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Review Article

ROLE OF *GOGHRTA* (COW'S GHEE) AND MEDICATED *GHRTA* (MEDICATED GHEE) IN METABOLISM AND MANAGING METABOLIC DISORDERS

Harishma Asok.S[1]*, Arjun Chand.C.P[2], Arun Pratap[3], Kasthuri Nair.A[4]

*[1]Final Year PG Scholar, [2]Associate Professor, [3]HOD and Professor, [4]Assistant Professor, Department of Kayachikitsa, Pankajakasthuri Ayurveda Medical College and PG Centre, Killy, Kattakada, Thiruvananthapuram, Kerala, India.

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ABSTRACT

Metabolism is a complex process involving all the chemical reactions in the body to maintain life and is controlled by various hormones and enzymes. Carbohydrate, lipid and protein metabolism are the processes by which the body converts nutrients into energy and other essential molecules. According to Ayurveda, the overall metabolism of the body depends upon proper functioning of *Agni* and improper dietary habits cause deranged functioning of *Agni* leading to various metabolic disorders. Maintaining a strong *Agni*, balancing the *Doshas*, nourishing the *Dhathu* through a healthy diet is a key way to optimize metabolism. *Goghrta* (Cow's ghee) has been given foremost importance and has been an inevitable part of diet in the Indian cuisine. Ayurveda considers *Goghrta* as the best among all fats. *Ghrta* can act on various levels of metabolism correcting the functions of *Agni, Doshas* and *Dhathus*. When digestion becomes normal *Poshaka dhathu* is formed from excellent *Ahara rasa* which enhances *Bala, Varna, Ojas* etc. The *Rasayana* effect of *Ghrta* helps to maintain the quality of *Dhathus* formed thereby promote health and longevity by improving metabolism and provides a healthy body. So it is good to include *Goghrta* in our daily diet in small quantities but large quantity may cause difficulty in digestion leading to *Ama* formation. Due to the *Samskarasya Anuvarthana* and *Yogavahi* property, medicated *Ghrta* makes it wider application in different diseased conditions. This review is to highlight the potential health benefits of *Goghrta* in metabolism and the role of medicated *Ghrta* in managing metabolic disorders.

INTRODUCTION

Food is the basic necessity of living being since it contains nutrient essentials of life. Ayurveda is concerned with both maintaining and promoting good health, as well as curing illness; emphasizing the importance of food. It can be noted that Hippocrates, the Father of medicine was conscious about the various aspects of nutrition. He has said that "Let food be thy medicine and let medicine be thy food". Ayurveda strongly believes that overall metabolism of the body depends upon proper functioning of Agni and improper dietary habits cause deranged functioning of *Agni* which may lead to *Ama* formation that initiates the series of pathological events in the body.

The importance of ghee in Indian diets has been recognized from prehistoric days because of its excessive nutritive value, pleasant aroma and textual properties. Ghee is viewed as an energy rich food that is rich in essential fatty acids, fat soluble vitamins and growth promoting factors. It has been accepted as best fat to other fats, for its better digestibility and anti cancerous properties. The anti oxidant properties of ghee help to increase HDL level and decrease LDL level in blood[1]. This review highlights the potential benefits of *Goghrta* for improving and maintaining metabolism, as well as the role of medicated Ghrta in managing metabolic disorders.

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Metabolism

Metabolism refers to the set of chemical reactions that occur in an organism to maintain life. These reactions are responsible for breaking down food to produce energy and building up molecules necessary for growth and repair of tissues. The rate of metabolism varies among individuals and is influenced by factors such as age, body composition, and physical activity level. Catabolism breaks down complex molecules to release energy whereas anabolism builds up complex molecules from simple ones utilising energy. Together, catabolism and anabolism forms the balance of energy consumption and production in the body which are essential for maintaining homeostasis.

Carbohydrate, Lipid and Protein Metabolism

Carbohydrate metabolism is the processes by which the body converts and uses carbohydrates as a source of energy. The breakdown of carbohydrates into simple sugars, such as glucose mainly occurs in the small intestine and the transport of simple sugars into the bloodstream can be used as a source of energy by cells. Cellular respiration involves four sets of reaction: Glycolysis, Formation of Acetyl Coenzyme A, Kreb's cycle and electron transport chain. Other key pathways involved are Glycolysis, Glycogenesis, Glycogenolysis, Gluconeogenesis.

Lipid metabolism involves the process by which the body converts and uses lipids (fats) as a source of energy and for the synthesis of important molecules such as hormones and cell membranes. Cholesterol is an important component of cell membranes and Triglycerides are the main forms of stored fat from excess glucose and fatty acids. The breakdown of dietary fats into fatty acids and glycerol occurs in the small intestine. The transport of fatty acids and glycerol into the blood stream, can be used as a source of energy by cells. The main pathways involved are lipolysis and lipogenesis.

During digestion, proteins are broken down into amino acids. These amino acids are used to synthesize new proteins for body growth and repair. Excess dietary amino acids are not excreted out instead converted into glucose (gluconeogenesis) or triglycerides (lipogenesis) or damaged proteins are broken down into their component amino acids, which can be used for energy or reassembled into new proteins.

Role of Hormones in Regulating Metabolism

Hormones play a crucial role in regulating metabolism and maintaining the balance of energy and nutrients in the body. Any disruption to hormone levels can lead to metabolic disorders such as diabetes, obesity and thyroid disorders. Some of the key hormones involved in metabolism are: Insulin, glucagon, epinephrine and norepinephrine, thyroid hormones, cortisol, growth hormones[2,3]

Ayurvedic Understanding of Metabolism

The food which is *Panchabhouthika* and *Shad rasatmaka* undergoes the process of digestion and from digested part of food, *Sukshma* (subtle), *Saara* (pure) and *Tejobhutha Ahara rasa* is formed. The main purpose of *Agni* is to digest and metabolise various components of the food and help in nourishment of body tissues. *Jatharagni* acts on the food in GIT and transforms it into absorbable form. *Bhuthagni* convert food into the form which can be assimilated at tissue level. *Dhatvagni* acts at tissue level and helps in tissue nourishment. These three steps of metabolism can be correlated with digestion (hydrolysis), intermediary metabolism (preparatory phase), and the Kreb's cycle.

The main *Doshas* involved in the process of digestion are *Samana vayu, Pachaka pitta* and *Kledaka kapha*. *Samana vayu* controls all neurohormonal influences involved in digestion which includes the control of enteric nervous system and parasympathetic nervous system. *Kledaka kapha* helps in moistening of food thus facilitates proper functioning of *Pachaka pitta* which is responsible for dividing *Anna* into *Saara* and *Kitta bhaga*. The *Samana vayu* moves all over the *Koshta* and does *Grahana, Pachana, Vivechana* and *Munjana*. Under the control of *Samana vayu*, *Ahara rasa* get absorbed in the blood and transported to *Hridaya. Rasa* and *Raktha dhathu* along with *Ahara rasa* get pumped from *Hridaya* and circulated to every organ. *Vyana vayu* controls circulation of *Rasa dhathu* so that whole body gets nutrition. *Ahara rasa* nourishes all *Dhathus* and preforms functions like *Tarpana, Vardhana*, *Dharana* and *Yapana. 'Santhathya bhojyadhathunam parivrithasthu chakravath'*-cyclical process of synthesis and breakdown of *Dhathu* can be considered as Metabolism of *Dhathu.* The nutrients of *Dhathu* obtained from *Ahara rasa* is *Poshaka dhathu* while *Dhathu* synthesised from *Poshaka dhathu* is *Poshya dhathu (Sthayi dhathu*).[4]

Importance of Cow's Ghee (*Goghrta*) in Metabolism

Ghee, also known as clarified butter is a complex lipid consisting of glycerides (majorly triglycerides-98%), free fatty acids(1-10mg/100g), phospholipids (0-80mg/100), sterols, fat soluble vitamins, carbonyls (4-6ug/g), glyceryl ethers (0.8Um/g) and alcohols (1.8-2.3Um/g).[5] It contains 46-47.8% Saturated Fatty Acids (SFA), 36% Mono Unsaturated Fatty Acid (MUFA), 18% of Poly Unsaturated Fatty Acid (PUFA) and a significant quantity of ruminant Trans-Fatty Acids (r TFA)[6].

Ghee is a good source of short and medium chain fatty acids, which are quickly metabolized for energy and do not contribute to the accumulation of fat in adipose tissue. This may contribute to improve carbohydrate metabolism by providing an alternative source of energy and reducing the need for glucose.

Butyric acid, a short chain fatty acid is exclusively present in ghee which contributes to its distinct flavour and easy digestion. It may have a beneficial impact on lipid metabolism by reducing inflammation and promoting healthy gut bacteria. Beneficial intestinal bacteria convert fibre into butyric acid and use it for energy and intestinal support[7]. It is proved that people with unhealthy digestive tracts do not produce butyric acid. Research shows that adequate production of butyric acid supports the production of killer T cells in the gut and a strong immune system [8].

Ghee is an important source of fat soluble vitamins like Vit A, D, E, K which can provide various health benefits for the body. The essential fatty acids and fat soluble vitamins which cannot be synthesised by body are obtained by consuming ghee. Among that Vit A and E are anti oxidants. Vit A provides healthy vision, boosts immune system functions and skin health. Vit D is important for bone health especially to children and pregnant women and also in absorbing calcium and phosphorus elements from the diet. Vit E is an antioxidant that helps protect cells from damage and is essential for normal pregnancy, birth and breast milk production. Vit K is important for blood clotting and bone health.

All these vitamins and other nutrients found in ghee can provide important health benefits when consumed in appropriate quantity thereby regulates the normal metabolism in the body

Table 1: Chemical Constituents of Cow's Ghee[9]

Constituents	**Percentage**
Triglycerides	97.098%
Diglycerides	0.25 -1.4%
Monoglycerides	0.16-0.038%
Ketoacid glyceride	0.015-0.018%
Glyceryl esters	0.011-0.015%
Free fatty acid	0.1-0.44 %
Phospholipids	0.2-1.0%
Sterols	0.22-0.4%
Vitamins A	2500 I.U (per 100gm)
Vitamin D	8.5 *10.7gm (per 100gm)
Vitamin E	24 * 10.3gm (per 100gm)
Vitamin K	1*10.4gm (per 100gm)
Butyric acid	4.5 -6.0%
Caproic acid	1.0-1.36%
Caprylic acid	0.9-1.0%
Lauric acid	6.0-7.0%
Myristic acid	21.0 -23.0%
Palmitic acid	19.0- 19.5%
Stearic acid	11.0-11.5%
Arachidonic acid	0.5-0.8%
Oleic acid	27.0 -27.5%
Linoleic acid	4.0-5.0%

Goghrta

Ayurveda values *Ghrta* as a treasured food as it has a number of healing properties. *Ghrta* balances *Pitta, Vata* and is acceptable for *Kapha* in moderation. It is considered as the best among all fats having *Madhura rasa*, *Guru snigda guna, Shita virya, Madhura vipaka,* nourishes *Kapha*, increase immunity, boosts memory and intelligence, increases semen and is good for *Ojas*. The consumption of *Ghrta* is good for health as it promotes longevity, increases *Agni*, improves absorption and assimilation.

Table 2: Pharmacological actions of *Goghrta*[10]

S.No	Pharmacological properties	S.S	C.S	A.H	D.N	K.N	B.P
1.	*Tejo vridhi*	+	-	-	-	-	+
2.	*Nirvapana*	-	+	-	-	-	-
3.	*Ojo vridhi*	+	+	+	-	+	+
4.	*Mrdukara*	-	+	-	-	-	-
5.	*Rasayana*	-	-	-	-	-	+
6.	*Swara prasada*	+	+	+	-	+	+
7.	*Chakshushya*	+	-	+	+	+	+
8.	*Varna prasada*	-	+	-	-	+	-
9.	*Vayasthapana*	+	-	+	-	+	+
10.	*Smriti vridhi*	+	+	+	+	+	+
11.	*Ayushya*	+	-	+	+	-	+
12.	*Budhi vridhi*	+	+	+	+	+	-
13.	*Balakara*	+	-	+	+	+	+
14.	*Agni vridhi*	+	+	+	+	+	+
15.	*Soukumarya*	+	-	+	+	-	-
16.	*Medo vridhi*	+	-	+	+	+	+
17.	*Kanthi vridhi*	+	-	+	+	+	+
18.	*Brihmana*	-	-	-	-	+	-
19.	*Rochana*	-	-	-	-	-	+
20.	*Lavanya vridhi*	+	-	-	-	-	+

Role of Medicated *Ghrta* in Metabolic Disorders

The major component in metabolism related disorders is *Agnidushti. Kapha dosha vridhi* due to *Avyayama, Divaswapna,* excessive intake of *Madhura, Snigda, Guru* or *Kapha Vardhaka Ahara* causes *Medodhatvagnimandya* resulting in excessive increase of *Medodhathu*. The raised *Medodhathu* in the form of *Abadha medas* circulates with *Rasa* and *Raktha dhathu* and disrupts the normal metabolism resulting in various metabolic disorders.

'Snehameva param vidyath durbala agnidipanam' - *Ghrta* is best to increase the low digestive power[11]. The *Dipana guna* of *ghrta* promotes *Agni* and relieves *Srothorodha* and *Agnimandya*. *Ghrta* is considered superior owing to its special attributes i.e., *Samskarasya Anuvarthanam* (It carries the properties of drugs without leaving its inherent properties).[12] This quality of *Ghrta* makes it an excellent vehicle for drug administration as it facilitates the dispersion of all medicinal properties to the deepest tissues making it a best catalytic agent. With regard to the three *Doshas*, *Ghrta* pacifies *Vata* by its unctuousness, *Pitta* by its coldness and *Kapha* when combined with *Kapha* pacifying herbs. The lipophilic nature of *Ghrta* circulates the therapeutic benefits of drugs into the cells including the brain as it is able to cross blood brain barrier. Due to the *Yogavahi* property, *Ghrta* helps to carry the therapeutic properties of herbs to all the body tissues easily. This unique nature of *Ghrta* makes it wider application in different disease conditions.

Mandagni, Kapha medo dushti, Srotorodha & Vatakopa are the important factors involved in the

pathogenesis of *Medoroga* (metabolic disorders). Therefore *Agnidipana, Amapachana, Kaphamedo-anilapaha* and *Srothosodhana chikitsa* should be given. Medicated *Ghrta* having *Katu Tiktha Kashaya rasa*, *Laghu ruksha guna*, *Ushna virya, Katu vipaka, Ama pachaka, Agni deepaka* properties may help to disrupt the pathogenesis.

Ghee is a significant source of Conjugated Linoleic Acid (CLA) that helps to decrease inflammatory mediators such as leukotrienes, prostaglandins and interleukins. Ghee has the potential to lower the Arachidonic acid metabolite level that decrease the secretion of leukotriene which is also recommended in preventing Atherosclerosis, Cardiovascular disease[13]. CLA has proven antidiabetic effect due to complex gene regulation vital in reducing adiposity, improved insulin action and signal transduction in skeletal muscles[14]. Oleic acid and conjugated linoleic acid present in ghee also decrease LDL to resist oxidation, which further prevent plaque formation.

Abundance of MUFA including omega-7, omega-9 fatty acids like oleic acid, vaccenic acid, Conjugated Linoleic Acid(CLA) along with traces of fat-soluble vitamins K2,A,D,E contributes to anti-atherogenic, anti-diabetic, anti-hypertensive, immunomodulatory effect[15]. PUFA mainly omega-3, omega-6 fatty acids like Alpha-linolenic acid (ALA), Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) reduces the risk of hypercholesterolemia and Cardiovascular diseases. The presence of TFA from ruminants exhibited no negative effect on coronary heart disease risk, but acted as anti-obesity, anti atherogenic, antidiabetic, antimutagenic, antihypertensive, immunomodulatory[16,17].

DISCUSSION

In the last several decades, *Ghrta* has been seen as a source that increases the prevalence of CAD as it contains saturated fatty acids and cholesterol. According to one group, *Ghrta* is highly saturated and has got a hypercholesteraemic potential and with changed lifestyle *Ghrta* may not be safe. Others hold the opinion that all saturated fats are not chemically alike and *Ghrta* being a medium chain triglyceride it will not cause fatty deposits and thereby it is neutral.

Ghee is composed of primarily saturated fats, including medium chain fatty acids (MCFAs).The absorption of ghee differs from other fats due to its high concentration of MCFAs. MCFA in ghee are smaller in size and water soluble than long chain fatty acids which make it easily absorbed by the small intestine and are transported directly to the liver via the portal vein bypassing the lymphatic system. This direct transport to the liver makes MCFAs rapidly oxidised for energy or converted to ketones which are used as energy source by brain and other organs[18]. So, the consumption of ghee in moderation may help boost energy levels and improve metabolic functions.

'Sneha saaro ayam purusha'- Man is essentially made of *Sneha* and is amenable to *Sneha*[19]. The *Rochana* property of *Ghrta* may help to increase the saliva secretion in mouth which contains digestive enzymes that can break down carbohydrates and initiate the digestion of food. The *Snigda, Mrdukara guna* may help to lubricate the digestive tract and promote smooth and easy digestion. *Ghrta* can act on various levels of metabolism including *Jatharagni, Bhuthagni* and *Dhatvagni.* At *Jatharagni* level it may correct the functions of *Samanavayu, Pachaka pitta, Kledaka kapha* thereby controls the neurohormonal activation, digestive enzymatic hormonal secretion and digestion respectively. *Teja* and *Agni Mahabhutha* are predominant in *Ghrta* which may help to improve the liver function and correct the liver enzymes. *Medo vridhi guna* of *Ghrta* may increase the HDL cholesterol levels in blood and removes excess cholesterol from the body cells and transport it to liver for elimination thereby regulating the lipid metabolism. When digestion becomes normal *Poshaka dhathu* is formed from excellent *Ahara rasa* which enhances *Bala, Varna, Ojas*, strengthens *Indriyas* and even boost the immune system. The *Rasayana* effect of *Ghrta* helps to maintain the quality of *Dhathus* formed thereby promote health and longevity by improving metabolism and provides a healthy body. So it is good to include *Goghrta* in our daily diet in small quantities but large quantity may cause difficulty in digestion leading to *Ama* formation.

Agni, Koshta, Prakruti, Age of an individual are the essential factors that should be considered before administering *Ghrta. Goghrta* is contraindicated for some individuals at certain times. Those having *Santharpanajanya vikaras*, being over obese and having *Kapha, Medas* in excess and those who do not do regular exercise should not take *Goghrta* in excess or regularly. In such conditions, medicated *Ghrta* can be taken preceded by *Dipana pachana.*

CONCLUSION

The present review briefly describes the potential health benefits of ghee in metabolism and the role of medicated *Ghrta* in managing metabolic disorders. Ayurveda believes that the body is a product of nutrition, and that diseases can arise due to impaired nutrition. Consumption of *Ghrta* in moderate quantity will act as *Hitha Ahara* as well as an *Oushadha* for increasing the bodily functions and for the prevention of diseases.

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***Address for correspondence**
Dr. Harishma Asok.S
Final Year PG Scholar
Department of Kayachikitsa,
Pankajakasthuri Ayurveda Medical College and PG Centre, Kattakada,
Thiruvananthapuram, Kerala.
Email: harishmasok310@gmail.com