



CONCEPT OF MEDODHATU WITH ITS PHYSIOLOGICAL IMPORTANCE W.S.R. TO LIPIDS

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ABSTRACT

In Ayurvedic classical texts, *Sama Dosha*, *Sama Dhatu* and *Sama Mala*, *Samaagni*, and *Prasanna Mana* are indicated signs of *Swasthya*. Among these *Sama Dhatu* is a major factor for healthy status of any person. *Dhatu*s are responsible for *Dharana* and *Poshana* of the body in their healthy state and when vitiated they also act as *Dushya* and hence vitiate and disturb the equilibrium of the body. There are 7 seven *Dhatu*s in the body and among these 4th *Dhatu* is *Medodhatu*. *Medodhatu* can be correlated with lipids in modern perspectives. This article is an attempt to give a detailed description of *Medodhatu* and lipids and to understand their importance in the body.

Keywords: *Dhatu*, *Meda*, *Dharana*, *Medodushti*, Lipids etc.

INTRODUCTION

The physiology of the human body depends upon the equilibrium of *Dosha*, *Dhatu* and *Mala*. *Doshas* can be stated as the main bio energies of the body and are

responsible for all physiological functions. The activities are executed through *Dhatu* and *Malas* and hence act as media. In these media, *Dhatu*s are the

stabilising pillar of the body whereas *Malas* are excretory byproducts that are formed due to different metabolic activities of the body. According to *Ayurveda*, the human body is built of *Seven Dhatus* or body elements and *Meda Dhatu* is the 4th *Dhatu* among those. *Medodushti* is a *Dushya* dominant disorder and hence *Medo Dhatu* is important in the development of pathogenesis of *Medodushti*. To understand the pathology related to *Medo Dhatu*, understanding physiology is mandatory, so, physiological aspects of principle *Dushya* i.e., *Medo Dhatu* is detailed.

MATERIAL AND METHODS

The materials were collected from the classical *Ayurvedic* literature, magazines and research journals.

CONCEPT OF MEDO DHATU

NIRUKTI OF MEDA-

The word *Meda* is derived from *Sanskrit* word 'Mid' with the addition of 'Asun' and 'Ach' *Pratayay* respectively.

- *Meda* is specific *Dhatu* which is originated from *Mamsa* and *Vapa* and *Vasa* are synonyms to it.
- *Meda* signifies corpulence and is a synonym for *Vapa* and *Vasa*.

Medas- fat, marrow, fat of body (san-English-dictionary)

SYNONYMS-

Asthi*kruta-* Next *Dhatu* after *Meda* is *Asthi* (Bone) and *Meda Dhatu* acts as a substrate for the formation of *AsthiDhatu*.

Mamsaj and Mamsateja- As, with the action of *Mamsadhatwaagni*, it is formed from *Mamsa Dhatu*.

STHAN AND SWARUPA OF MEDO DHATU¹

Medo Dhatu is *Sneha* dominant *Drava Dhatu* and having *Guru* (heavy), and *Snigdha* (oiliness) properties.

Anatomically, *Meda* is a yellowish, greasy, soft, solid material known as fat. A countless number of globules of fat form a thick, spongy layer under the skin.

ANJALI PRAMANA OF MEDO DHATU²

The quantity of *Meda* according to *ancient Acharyas* is 2 *Anjali* and *Praman of Vasa* is 3 *anjali*. The *Anjali*

praman may have variation from person to person. Thus, total *Medas* content adding *Medo Dhatu*, and *Vasa* is 5 *anjali*. If we add total *Anjali Pramanas* of all elements are counted as 56.5 *Anjali*; hence the proportion of *Medas* in the body element is 1/11 of total body weight. This number is important as modern science also tells that the total fat content of the body is 1/12 of total body weight.

PROPERTIES AND PANCHBHAUTIC COMPOSITION OF MEDODHATU³⁻

Meda Dhatu is *sneha* dominant *Drava Dhatu*, (*sneha* is *Guru* and *Snigdha*g*unayukta*, *Teja* and *Bhrajishnutayukta*, dominated by *Jalamahabhuta*). *Prithvi*, *Apa* and *Teja Mahabhutas* are dominant constituents of *Meda Dhatu*.

TYPES OF MEDO DHATU^{4:}

To understand *Medo Dhatu* from a modern perspective, it can be said that there are 2 types of *MedoDhatu-*

1. Baddha Meda or Poshya Medo Dhatu.

2. Abaddha Meda or Poshaka Medo Dhatu.

1. Poshya / Baddha Medo Dhatu-

Poshya Medo Dhatu is stored in *Medodharakala*. It is immobile in nature (*Gativivarjita*). *Udara* and *Anuasthi* are sites of *Medodhaarakala*. Other sites like *Sphikka*, *Stana* and *Gala* are also depots of *Poshya Meda*.

2. Poshaka/ Abaddha Meda Dhatu-

Poshaka Medo Dhatu is mobile (*gatiyukta*) and circulated with *Rasa-Rakta Dhatu* in the whole body to provide nutrition to *Poshya MedoDhatu*. Circulating lipids along with cholesterol within the blood can be visualised by different imaging techniques.

After *Mamsagnipaka*, this *Poshaka MedoDhatu* is distinguished in the form of *Sukshmabhaga* & *Sthulabhaga* and then further transformation of *MedoDhatu* occurs by this.

UTPATTI OF MEDO DHATU

Origin of *Medo Dhatu* is from *Prasadbhaga of Mamsa Dhatu*.

When *poshak mamsa Dhatu* is acted by *mamsagni*, it is then divided into three parts due to *mamsagni paka-*

- 1) *Sthulabhaga*- This part is responsible for *sthayi mamsa Dhatu*.
- 2) *Sukshamabhaga*- This part is responsible for the further formation of *Medo Dhatu*.
- 3) *Kittabhaga*- Also known as *khamala* (waste of openings) of body.

Here *Medodhatwagni* acts upon *Sukshamabhaga* (*poshaka Medo Dhatu*) and *Poshaka Medo Dhatu* is then converted into *stulabhaga* (*Shtayi /poshya Medo Dhatu*), *Sweda* (*Malabhaga*) and *Poshaka Asthi Dhatu* as a *Sukhsma Bhaga*. The processes of nourishment of *Medo Dhatu* by *Annarasa* keep running in this manner.

Acharya Charak mentioned that the nutrients of *Medo Dhatu* present in *Mamsa Dhatu* are converted into *Medo Dhatu* when these nutrients combine with *Apa mahabhuta* during *paka* which makes *Dhatu snigdha and drava*.

KARMA OF MEDO DHATU-

Different *Acharyas* mentioned the function of *Medo Dhatu* as⁵-

1) Snehana-

Lustre of skin, hair and eyes depends upon *Sneha* quality of *Meda*. In *Medovridhhi* or *Medoroga*, the *Snigdhatrata* arises which may be due to *Snehana* function of *Meda*.

2) Sweda⁶-

Sweda is *mala* of *Medo Dhatu*. *Acharya Sharangdhara* listed *Sweda* as *Upadhatu* of *meda*.

3) Asthipushhti-

Nourishment of further *Dhatu* i.e., *Asthi Dhatu* is also a function of *Medo Dhatu*. Nourishment of its *snayu upadhatu*, (*and Sandhi acc. to Chakrapani*), is another function of *medodhatu*.

4) Dridhatva-

Dridhatva or strength is provided by *snayu upadhatu* of *meda*. *Snayu* provides strength to the *Asthi* and *Sandhi*. *Meda* also provides strength to abdominal organs. It helps in the bindings of important organs. Layers of fatty tissue depots over the underlying organ present in the abdomen protect from outside pressure and frictions. *Dridhatva* is also taken as energy as *meda* is an energy store of the body and

provides almost double energy compared to carbohydrates and proteins.

5) Netra and Gatrasnigdhta-

Both are a symptom of *Sthaulya* and may produce due to increase *Snehana* function of *Meda*.

UPADHATU OF MEDA⁷

According to *Acharya Charak snayu* is *Upadhatu* of *Meda*. In *Vaidhyaka Shabda Sindhu*, *Snayus* is the *Nadi* that conducts *vayu*. *Vayu* conducts the *Sneha* of *Meda* and make the *Sira*, and *Snayu*. *Snayu* provides strength to the body by binding *Mamsa* (muscles), *Asthi* (bones), *Meda* (adipose tissue) and strengthening the joints.

The body is stable and sturdy because of *snayu*.

MALA OF MEDA⁸-

Sweda is *mala* of *meda*.

MEDODHARA KALA-

Kala refers to the fine structures separating the *Dhatu*s from there *Ashaya*⁹. *Medodhara kala* is 3rd *kala* in the body. The function of *Medo Dhatu* is to support *Medo Dhatu*¹⁰. An interesting and far-reaching statement made by *Acharya Sushruta* that, the *meda* that fills up the shaft of long bones is known as *majja* and that which is present in the small bones (*anuasthi*) is called *sarkta meda* i.e., blood cum fat¹¹.

MEDOVAHA SROTAS¹²-

The channels present in the body through which *Poshaka Dhatu*, and *Mala* pass to and from the *Sthayi Poshya Dhatu* are called *Srotas*. According to *Acharya Charak*, “nutrient substances which nourish the *Dhatu* undergo *Paka* by the *Ushma* of *Dhatu* (*Dhatwagni*) and then only they made available to the *Dhatu* through their *Srotasa*.

Medovah srotas can be explained as the *Srotas* carrying the nutritive material up to the site of *Medo Dhatu* or the channels which give nutrition to the *Medo Dhatu*. The channels which are related to the transport of adipose tissue are considered as *Medovah srotasa* as explained by *C. Dwarkanath*¹³.

The capillaries of the peripheral tissue and omentum are to be considered *medovah srotas* according to *Dr Ghanekar BG*.¹⁴

A network of capillaries or blood vessels holds the fat cells together distributed them to them.¹⁵ Hence the channels through which the *Poshaka or Asthaya Medo Dhatu* circulated in the whole body in mixed form with *Rasa and Rakta*, to nourish the *Sthayi or poshya Medo Dhatu* are called *Medovah Srotas*. In case of defect or vitiation of *Medovah Srotas*, *Medodushti* or *Medoroga* takes place.

Moola of Medovah Srotas

According to *Brihatrayee-*

Charak-Vrikka and Vapavahana¹⁶

Sushruta- Vrikka and Kati¹⁷

Vagbhatta- Vrikka and Mamsa¹⁸

The word *moola* means origin. The *medovaha srotas moola* means the organs which are the origin of *Medo Dhatu*. *Moola* can be understood as the organs which are closely related to the functions of *MedoDhatu*, or important sites related to the beginning or end of the channels of *Medo Dhatu*.

Hence according to all the three *Acharyas*, *vrikka* is one of *medovaha srotas*. It seems that all *Acharyas* are known to the importance of *vrikka* physiologically and anatomically. But *Acharya Sushruta and Acharya Vagbhatta* mentioned *kati and mamsa* as the second *moola* of *medovah srotas* which seems less physiologically and more anatomically correct as compared to *vapavahan* which is mentioned by *Acharya Charak* as the second *moola* of *medovahsrotas*.

VRIKKA

Vrikka is formed from *Sara part of Rakta*(blood) and *Meda* (fat). Its function is to nourish the *meda*. The situation of *vrikka*, which are 2 in number, is in both the side of the mid vertebral line inside the abdominal cavity. According to *Acharya Sharangdhara*, *vrikka* nourishes the *medo Dhatu* inside the stomach area of the abdominal cavity¹⁹ while *Acharya Charak* mentioned them as *Moola of Medovah Srotas*. *Acharya Sushruta* and *Vagabhatta* also mentioned *Vrikka* as the *Moola* of *Medovah srotas* and also placed at the primary position. There is no clear evidence of kidneys taking part in fat metabolism both according to modern science and *Ayurveda*. But if suprarenal glands, which are present just above the

kidney attached to it, and function in the body in the metabolism of fat by its secretions, the perspective of *Acharyas* can be correctly established with correct relation according to modern science. Hence *vrikka* (kidney) with suprarenal glands are *Moola of Medovah Srotas*.

VAPAVAHAN

Acharya Chakrapani also accepted the viewpoint of *Acharya Charak* of *Vapavahan* as the place of *meda*. It is also known as *Taila vartika*.²⁰ *Dr.Ghanekar* explained it as the place where maximum *meda* is stored.²¹ The situation of *vapavahan* is beneath the *Jathare* (stomach) and beyond *Pleeha* (spleen). *Kloma* is also used as the synonym of *vapavahan*. *Kloma* in *ayurvedic* science is not clearly defined. But it is included in *kosthanga* according to *Acharya Charak*. So, based on this fact, if pancreas is *kloma*, which is very important for digestion and metabolism of fat, the *vapavahan* can be called the *moola of medovaha srotas*. Physiologically the fact fits in both *Ayurveda* and Modern science's perspective.

KATI

Kati is the place where generally the fat accumulates. *Kati* is mentioned as *Moola* by *Acharya Sushruta*. Anatomically *kati* has a big amount of fat around it, and in patients with obesity, it is vast in quantity. This may be the reason why *Acharya Sushruta* mentioned *kati* as the *Medovaha srotas moola*.

MAMSA

The layer of fat under the skin is closely related to the muscles. *Mamsa* as *Medovah srotasmoola* can be correlated with the *vasa (mamsagata sneha)* below the skin. That's why *Acharya Vagabhatta* considered *Mamsa* as *Moola of Medovah srotas*.

MEDASARA PURUSHA²²⁻

Physical characters-

- Lustre of the skin
- Deepness in voice
- Glittering eyes
- Shiny hairs and nails
- Unctuous and moist lips
- Shiny teeth
- Oily urine
- Oily faeces

Behavioural and Psychological characters-

- *Medasara purusha* is blessed with wealth,
- Dignity in society
- Happiness
- Luxury
- Righteousness
- Generosity
- Delicacy

DIFFERENCES BETWEEN MEDA, MAJJA AND VASA

MEDA- *Meda* is the *sneha* part present in form of a compound in the body. This *meda* is mainly present in the structure of the cell and other structures in compound form and mainly in phospholipids and sterols. It cannot be separated from the cell as it is the structural element of the cell and its removal from the cell ultimately leads to the death of the cell. Hence this *sneha* is not available to the body for use.

MAJJA- *Acharya Charak* had mentioned detailed information about the formation of *Majja Dhatu*. *Acharya* said that the formation of *Majja Dhatu* is from *Asthi Dhatu*. The *Snigdhamasa of Medo Dhatu* fills the hollow spaces created by *Vayu Mahabhuta* in long bones which are then called *Majja Dhatu*.

Majja and Meda both are fat tissue, but *Ayurveda* mentioned them as two different *Dhatu*. It might be due to their different specialised functions in the body. *Vaidhyak Shabda Sndhu* described *Majja as shuddha Sneha* (pure fat). The composition which is said to be *Shuddha sneha* of *Majja* is similar to the fat stores in the adipose tissue which are present everywhere in the body like sterarin and olein.

Kaviraj Gananath sen explained 2 kind of *majja*

1) *Rakta* 2) *Peeta*.

Peeta majja is found in *Nalakasthi* and *Raktamajja* is found in all other long bones.

VASA- *Vasa* are *Mamsa Dhatu's Upadhatu*. *Vasa* is mainly oily substances derived from *Mamsa Dhatu*. *Vasa* is indicated for persons debilitated after heavy work, walking and exertion, indulged in excessive sexual intercourse, anaemic patients and for patients suffering from the disease of bone, joints, blood vessels, ligaments. *Vasa upadhatu* improves complexion and maintains the shape of the body.

According to modern sciences, *vasais* neutral fat stored in the body and named adipose tissue. It is liquid in living conditions and takes solid form after death.

It helps in the maintenance of body temperature (homeostasis) because it is a bad conductor of heat. It is present in maximum quantity in muscles, subcutaneous tissue, and abdomen. Cells of subcutaneous tissues have *Vasa* in place of protoplasm, but *Vasa* is *Upadhatu* and its functions are only *Dharan* and not *Poshana*. Hence it can be taken outside from the cell.

Sneha is present in compound form in *meda*, in mixture form in *Majja* and pure form in *vasa*.

CONCEPT OF LIPID

'Lipids' word is derived from the Greek word *lipos* which mean fat. Lipids are the chief concentrated storage form of energy, and hence definitely are of great importance to the body.

They have also a role in cellular structure and various biochemical functions. It is difficult to define them precisely as lipids are heterogeneous groups of compounds. The organic substances are soluble in organic solvents (like alcohol, ether etc.) but insoluble in water, and potentially related to fatty acids and utilized by living cells. Lipids are a major form of stored nutrients (TGs), precursor of gonadal and adrenal steroids and bile acids (cholesterol) and messengers like prostaglandins which act intracellular and extracellularly are also made of lipids. Complex lipids in the blood are delivered to cells throughout the body as water-soluble complexes by lipoproteins.

Physiologically lipids present in the body form 2 components-

1. Structural lipids or element constant-

In the entire organ of the body, cytoplasm and cell membrane are composed of element constant. So that in case of starvation, the fat content of cytoplasm and cell membrane does not diminish. Element constant is chiefly composed of phospholipids and the value of it always remains constant.

2. Element variable-

Chiefly neutral fats are its components. The depots of fat (adipose tissues) are the sites where they are present in free form and represent stored energy. Depot fats are not static but due to their continuous synthesis and breakdown in the body, they remain in a continuous state of change.

• Classification of lipids

Lipids are classified mainly in 2 ways-

❖ Based on the storage and structural lipids and some other functional lipids.

❖ Based on lipid composition

1. **Simple lipids**- simple lipids are esters of fatty acids with alcohols.

a) Neutral fats: Triglycerides (TGs), ester of various fatty acids with glycerol.

b) Waxes- cholesterol and its esters.

2. **Compound lipids**- these are esters of fatty acids with alcohols and contains other groups.

a) Phospholipids - Esters containing phosphoric acids and a nitrogen base i.e., lecithin and cephalin.

b) Glycolipids - esters containing carbohydrate and a nitrogen base i.e., cerebrosides.

c) Sulpholipids - esters containing sulphuric acid.

d) Lipoproteins – lipids attached with proteins.

3. **Derived lipids**- hydrolysis of simple and compound lipids results in derivative formation and they still process the physical characteristics of lipids. They are divided as-

a) Fatty acid- saturated and unsaturated

b) Sterols

c) Fat-soluble vitamins

• Functions of lipids-

Unlike carbohydrates which are heavily hydrated to perform a wide variety of functions, lipids are stored in a relatively water-free state in the tissue.

Lipids perform several important functions-

1) Energy store - Lipids are the concentrated fuel store of the body (triglycerides).

2) Regulates membrane permeability- Lipids are constituents of membrane structure and regulates the membrane permeability (phospholipids and cholesterol)

3) Source for vitamins – they serve as a source for fat-soluble vitamins (Vit. A, D, E, K.)

4) Metabolism regulation – Lipids are important as cellular metabolic regulators.

5) Protective functions – lipid protects the internal organs by serving as a cushion to absorb shock.

6) The appearance of the body - lipid provides shape and a smooth appearance to the body.

7) Insulating function – the subcutaneous lipids serve as insulating materials against heat and cold from the atmosphere.

8) Electron transport chain – lipid present in inner mitochondrial membrane actively participate in the electron transport chain.

Lipid transport in the body-²³

Triglycerides, cholesterol, and phospholipids are transported in the form of lipoproteins in the plasma. These lipoproteins have apoproteins, which is a protein component. Examples of apoproteins are- A-I, A-II, C, E, B-48 and B-100. There are mainly 2 ways for transport of lipids.

1) **Exogenous pathway**

2) **Endogenous pathway**

1) **Exogenous pathway-**

The exogenous pathway is credible for dietary fat's digestion and tissue dissemination. This transport is done through chylomicrons. Chylomicrons are the water-soluble micelles that are formed when interstitial cells or enterocytes takes up the dietary triglycerides and 50 % of cholesterol after combination with bile salts. These chylomicrons then secreted intestinal lymphatic, and via the thoracic duct, they reach to blood. Apo CII/III is incorporated by them. The lipoprotein lipase enzyme which is present in the endothelial surface of capillary beds in cardiac muscle, skeletal muscle and adipose tissue, removes the TG component. Free fatty acids and glycerols are formed from the catalysis of triglycerides which is done by lipoprotein lipase. In the fat cells of adipose tissues and muscles, these free fatty acids and glycerols diffuse freely. Here Precursor of HDL is formed after the shed of apolipoproteins and phospholipids and the remaining cholesterol is taken up by the hepatic LDL receptor

and to be used to produce VLDL and bile acid and some are excreted into the bile.

2) Endogenous pathway

The endogenous pathway transports lipids from peripheral tissue to the liver and from the liver to peripheral tissue. It is classified into two subsystems.

i) **The ApoB-100 lipoprotein system:** in this transport of cholesterol, triglycerides, phospholipids etc. is done from the liver to other tissues through VLDL and LDL

ii) **The ApoA-I lipoprotein system:** in this transport of reverse cholesterol through HDL from other tissues to the liver.

Depot fats-

Plasma proteins and fat depots are two forms in which fat is present in the body. Fat makes about 12% of the total weight of the body. A maximum part of this fat remains stored. These fat storages are called fat depots.

Table 1: Showing fat distribution in the body tissue-

Body tissue	Fat distribution in %age
Subcutaneous tissue	50
Peripheral tissue	15
Mesentery	20
Omentum	10
Intramuscular connective tissue	9

Composition of depot fats

These are consisting mainly of mixed triglycerides with some amount of cholesterol, lecithin, and polyunsaturated fatty acids.

Functions of depot fats-

1. physical- regulation of body temperature (thermostatic)
2. mechanical- it protects against injury
3. chemical- storages of energy (1100cal/kg body weight)

Storages of fat-

Large quantities of fats are stored in two major tissues in the body-

- adipose tissue
- liver

Adipose tissue-

Adipose tissue makes about 20 per cent of a normal young adult's total body weight. In an average person, it is about 15 kg. This storage can be increased to no limits. If the body mass increases, it represents the enlargement of the adipose tissues. Approximately 90 per cent of the adipose tissue's mass represents stored triglycerides.

Liver

In conditions like starvation, diabetes mellitus and any other such condition, a large number of triglycerides appears in the liver. Mobilisation of most of the triglycerides occurs as free fatty acids from the adipose tissue in the blood and then re-deposition occurs as triglycerides in the liver.

CONCLUSION

Meda dhatu is an important part of the body and performs many functions and maintains the homeostasis of the body. According to both Ayurveda and modern point of view, there are many similarities between medodhatu, and lipids as discussed in this article. These similarities also show the importance of medodhatu in the body.

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