues. This effect has been observed in absence of pituitary hormone. Toxic amount does not show such effect.

12) FAT METABOLISM:

The serum cholesterol and phospholipid rise in hypothyroid state, e.g. cretinism and myxedema. In hyperthyroidism the serum cholesterol falls. This is partly due to the increased excretion of cholesterol in the bile and partly due to destruction in the liver. In hypothyroid state, after depletion of carbohydrate reserve due to increased oxidation, there is an enhanced breakdown of depot fat and so a rise in ketone body formation. On the other hand during thyroid deficiency, increase in depot fat is usually not observed.

13) MAMMARY GLANDS:

Increases the output and fat content of milk.

14) SEXUAL GROWTH:

Thyroid controls the normal functions of gonads. In cretins there is retardation of the gonadal growth and secondary sex characters do not appear. In myxedema due to hypofunction of gonads amenorrhoea occurs in women

Role of Agni and Thyroid Hormone Function

Sr.No.	Functions of Agni [30]	Thyroid Hormone.Functions [31]	Hypothyroidism	Hyperthyroidism
1	Paaka	Calorigenic action, Regulates metabolism of carbohydrates, proteins, fats	BMR falls by 20-40%	BMR increases by 60-100%
2	Bala	Essential for normal activity of skeletal muscles times per second)	Weakness of muscles	Muscular Tremor (frequency 10-15 times per second)
3	Utsaha	Essential for normal sexual function	Loss of libido,	lethargy Loss of libido, impotency
4	Matravatushma	Induced Thermogenesis	Cold intolerance	Excess sweating
5	Kshudha	Increases Secretion and movements of GI tract	Decreased appetite	Craving
6	Medha	Stimulating factor for nervous system increases blood flow to brain	Impaired memory, inability to concentrate	Irritability
7	Varna	Necessary factor for Erythropoiesis	Pallor	Increased skin pigmentation

Role of Dhaatvagni and Thyroid Hormone Function and its Disorders :

Dhaatwagni	**Functions of Dhatu [32]**	**Thyroid Hormones Functions [31]**	**Thyroid Disorders [31 Hyperthyroidism**	**Hyperthyroidism**
Rasaagni	Preenana	Metabolites causes vasodilation so blood flow increases.	Heart rate decreases	Systolic Hypertension
Raktaagni	Jeevana	Necessary factor for Erythropoiesis Anaemia	Anaemia	
Mamsaagni	Lepa	Essential for normal activity of skeletal muscles	Weaknes s of muscles	Muscular Tremor
Medaagni	Snehana	Maintaining the weight of body Decreases cholesterol, triglycerides levels in plasma	Increase in body weight.	Weightloss
Asthyagni	Dharan	Closure of epiphysis under the influence of thyroxine	Stunted growth, hair fall	Deformed bones and teeth
Majjaagni	Purana	Stimulating factor for central nervous system	Parastheias	Hyperexcitability
Shukraagni	Garbhotp adana	Essential for normal sexual function	Loss of libido, Menorrhagia	Leads to impotence, Oligomenorrhea

CONCLUSION:

1. Agni is the most important basic fundamental unit of our body which works in metabolism.
2. Thyroid hormones functions in basic metabolism of our body.
3. Thyroid hormones functions as agni in our body.

REFERENCES

1. Charaka Samhita Part – I Vaidyamanorama Hindi Commentry by Ravi Dutta Tripathi, Chaukhamba Sanskrit Pratishthan, Delhi, Sutrasthan, Adhyay 12/11.
2. Charaka Samhita Part – I Vaidyamanorama Hindi Commentry by Ravi Dutta Tripathi, Chaukhamba Sanskrit Pratishthan, Delhi, Sutrasthan, Adhyay 18/50.
3. Madhavnidanam Part II Vidyotini Hindi Commentry by Shri yadynandan Upadhyay, Adhyay 35/1.
4. Ashtang-Hridayam, Nirmala Hindi Commentry by Brahmanand Tripathi, Chaukhamba Sanskrit Pratishthan, Delhi, Nidansthanam, Adhyay 12/1.]
5. Website- www.pubmed.com, www.ncbi.nlm.nih,
6. Charaka Samhita Part – I Vaidyamanorama Hindi Commentry by Ravi Dutta Tripathi, Chaukhamba Sanskrit Pratishthan, Delhi,Sutrasthan, Adhyay 20/20.
7. Parishadhya Shabdartha Shariram. Author- Acharya Trivedi. Page no.43 130
8. Charaka Samhita Part – I Vaidyamanorama Hindi Commentry by Ravi Dutta Tripathi, Chaukhamba Sanskrit Pratishthan, Delhi,Sutrasthan, Adhyay 12/11, page no.-188
9. Ashtanga Hrudaya, Dr. Brahmanand Tripathi, Chaukhamba Sanskrit Sansthana, Varanasi, Reprint 2011, Sharirasthana, 11th chapter, 3 rd shloka, Nirmala Hindi commentary, Page no. 160.
10. Sushrut Samhita part I, Sushrut-vimarshini Hindi Commenry by Anantram Sharma, Chaukhamba Surbharti Prakashan, Varanasi, Sutrasthanam, Adhyay 35/27, page no. 278.
11. Padarth Vigyana Textbook, Vd. Mokashi and Vd. Vavhal, Shantanu Prakashan, 5th Edition, 2012, Part-I, Page no.47
12. Ashtanga Hrudaya, Dr.Anna Moreshwar Kunte, Chaukhamba Sanskrit Sansthana, Varanasi, Reprint 2011, Sharirasthana, 3rd chapter, 60th shloka, Arunadatta commentary, Page no.396
13. Prof. Ravidatta Tripathi, Charak Samhita, Chikitsasthan Chapter15, Shloka 38, Chaukhamba Pratishthan, Page no.367. 131 | P a g e
14. Dr.Shri Bhaskar Govindaji Ghanekar, Sushrut Samhita, Sutrasthan, Chapter 21,Shlok 10,Motilal banarasidas Prakashan, Page no.86.
15. Dr. Brahmanand Tripathi, Nirmala hindi commentary,Astanga Hrdayam, Sutrasthan, Chapter1, Shlok 8, Chaukhamba Pratishthan, Page no.9.
16. Vaidya Krishnashastri Navre, Sharangdhara Samhita, Purvakhanda, Chapter 5, shlok 24-27, Page no.39.

17. Shri. Brahmsankara Misra,Bhavprakasa, Purvakhand, Chapter 3, shlok 169,180 Chaukhanba Prakashan, Page no.52,57
18. Dr. Ganesh Krishna Gadre Sarth Vagabhatta of marathi translation of Vagbhatakrita Ashtanghridya,2015, Chaukhambha Surbharati Prakashan, Varanasi Sharirsthan 3/49Page no.137.
19. Acharaya Kashinath pandeya and Prof.Gorakhanath chaturvedi,Charaka Samhita of Agnivesha elaborated by Charaka and Redacted by Dridhabala with Vidyotini Hindi commentary, 2015, Chaukhambha Bharati Academy, Varanasi Chikitsasthan15/39 Page no.456.
20. Kaviraja Ambikadutta Shastri, 2016, Sushrut Samhita of Maharshi Sushruta edited with Ayurveda-TattvaSandipika,Chaukhambha Sanskrit Sansthan,2016, Varanasi Sutrasthan 35/32 page no.173. 132 | P a g e
21. Acharaya Kashinath pandeya and Prof.Gorakhanath chaturvediCharaka Samhita of Agnivesha elaborated by Charaka and Redacted by Dridhabala with Vidyotini Hindi commentary, 2015, Chaukhambha Bharati Academy, Varanasi Chikitsasthan15/56 Page no.462.
22. Kaviraja Ambikadutta Shastri, 2016, Sushrut Samhita of Maharshi Sushruta edited with Ayurveda-Tattva-Sandipika by Kaviraja Ambikadutta Chaukhambha Sanskrit Sansthan,2016, Varanasi Uttertantra 40/169-page no.306.
23. Acharya Girijadayal Shukla, Bhel Samhita, Chaukhamba Vidhyabhavan Varanasi,1959Sharirsthan4/11 Page no.88.
24. Acharaya Kashinath pandeya and Prof.Gorakhanath chaturvediCharaka Samhita of Agnivesha elaborated by Charaka and Redacted by Dridhabala with Vidyotini Hindi commentary 2015, Chaukhambha Bharati Academy, Varanasi Chikitsasthan 15/56 Page no.462.
25. Dr. Ganesh Krishna Gadre Sarth Vagabhatta of marathi translation of Vagbhatakrita Ashtanghridya, 2015, Chaukhambha Surbharati Prakashan, Varanasi Sharirsthan 3/59Page no. 138.
26. Akash kumar Agrawal, C.R.Yadav, and M.S.Meena, Wolters Kluwer-Medknow Publications, Physiological aspects of Agni, Ayu.2010 Jul-Sep; 31(3):395-398. 133 | P a g e
27. Charaka Samhita, Prof.R.H.Singh, Chaukhamba Surbharti Prakashan, Varanasi, 2011, Sutrasthana, 25th chapter, 40th shloka, Page no.132
28. Ashtanga Hrudaya, Dr.Anna Moreshwar Kunte, Chaukhamba Sanskrit Sansthana, Varanasi, Reprint 2011, Sutrasthana, 11th chapter, 34th shloka, Page no.188
29. .Padarth Vigyana Textbook, Vd. Mokashi and Vd. Vavhal, Shantanu Prakashan, 5th Edition, 2012, Part-II, Page no.229

30. CharakaSamhita Part – I Vaidyamanorama Hindi Commentry by Ravi Dutta Tripathi, Chaukhamba Sanskrit Pratishthan, Delhi,Chikitsasthanam, Adhyay 18/50 Page no.282.
31. Ashtanga Hrudaya, Dr.Anna Moreshwar Kunte, Chaukhamba Sanskrit Sansthana, Varanasi, Reprint 2011, Sutrasthana, 11th chapter, 30-33th shloka, Page no.187
32. Ashtanga Hrudaya, Dr.Anna Moreshwar Kunte, Chaukhamba Sanskrit Sansthana, Varanasi, Reprint 2011, Sutrasthana, 11th chapter, 4th shloka, Page no.183
33. Sembulingam K; Sembulingam Prema, Essentials of Medical Physiology, 6th Edition, Jaypee Brothers Medical Publishers (P) Ltd; New Delhi India,2012 Thyroid Gland, Page no.388
34. Sembulingam K; Sembulingam Prema, Essentials of Medical Physiology, 6 th Edition, Jaypee Brothers Medical Publishers (P) Ltd; New Delhi India, 2012 Thyroid Gland, Page no.389