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REVIEW ARTICLE

A Conceptual Study of Medo Dhatu w.s.r. to Human Body Fat

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ABSTRACT

Background: Ayurveda explains the human body with the help of seven basic tissues called Dhatus. Medo Dhatu is the fourth Dhatu. It is the oily, soft and heavy tissue of the body that gives smoothness, firmness and stored strength. Modern science studies body fat mainly as adipose tissue, which stores energy, keeps the body warm, protects organs and also works like a hormone-producing organ. A clear comparison of these two ideas can help students and physicians to understand fat-related problems such as obesity and dyslipidemia in a better way.

Aim: To study the classical concept of Medo Dhatu and to correlate it with human body fat.

Objectives: To review the classical Ayurvedic literature and research journals available on Medo Dhatu. To understand the Ayurvedic concept of Medo Dhatu. To evaluate the relation between Medo Dhatu and human body fat.

Materials and Methods: This was a conceptual, literary and comparative study. Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, Ashtanga Sangraha and Sharangadhara Samhita, along with the commentaries of Chakrapanidatta, Dalhana and Arunadatta, were studied. Standard modern textbooks of physiology, biochemistry, anatomy and pathology, and published research papers on adipose tissue and lipid metabolism were also reviewed. The collected matter was compared under six headings: structure, location, function, metabolism, quantity and disease.

Results & Conclusion: The classical description of Medo Dhatu shows close similarity with the modern knowledge of human body fat in structure, site, function, metabolism and disease. Medo Dhatu can therefore be understood as the Ayurvedic counterpart of adipose tissue together with circulating lipids. These links are conceptual and need clinical and laboratory proof in future studies.

Keywords: *Medo Dhatu, Adipose tissue, Body fat, Dhatvagni, Baddha Meda, Abaddha Meda, Medovaha Srotas, Lipid metabolism*

1. INTRODUCTION

Ayurveda is the science of life. Its first aim is to protect the health of a healthy person, and its second aim is to cure the disease of a sick person. To reach both aims, a physician must first know the normal body very well. Acharya Charaka says that a person should guard the body before everything else, because when the body is lost, everything is lost.[1]

In Ayurveda, the body is made of Dosha, Dhatu and Mala. The word Dhatu comes from the root “Dha”, which means to hold or to support. So, a Dhatu is that which holds the body together and keeps it nourished (Dharana and Poshana). There are seven Dhatus: Rasa, Rakta, Mamsa, Meda, Asthi, Majja and Shukra. Each Dhatu is formed from the one before

it with the help of its own Dhatvagni. The fixed tissue is called Sthayi Dhatu, and the nourishing part that moves towards it is called Poshaka Dhatu.[2]

Medo Dhatu holds the fourth place in this chain. It is formed from Mamsa Dhatu. Jala and Prithvi Mahabhuta are dominant in it, and so it is Snigdha (oily), Guru (heavy), Mridu (soft) and Manda (slow). Because of these qualities, Medo Dhatu keeps the body smooth and oily, gives firmness and fullness to the body, produces Sweda as its Mala, and nourishes Asthi Dhatu.[3] The classics also describe two forms of Meda. Baddha Meda is the fixed fat stored in its own places. Abaddha Meda is the moving fat that travels with Rasa and Rakta and feeds the stored fat.

Modern physiology describes body fat in a similar way. Fat is stored in adipose tissue as triglycerides inside special cells called adipocytes. At the same time, a small amount of fat always moves in the blood in the form of lipoproteins and free fatty acids.[4,5] Today adipose tissue is not seen as a simple store. It is an active organ that controls energy balance, produces hormones such as leptin and adiponectin, and affects insulin action and inflammation.[6,7]

Changes in lifestyle, such as eating too much, eating heavy and sweet food, sitting for long hours, sleeping in the daytime and mental stress, have caused a fast rise in obesity, dyslipidemia, type 2 diabetes and heart disease. All these problems are linked with the wrong storage and use of fat. Ayurveda has described these same causes long ago under Medo Vriddhi, Sthaulya and Medoroga.[1] Therefore, there is a real need to read the classical concept of Medo Dhatu again in the light of present knowledge of body fat. Such a study can act as a bridge between Ayurvedic physiology (Kriya Sharir) and modern physiology, and can help students, teachers and physicians.

2. AIM AND OBJECTIVES

Aim: To study the classical concept of Medo Dhatu and to correlate it with human body fat.

Objectives:

- To review the classical Ayurvedic literature and research journals available on Medo Dhatu.
- To understand the Ayurvedic concept of Medo Dhatu.
- To evaluate the relation between Medo Dhatu and human body fat.

3. MATERIALS AND METHODS

3.1 Type of Study

The present work is a conceptual, literary and comparative study. It is descriptive and analytical in nature. No patient, animal or laboratory test was involved, and no drug or procedure was given.

3.2 Materials

A. Ayurvedic sources

- Main texts: Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, Ashtanga Sangraha and Sharangadhara Samhita.[8,9]
- Commentaries: Ayurveda Dipika of Chakrapanidatta, Nibandha Sangraha of Dalhana and Sarvangasundara of Arunadatta.
- Other sources: Raja Nighantu and Sanskrit dictionaries for Nirukti, and standard textbooks of Kriya Sharir.[10]

B. Modern sources

- Standard textbooks of physiology, biochemistry, histology, anatomy, pathology and medicine.[11]
- Peer-reviewed research and review papers on adipose tissue, fat distribution, lipid classification, lipid absorption, lipoproteins and fatty acid oxidation.

3.3 Methods

- **Step 1 – Collection:** All references related to Medo Dhatu, such as Nirukti, Utpatti, Panchabhautika composition, Guna, Karma, Pramana, Upadhatu, Mala, Medovaha Srotas, Medodhara Kala, Baddha and Abaddha Meda, Medo Vriddhi, Medo Kshaya and Medosara Purusha, were collected from the texts.
- **Step 2 – Conceptual analysis:** The role of Dhatvagni, the three Dhatu Poshana Nyayas and the relation of Medo Dhatu with Kapha Dosha and Sweda were studied in depth.
- **Step 3 – Modern review:** Structure and types of adipose tissue, fat distribution, synthesis and breakdown of fat, lipid transport through the exogenous and endogenous pathways, lipoproteins and disorders of fat were reviewed.

- **Step 4 – Comparison:** Both views were compared under six headings: structure, location, function, metabolism, quantity and disease.
- **Step 5 – Compilation:** The findings were arranged in tables and flow charts, and the results were discussed.

4. REVIEW OF LITERATURE

4.1 Ayurvedic Review of Medo Dhatu

4.1.1 Vyutpatti and Nirukti (Word origin and meaning)

The word Medas is made from the root “Mid”, which means to be oily or to give oiliness (Mid Snehane), with the suffix “Asun”. So, Medo Dhatu literally means “the Dhatu that makes the body oily”. The Nirukti also says the same.

Raja Nighantu gives the synonyms of Meda. It calls Meda the essence of Mamsa (Mamsasara) and the oil of Mamsa (Mamsasneha), and lists Vasa and Vapa as related words.

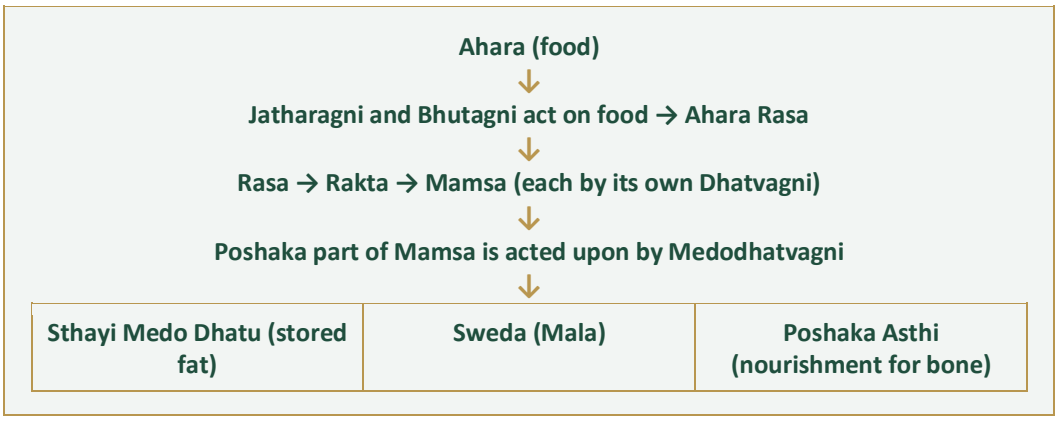
4.1.2 Panchabhautika Composition

Every Dhatu is made of all five Mahabhutas, but one or two of them are dominant. Dalhana explains that Jala (Ambu) and Prithvi (Bhu) are dominant in Medo Dhatu. Jala Mahabhuta gives Medo Dhatu its Snigdha, Mridu, Sara and Pichchhila qualities, so it is oily, soft and slightly sticky. Prithvi Mahabhuta gives it Guru, Sthula and Sthira qualities, so it is heavy, bulky and stable. Teja helps in its formation (Paka), and Vayu helps in its spread in the body. This mix explains why fat feels soft and smooth but still gives shape and bulk to the body.

4.1.3 Utpatti (Formation) of Medo Dhatu

Medo Dhatu is formed from the nourishing part of Mamsa Dhatu. Acharya Charaka describes how each Dhatu changes into the next under the heat (Ushma) of its own Agni. When Mamsa is cooked by its own Agni, and the qualities of Teja and Jala increase in it, it becomes oily and is changed into Meda.

In simple words, the process works in three parts. The Poshaka part of Mamsa is acted upon by Medodhatvagni. Its Prasada (useful) part becomes Sthayi Medo Dhatu. Its Kitta (waste) part becomes Sweda, the Mala of Meda. A finer part goes forward as the Poshaka part for the next Dhatu, Asthi. This is shown in Flow Chart 1.



Flow Chart 1: Formation of Medo Dhatu

4.1.4 Dhatu Poshana Nyaya (Laws of tissue nourishment)

Chakrapanidatta explains three Nyayas (examples) to show how Dhatus get their food.[1] They are useful to understand how fat is made and stored.

- **Ksheera-Dadhi Nyaya (law of full change):** Just as milk changes fully into curd, and curd into butter and ghee, one Dhatu changes fully into the next. This explains the step-by-step formation of Meda from Mamsa.
- **Kedari-Kulya Nyaya (law of channels and fields):** Water from a canal first fills the nearest field and then flows to the next field. In the same way, the nourishing fluid reaches each Dhatu in turn through its own Srotas. Meda gets its share after Rasa, Rakta and Mamsa.
- **Khale-Kapota Nyaya (law of selective picking):** Pigeons come to a threshing floor and pick only the grains they need, then fly back to their own places. In the same way, each Dhatu picks the nutrients it needs from the common pool. Meda takes up only the oily part that suits it.

4.1.5 Pramana (Quantity)

Acharya Vagbhata gives the quantity of body parts in Anjali (the measure of two cupped palms). Meda is said to be 2 Anjali and Vasa (muscle fat) 3 Anjali. Together, the fatty parts of the body come to 5 Anjali.

When this is compared with the total measured body fluids and tissues (about 56.5 Anjali), fat forms roughly one-eleventh of the whole. The classics also say that this measure is for a person of normal build and can change with Prakriti, age, food and habits. This shows that the ancient scholars knew that fat forms a fixed, measurable part of the body.[12]

4.1.6 Guna (Properties)

The main Gunas of Medo Dhatu are Snigdha, Guru, Mridu, Manda, Sthira and Sandra. It is whiter and softer than Mamsa and is more fluid than it. Because of these properties, Medo Dhatu gives roundness and softness to the body, acts as a store of strength, and protects the inner parts from shock and dryness.

4.1.7 Ashraya–Ashrayi Bhava (Relation with Dosha)

Each Dosha lives in certain Dhatus. The Dhatu is the house (Ashraya) and the Dosha is the one who lives in it (Ashrayi). Acharya Vagbhata says that Vata lives in Asthi, Pitta in Sweda and Rakta, and Kapha in all the remaining Dhatus, including Meda.

Kapha and Meda share the same Gunas: Snigdha, Guru, Manda and Sthira. So, whatever increases Kapha also increases Meda, and whatever reduces Kapha also reduces Meda. This is why heavy, sweet and oily food, daytime sleep and lack of exercise lead to both Kapha Vriddhi and fat gain, and why Langhana, Vyayama and Ruksha Udvartana reduce both.[13]

4.1.8 Karma (Functions)

Acharya Sushruta gives four functions of Meda, and Acharya Vagbhata calls Sneha its best function.

- **Snehana:** It gives oiliness to the skin, hair, eyes and joints and keeps them smooth and shining. It prevents dryness and friction inside the body.
- **Sweda:** Sweat is formed as the Mala of Meda. Sweat keeps the skin moist and helps to control body heat.
- **Dridhatva:** It gives firmness, fullness and stability to the body. It works as a cushion for inner organs and as a reserve of strength during work, fasting and illness.
- **Asthi Pushti:** By the rule of Dhatu Poshana, Meda nourishes Asthi Dhatu, the next Dhatu in the chain.

4.1.9 Upadhatu and Mala

An Upadhatu is a by-product of Dhatu formation. It supports the body but does not form any further Dhatu. Snayu is the main Upadhatu of Meda. Some Acharyas add Sandhi, and Sharangadhara mentions Sweda. Snayu is of four kinds: Pratana (branched), Vritta (round, like tendons), Prithu (flat) and Sushira (hollow). Snayus hold the joints and organs together like the ropes that bind the planks of a boat.[18] The Mala of Meda is Sweda according to almost all the Acharyas (Table 1).

Table 1: Upadhatu and Mala of Medo Dhatu according to different Acharyas

Text	Upadhatu of Meda	Mala of Meda
Charaka Samhita	Snayu	Sweda
Sushruta Samhita	Snayu, Sira	Sweda
Ashtanga Sangraha	Snayu, Sandhi	Sweda
Sharangadhara Samhita	Sweda	Mala of tongue, teeth and armpit

4.1.10 Medovaha Srotas

Medovaha Srotas are the channels that carry and supply Meda. The Acharyas give their Mula (root) as follows:[14]

Table 2: Mula of Medovaha Srotas and its modern view

Acharya	Mula	Possible modern view
Charaka	Vrikka, Vapavahana	Perirenal fat around the kidneys; greater omentum (fat apron of the abdomen)

Acharya	Mula	Possible modern view
Sushruta	Kati, Vrikka	Fat of the buttocks and hips; perirenal fat
Vagbhata	Mamsa, Vrikka	Fat between and inside muscles; perirenal fat

Injury to the root of Medovaha Srotas (Viddha Lakshana) gives sweating, oily body, dryness of the palate (Talu Shosha), swelling and thirst. The causes of Medovaha Srotodushti are lack of exercise, daytime sleep, too much fatty food and too much alcohol.[15]

4.1.11 Medodhara Kala

Kala is a thin layer that separates a Dhatu from its Ashaya. Acharya Sushruta calls the third Kala Medodhara Kala. He says that Meda is present mainly in the Udara (abdomen) and inside the small bones, while in the large long bones it is present as Majja.

4.1.12 Baddha and Abaddha Meda

In his commentary on Sthaulya, Chakrapanidatta divides Meda into two types.[1] **Baddha Meda** is fixed, solid fat. It is stored in Medodhara Kala, mainly in Udara, and also in Sphik (buttocks), Stana (breasts) and Gala (neck). **Abaddha Meda** is free, moving fat. It travels with Rasa and Rakta in the channels and gives food to the fixed fat. When Abaddha Meda increases, it blocks the channels; when Baddha Meda increases, the body becomes bulky.[16]

4.1.13 Medo Vriddhi and Sthaulya (Increase of fat)

Acharya Charaka gives the causes of Sthaulya (obesity) in one line.

These causes are overeating (Atisampurana), heavy, sweet, cold and oily food, no exercise (Avyayama), no sexual activity (Avyavaya), daytime sleep (Divaswapna), always being in a pleasant mood without any worry (Harshanitya, Achintana), and family tendency (Beeja Swabhava). The signs of Medo Vriddhi are given by Sushruta and Vagbhata.

So, the person has an oily body, a big belly and big flanks, cough and breathlessness even after little work, hanging buttocks, breasts and belly, and bad body smell. Acharya Charaka adds the eight problems of an Atisthula person: short life (Ayuhrasa), slow movement (Javoparodha), difficulty in sexual act, weakness (Daurbalya), bad smell (Daurgandhya), heavy sweating (Swedabadha), too much hunger and too much thirst.

4.1.14 Medo Kshaya and Karshya (Decrease of fat)

Medo Kshaya is caused by dry and light food, long fasting, eating too little (Pramitashana), too much Vamana or Virechana, grief, anger, worry, too much exercise, old age and long illness. Its signs are cracking of joints, tiredness, strain of the eyes, thin belly, numbness of the waist, enlarged spleen, dryness, thin body and a strong desire for fatty meat. Table 3 compares the two states.[17]

Table 3: Comparison of Medo Vriddhi and Medo Kshaya

Point	Medo Vriddhi	Medo Kshaya
Body build	Bulky; big belly, flanks, buttocks and breasts	Thin body (Krisha); thin belly
Skin	Very oily skin, heavy sweating, bad smell	Dry and rough skin
Joints	Heaviness, poor movement	Cracking sound in joints (Sandhi Sphutana)
Breathing	Breathlessness on little work, cough	Not seen
Strength	Tires easily	Tiredness and weakness
Special signs	Hunger and thirst increased	Enlarged spleen, numb waist, desire for fatty food
Modern view	Obesity, dyslipidemia, metabolic syndrome	Undernutrition, wasting, low body fat

4.1.15 Medo Pradoshaja Vikara (Diseases due to vitiated Meda)

Acharya Charaka says that the diseases of vitiated Meda are the “Nindita” (blamed) conditions, mainly Atisthaulya, and the premonitory signs (Purvarupa) of Prameha.[1] Other texts link vitiated Meda with Kaphaja Prameha and Madhumeha,

Medoja Granthi, Medoja Arbuda (fatty lumps), Galaganda, Medoja Oshtha Roga and heavy sweating (Atisweda). Most of these are today seen as lifestyle and metabolic disorders.

4.1.16 Medosara Purusha (Person with excellent Meda)

A Medosara person has special oiliness in the skin colour, voice, eyes, hair, body hair, nails, teeth, lips, urine and stool. Such a person is wealthy, enjoys comforts, is generous and simple, and has a soft and delicate nature. Sushruta adds that the body is large and the person cannot bear hard work. This is the picture of a person with healthy and well-formed fat.

4.2 Modern Review of Human Body Fat

4.2.1 Adipose Tissue

Adipose tissue is a special loose connective tissue. Its main cells are adipocytes (fat cells). Each white fat cell holds one large drop of fat, which pushes the nucleus to the edge of the cell, giving a "signet ring" look under the microscope. Fat cells are held in a network of fibres and are richly supplied with blood vessels and nerves. Stored triglyceride forms about 80–90% of the weight of adipose tissue. Fat in the body comes from two sources: fat taken in food, and fat made in the body from extra carbohydrate and protein, mainly in the liver.

4.2.2 Types of Adipose Tissue

- **White adipose tissue (WAT):** This is the main type in adults. Each cell has one big fat drop (unilocular). It stores fat, keeps the body warm, works as a cushion and releases hormones.[18]
- **Brown adipose tissue (BAT):** Each cell has many small fat drops (multilocular) and many iron-rich mitochondria, which give it a brown colour. It does not mainly store fat; it burns fat to make heat with the help of uncoupling protein-1 (thermogenin). It is plentiful in newborns, mainly in the neck and between the shoulder blades, and is present in small amounts in adults.[19]
- **Beige (brite) fat:** These are brown-like cells that appear inside white fat on exposure to cold or exercise.

4.2.3 Distribution of Body Fat

In healthy adults, body fat is about 15–20% of body weight in men and about 25–30% in women, but this changes with age, sex, food and activity. Nearly half of body fat lies under the skin. The rest is found inside the abdomen and around the organs. Fat inside the abdomen (visceral fat) is more harmful than fat under the skin, because it sends fatty acids and chemical signals directly to the liver through the portal vein.[20] Table 4 shows the main fat depots.

Table 4: Main fat depots of the human body

Fat depot	Site	Main role
Subcutaneous fat	Under the skin, mainly belly, hips, thighs, arms	Largest store; keeps heat in; gives body shape
Omental fat	Greater omentum, hanging from the stomach like an apron	Visceral store; fights infection in abdomen
Mesenteric fat	Folds holding the intestines	Visceral store; supports the intestine
Perirenal fat	Around the kidneys	Cushion and support for the kidneys
Intermuscular and intramuscular fat	Between and inside muscles	Local fuel for working muscle
Bone marrow fat	Yellow marrow inside bones	Energy store; linked with bone health
Brown fat	Neck, between shoulder blades	Heat production

4.2.4 Functions of Body Fat

- **Energy store:** One gram of fat gives about 9 kcal, more than twice the energy of one gram of carbohydrate or protein (about 4 kcal). Fat is stored almost without water, so it is the most compact fuel of the body. An average adult stores many times more energy as fat than as glycogen.
- **Heat insulation:** Fat is a poor conductor of heat. The fat layer under the skin reduces heat loss, so lean people feel cold more easily.

- **Mechanical cushion:** Fat around the kidneys, eyeballs, heart, palms and soles protects them from shock and holds them in place.
- **Endocrine role:** Adipose tissue releases leptin (controls hunger), adiponectin (improves insulin action), resistin, tumour necrosis factor-alpha, interleukin-6 and angiotensinogen, and converts male hormones into oestrogen.
- **Other roles:** Fat helps the absorption of vitamins A, D, E and K, and forms part of every cell membrane and of nerve sheaths.

4.2.5 Lipids and Triglycerides

Lipids are fats and fat-like substances that do not dissolve in water but dissolve in ether or chloroform. The LIPID MAPS system divides them into eight classes: fatty acids, glycerolipids, glycerophospholipids, sphingolipids, sterols, prenols, saccharolipids and polyketides.[21] Fatty acids may be saturated (no double bond) or unsaturated (one or more double bonds). Linoleic acid (omega-6) and alpha-linolenic acid (omega-3) are essential, as the body cannot make them.[22] A triglyceride is made of one glycerol and three fatty acids. It is the main storage form of fat in the body. Cholesterol is a sterol; it is needed for cell membranes, bile acids, vitamin D and steroid hormones.

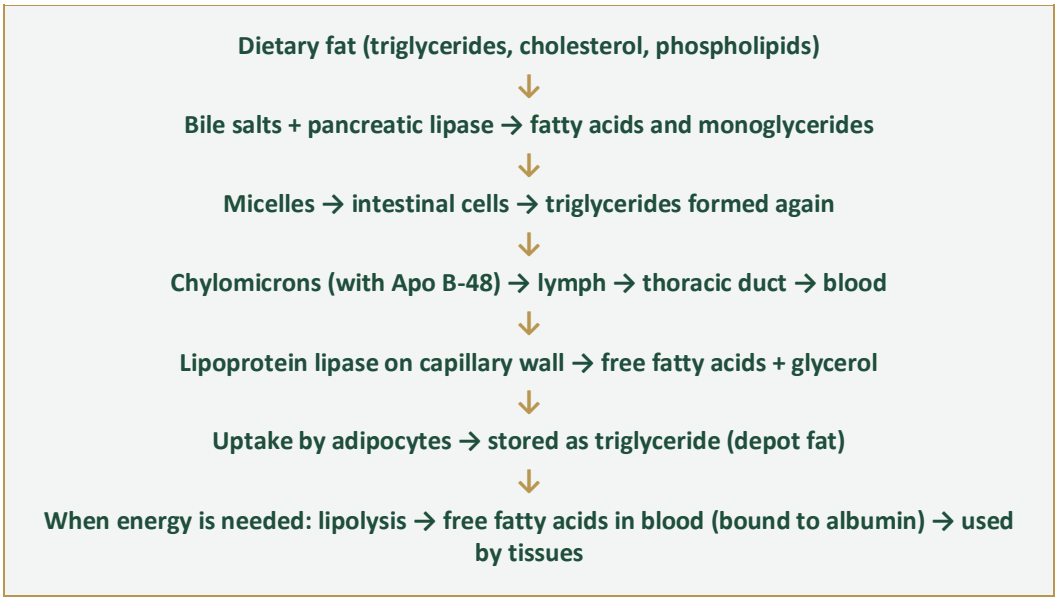
4.2.6 Formation of Fat (Lipogenesis)

When we eat more carbohydrate than the body needs at once, a small part is stored as glycogen, but the store of glycogen is limited to a few hundred grams. The extra glucose is broken down to acetyl-CoA, and from it fatty acids are built in the liver with the help of malonyl-CoA and NADPH. These fatty acids join with glycerol-3-phosphate to form triglycerides. Extra amino acids from protein can also be changed into acetyl-CoA and then into fat. The liver packs the new triglycerides into very low-density lipoproteins (VLDL) and sends them to adipose tissue for storage. Insulin is the main hormone that favours fat storage.

4.2.7 Digestion, Absorption and Transport of Fat

Fat digestion begins a little in the mouth and stomach by lingual and gastric lipase, but most of it happens in the small intestine. Bile salts break fat into small drops (emulsification), and pancreatic lipase with colipase splits triglycerides into free fatty acids and 2-monoglycerides. These form tiny micelles with bile salts and reach the intestinal cells. Short-chain fatty acids go directly into the portal blood. Long-chain fatty acids are joined again into triglycerides inside the intestinal cells, packed with cholesterol, phospholipids and apoprotein B-48 into chylomicrons, and sent into the lymph.[23]

Fat moves in blood by two routes. In the **exogenous pathway**, chylomicrons carry food fat from the intestine through the lymph into the blood. The enzyme lipoprotein lipase on the walls of capillaries breaks their triglycerides, and fat cells and muscle cells take up the fatty acids. The leftover chylomicron remnants go to the liver. In the **endogenous pathway**, the liver sends out VLDL. VLDL loses its triglycerides and becomes IDL and then LDL, which gives cholesterol to body cells. HDL picks up extra cholesterol from the tissues and takes it back to the liver; this is called reverse cholesterol transport.[24] Flow Chart 2 and Table 5 show these steps.



Flow Chart 2: Journey of food fat to the fat store

Table 5: Plasma lipoproteins at a glance

Lipoprotein	Made in	Main content	Main work
Chylomicron	Intestine	Food triglyceride; Apo B-48	Carries food fat to tissues
VLDL	Liver	Triglyceride made in the liver; Apo B-100	Carries liver fat to fat and muscle
IDL	From VLDL in blood	Triglyceride and cholesterol	Short-lived; turns into LDL
LDL	From IDL in blood	Mostly cholesterol; Apo B-100	Gives cholesterol to cells; high level harms arteries
HDL	Liver and intestine	About 50% protein; Apo A-I	Takes extra cholesterol back to the liver (protective)

4.2.8 Breakdown of Fat (Lipolysis and Beta-oxidation)

During fasting, exercise, stress or illness, hormones such as adrenaline, noradrenaline, glucagon, cortisol and growth hormone switch on lipase inside the fat cell. Stored triglyceride is split into glycerol and free fatty acids. Free fatty acids travel in blood bound to albumin. Inside the cells they are carried into the mitochondria by carnitine and broken down step by step (beta-oxidation) to acetyl-CoA, which enters the citric acid cycle to give ATP. Glycerol goes to the liver and can be used to make glucose. Insulin stops this breakdown.[25,26]

4.2.9 Measurement of Body Fat

Body fat is assessed by body mass index (BMI), waist circumference, waist-to-hip ratio, skinfold thickness, bioelectrical impedance and dual-energy X-ray absorptiometry (DEXA). For Asian Indians, a BMI of 23–24.9 kg/m² is taken as overweight and 25 kg/m² or more as obesity, and a waist size above 90 cm in men and 80 cm in women shows abdominal obesity.[27]

4.2.10 Disorders of Body Fat

Excess fat: Obesity, especially abdominal obesity, leads to insulin resistance, type 2 diabetes, high blood pressure, dyslipidemia (high triglyceride, high LDL and low HDL), fatty liver, sleep apnoea, joint disease and heart disease. Excess fat also causes heavy sweating, body odour and breathlessness on effort. **Too little fat:** Severe undernutrition, wasting in chronic disease (cachexia) and lipodystrophy reduce body fat. These lead to weakness, dry skin, feeling cold, poor healing and hormonal problems.

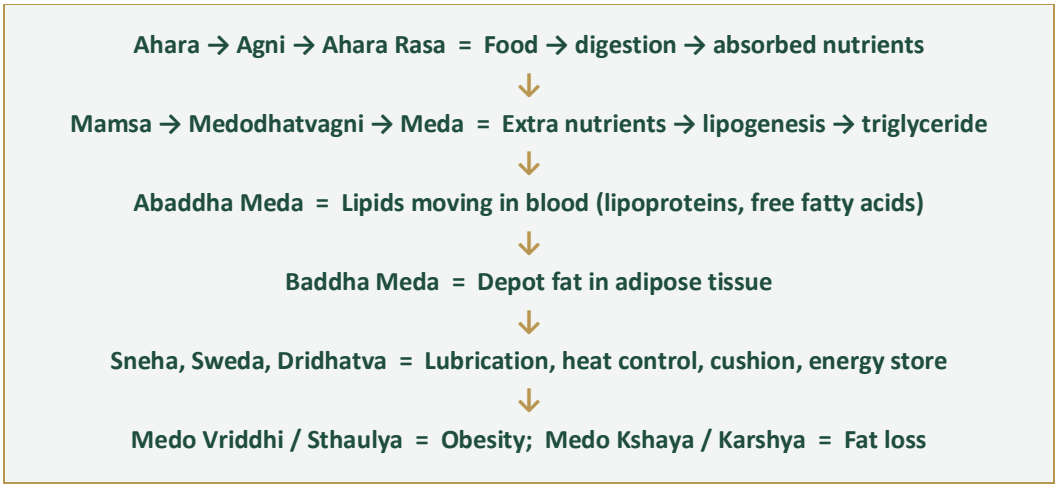
5. OBSERVATIONS AND RESULTS

After a careful comparison of both views, the following points of similarity were found. They are summed up in Table 6 and Flow Chart 3.

Table 6: Correlation between Medo Dhatu and human body fat

Aspect	Medo Dhatu (Ayurveda)	Human body fat (Modern)
Definition	Fourth Dhatu; gives oiliness and bulk	Loose connective tissue made of adipocytes
Origin	From Mamsa Dhatu by Medodhatvagni	From food fat and from extra carbohydrate and protein (lipogenesis)
Composition	Jala and Prithvi Mahabhuta dominant	About 80–90% triglyceride, little water
Guna	Snigdha, Guru, Mridu, Manda, Sthira	Oily, soft, heavy, slow to change
Fixed form	Baddha Meda in Medodhara Kala	Depot triglyceride inside fat cells
Moving form	Abaddha Meda moving with Rasa and Rakta	Chylomicrons, VLDL, LDL, HDL and free fatty acids
Main sites	Udara, Sphik, Stana, Gala; Anu Asthi	Belly (visceral) fat, hips, breasts, neck; yellow bone marrow

Aspect	Medo Dhatu (Ayurveda)	Human body fat (Modern)
Mula of Srotas	Vrikka, Vapavahana, Kati, Mamsa	Perirenal fat, omentum, gluteal fat, muscle fat
Functions	Sneha, Sweda, Dridhatva, Asthi Pushti	Lubrication, heat control, cushion, energy store, links with bone
Control	Medodhatvagni; Kapha as Ashrayi	Enzymes and hormones (insulin, glucagon, adrenaline)
Mala	Sweda	Sweat linked with heat control; more sweating in obesity
Upadhatu	Snayu (and Sandhi)	Ligaments and tendons (connective tissue)
Quantity	Meda 2 Anjali + Vasa 3 Anjali	About 15–30% of body weight
Excess	Medo Vriddhi, Sthaulya, Prameha Purvarupa	Obesity, dyslipidemia, diabetes, metabolic syndrome
Deficiency	Medo Kshaya, Karshya	Undernutrition, cachexia, lipodystrophy
Best state	Medosara Purusha	Healthy body composition



Flow Chart 3: Correlation of Medo Dhatu with human body fat

6. DISCUSSION

The present study was done to understand Medo Dhatu in the light of modern knowledge of body fat. The review shows that the Ayurvedic idea of Meda is not just a name for a tissue. It is a full concept that covers how fat is made, where it is kept, how it moves, what work it does and what happens when it is too much or too little.

6.1 Structure and Guna

Medo Dhatu is Snigdha, Guru, Mridu and Sthira, with Jala and Prithvi dominant. Adipose tissue is also oily, soft and bulky. It is mostly made of triglyceride and holds very little water. The Prithvi part explains its bulk and fixed shape, and the Jala part explains its oiliness and softness. Thus, the Gunas of Meda are a simple and accurate description of the physical nature of body fat.

6.2 Formation: Dhatvagni and Lipogenesis

The classics say that Meda is formed from Mamsa by Medodhatvagni, with a rise of Teja and Jala qualities. In modern terms, extra nutrients are changed by enzymes in the liver and fat cells into triglyceride. The “Agni” of Meda can be understood as the group of enzymes and hormones, such as fatty acid synthase, lipoprotein lipase, hormone-sensitive lipase and insulin, that control the making and breaking of fat. When Medodhatvagni is weak (Manda), fat is formed in a raw, poor form and gets stored in excess. This is close to the modern idea of insulin resistance and poor fat burning in obesity.

The three Nyayas also have modern meaning. Ksheera-Dadhi Nyaya fits the chain of chemical change from glucose to acetyl-CoA to fatty acid to triglyceride. Kedari-Kulya Nyaya fits the supply of nutrients by blood to each tissue in turn. Khale-Kapota Nyaya fits the selective uptake of fatty acids by fat cells with the help of lipoprotein lipase and fatty acid transport proteins on the cell wall.

6.3 Baddha Meda, Abaddha Meda and Lipid Transport

The division of Meda into Baddha and Abaddha is one of the strongest points of this correlation. Baddha Meda is fixed and stored, just like triglyceride inside fat cells. Abaddha Meda moves with Rasa and Rakta and feeds the stored fat, just like chylomicrons and VLDL that bring triglyceride to fat tissue, and free fatty acids that leave the store when needed. The classical idea that excess Abaddha Meda blocks the channels (Margavarodha) matches the modern view that high LDL and triglyceride levels in blood lead to fat deposits in artery walls (atherosclerosis).

6.4 Sites: Medodhara Kala and Medovaha Srotas

Sushruta places Meda mainly in Udara and in small bones (Anu Asthi). The Udara fat matches visceral fat, which today is known as the most harmful fat in metabolic disease. The fat in small bones matches yellow bone marrow fat, which is now studied as a separate fat store that is linked with bone health.[28] The roots of Medovaha Srotas are Vrikka and Vapavahana. The kidneys are surrounded by a thick layer of perirenal fat, and Vapavahana is the omentum, which is a large fat apron in the abdomen. So, the classical Mula points directly to two of the main fat depots of the body. The places of Baddha Meda, namely Udara, Sphik, Stana and Gala, are the very places where fat collects in obesity.

6.5 Functions: Sneha, Sweda and Dridhatva

Sneha, the best function of Meda, is seen in the oily look of healthy skin, hair and eyes. Modern science also shows that skin lipids, sebum and fat under the skin keep the skin soft and protect it. Dridhatva matches the cushioning and support given by fat to the kidneys, eyeballs, heart and soles. The classical statement that fat persons bear cold better matches the insulating role of subcutaneous fat. The link of Meda with Sweda is also meaningful. Sweat is the main way the body loses heat, and fat changes heat balance. That is why obese people sweat more and can have body odour, which is exactly the Swedabadha and Daurgandhya of Sthaulya.

6.6 Asthi Pushti

Ayurveda says that Meda nourishes Asthi. Modern research shows that fat and bone are closely linked. Fat cells and bone cells come from the same stem cells in the marrow, and hormones from fat such as leptin and oestrogen affect bone strength.[28] Very low body fat, as in severe undernutrition, is linked with weak bones. These findings give a modern base to the old idea of Asthi Pushti by Meda.

6.7 Kapha and Meda

Kapha lives in Meda, and both share the same Gunas. This explains why Kapha-increasing food and habits also increase fat. In modern terms, rich food, a high insulin level and less physical activity all favour fat storage. Hence, Kapha–Meda balance can be compared with the balance between fat storage (driven by insulin) and fat burning (driven by glucagon, adrenaline and exercise).

6.8 Quantity

Meda and Vasa together are given as 5 Anjali, which is roughly one-eleventh of the body parts that are measured in the classics. Modern data show that body fat is about 15–30% of body weight in healthy adults. The numbers cannot be matched exactly, because the Anjali is a measure of volume based on a person's own palm, while modern data use weight. Still, both systems agree that fat is a large and measurable part of the body, and both accept that its amount changes from person to person.

6.9 Disease: Medo Vriddhi and Medo Kshaya

The causes of Sthaulya given by Charaka, such as overeating, heavy and sweet food, no exercise, daytime sleep, a worry-free easy life and family tendency, are the same as the modern causes of obesity: extra calories, sedentary life, poor sleep habits and genetic factors. The eight problems of Atisthaulya, such as short life, slow movement, weakness, too much sweating and too much hunger and thirst, match the modern complications of obesity. Medo Pradoshaja Vikara like the Purvarupa of Prameha and Madhumeha match the link between obesity and type 2 diabetes, and Medoja Arbuda matches a lipoma. On the other side, the signs of Medo Kshaya, such as cracking joints, dryness, thin belly and weakness, match low body fat in undernutrition and wasting diseases. The desire for fatty food in Medo Kshaya is a natural way of the body to make up for its loss.

6.10 Medosara Purusha

Medosara describes a person whose fat is of the best quality, not just large in amount. Such a person has an oily glow, a good voice and a soft nature. This can be compared with a person who has a healthy body composition, with enough fat in the right places and good metabolic health. This idea can be used in future studies that compare Sara assessment with body fat percentage and blood lipid levels.

6.11 Points of Difference

Some differences should also be noted. Medo Dhatu is a functional concept based on Guna, Karma and Dosha, while adipose tissue is a structural and chemical concept. Upadhatu Snayu has no direct link with fat in modern anatomy. Brown fat and the hormone-producing work of fat are not clearly described in the classics, although the link of Meda with heat and with hunger can be seen as a hint. So, the correlation is useful for understanding, but it should not be taken as an exact one-to-one match.

7. CONCLUSION

The present conceptual study shows that the classical concept of Medo Dhatu agrees closely with the modern knowledge of human body fat. Medo Dhatu is the fourth Dhatu, formed from Mamsa Dhatu by Medodhatvagni, with Jala and Prithvi dominant. Its Snigdha, Guru and Mridu nature, its functions of Sneha, Sweda, Dridhatva and Asthi Pushti, and its close link with Kapha Dosha match the soft, oily and bulky adipose tissue that stores energy, controls heat, protects organs and supports bone.

Baddha Meda corresponds to stored depot fat, and Abaddha Meda corresponds to circulating lipids. Medodhara Kala in Udara and Anu Asthi corresponds to visceral fat and bone marrow fat, and the Mula of Medovaha Srotas, Vrikka and Vapavahana, corresponds to perirenal fat and the omentum. Medo Vriddhi and Sthaulya are similar to obesity, dyslipidemia and type 2 diabetes, while Medo Kshaya and Karshya are similar to loss of body fat. Hence, Medo Dhatu can be understood as the Ayurvedic view of adipose tissue together with circulating lipids. Keeping Medo Dhatu in balance through right food, exercise and healthy daily routine is the key to preventing fat-related disorders. These links are conceptual and should be confirmed by clinical and laboratory studies.

Limitations of the Study

- This was a literary study, and no clinical or laboratory work was done to prove the correlation.
- Classical verses can be explained in more than one way, and verse numbers differ between editions.
- Modern data were taken from secondary sources such as textbooks and published papers.
- Body fat measurement, lipid profile and statistical analysis were not part of this study.

Scope for Further Study

- Clinical studies to relate Medo Vriddhi and Medo Kshaya with lipid profile, BMI, waist size and DEXA findings.
- Studies on the assessment of Medosara and its link with body fat percentage.
- Studies on the role of Medodhatvagni in metabolic syndrome and insulin resistance.
- Trials of Ayurvedic diet, Vyayama, Udvartana and drugs that act on Medovaha Srotas in obesity and dyslipidemia.

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DECLARATIONS

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