AYURLINE: IJ-RIM

International Journal of Research in Indian Medicine

Article Received Date: 13 /09 /2024 Reviewed on Date: 27 /11/2024 Accepted on: 18/12/2024

Ayurverdic management of non-communicable disease

Surve P. P.[1], Survase M.R. [2]*

1. Asso. Professor, Dept. of Dravyaguna, 9422211662 dr.pankajps@gmail.com
2. Asso. Professor, Dept. of Pancahkarma,

CSMSS Ayurvedic Mahavidyalaya, Kanchanwadi, Chhatrapati sambhajinagar, Maharashtra.

***Corresponding Author**: drmegha26@gmail.com; 8149888802

Abstract:

Ayurveda is ancient science of life that aims to maintaining the healthy life as well as preventing the disease for the benefit of human beings. It has proven its importance from time immortal. The acharya like Charaka, Sushruta had mentioned about various diseases/disorders along with the management and treatment in their respective treatise. These learnings from ancient acharyas still have proven its significant from time to time.

Ayurveda and modern science both mentioned the nearabout same characteristics in case of Obesity and Diabetes. Unknowingly following repeated unhealthy life style leads to Non-Communicable diseases (NCDs).

This lifestyle disorder can be managed by following proper *Aahar-vihar*, *Panchakarma*, *Rasayan therapy* and usage of some herbal ayurvedic treatment acting as immunomodular, adaptogenic, antioxidant, hyperlipidemic. Immunomodulatory drugs modify the response of the immune system by increasing or decreasing the production of serum antibodies. Adaptogens help the body to adapt stress, maintain or normalize metabolic functions, and restore systemic equilibrium. Antioxidants modulate oxidant-antioxidant profile of body system by neutralizing pro-oxidant molecules. Antihyperlipidemic drugs reduces elevated levels of LDL and decreased level of HDL in the blood. Antilipidemic herbs are found effective. Some of the herbs that acts as Immunomodular, Adaptogenic, Antioxident, Antihyperlipidemic can be boon to the individuals that is suffering from lifestyle disorders like obesity and Diabetes.

Keywords: Ayurvedic treatment, Panchakarma, NCDs, Lifestyle disorder, Immunostimulators, Adaptogens, Antioxidants.

Introduction

The quality and health of a person's life is of most important thing that can be achieved using the indigenous science of Ayurveda. It is ancient science of life aiming to maintain the health as well as prevent a disease of human beings without untoward effect. In the classical literature of Ayurveda, the causes, types, symptoms about various diseases/disorders are elaborated along with its management and the treatment. The ancient acharya Charaka, Sushruta had quoted the proper usage of therapies and detailed about many herbs, single or compound to manage a diseased basis on its pathophysiological conditions. Many herbal formulations, therapies as Panchakarma are timely proven useful even in the today's era of

advanced modern medicaments.

According to National Institute of Nutrition, Hyderabad, about 20.7% and 26.3 % of women and men respectively were found to be overweight, in India during 2015-16. Even advance countries are suffering from the comorbid conditions related to unhealthy life style. These disorders are more effectively defined by assessing its linkage to morbidity and mortality. Hyperlipidemia if not managed increases risk of coronary heart disease and atherosclerotic heart disease.

In this day-to-day life, every individual is trying to achieve the goal in terms of physical comfort neglecting individual physical and mental health. This result in genesis of number of diseases among them lifestyle related disorders are common. The lifestyle disorders alike obesity or Diabetes are becoming a global public health issue. According to W.H.O Report-2002, obesity is amongst the top ten high risks factors leading to various life-style related disorders increasing morbidity and mortality. The individual having BMI greater than 25 kg/m3 is considered as overweigh and greater than or equal to 30 is obese. The coronavirus disease 2019 has recently become one of the most dominant health care burdens worldwide. Patients with obesity are at high risk of mortality from COVID-19 infection[1].

Medoroga and *Prameha* a is one of the lifestyle disorders characterised by deposition of *meda dhatu* (excess fat) into the body and excessive urination along with *meda and kleda* respectively.In ayurveda *Sthaulya* i.e. obesity has been described since very early days in various samhitas. Acharya Charaka has described sthaulya among eight most unhealthy personality in Ashtaunindatiya Aadhyaya as *'Ashtaunindatiya Purusha'* [2] and in *Santarpanjanya Roga* [3].

Atisthula i.e. obese person is mentioned by Charaka as one of the *Ashtaunindatiya purusha* hence such person is considered as undesirable one. In classical literature, "A person in whom there is excessive accumulation of Meda and Mansa leading to flabbiness of hips, abdomen and breast has been categorized as *Atisthaulya*. In ayurveda *Sthaulya* is considered as *Kashtasadhya vyadhi* i.e. difficult to treat, but can be managed.

Under the chapter of Santarpaneeya Adhyaya, the Charaka had enlisted '*Santarpanajanya vyadhi'* like prameha, obesity that are caused by over nourishment of bodily elements especially vitiated kapha doshas. Intake of diet having *snigdha, madhur, guru guna*, avoiding physical activity, unhealthy lifestyle like continue sleeping throughout day leads to number of diseases and result into lifestyle disorders[4].Individuals having sedentary life, inadequate practice of exercise (avyayam), day time sleeping (diwaswap), fatty diet (snigdha aahar), excess sweet food (madhuraanna) are suffering from medoroga i.e. obesity, as explained by Acharya Charaka and Bhavaprakasha.

According to modern science Obesity is a state of excess adipose tissue mass. Obesity is defined as a growth of the adipose tissue due to an enlargement of fat cell size (hypertrophic obesity) or increase in fat cell number (hyperplastic obesity) or combination of both. On the basis of onset, obesity is of three types as-insidious, gradual, rapid. While on the basis of severity –it is classified as-mild, moderate, severe. Increased body weight termed as obesity is outcome of faulty habits, behavior and life pattern of a individual. Protraction of such things may lead to other severe conditions. Obesity greatly increases risk of chronic disease morbidity namely disability, depression, type 2 diabetes, cardiovascular disease, certain cancers and mortality. Childhood obesity results in the same conditions, with premature onset, or with greater likelihood in adulthood[4]. Prameaha showing characteristic of excessive urination along with *meda and kleda* often corelated as Diabetes is well explained by acharya in Ayurdeda. Prameha disease includes twenty types basis on its symptoms. Some are easily manageable and is *sadhya*. Its treatment includes sanshodhana and upshaman[5].

It is clearly visible that in the Ayurveda and Modern science both mentioned the same characteristics in Obesity and Diabetes. In modern medicine, medications are available for the treatment of obesity as well as Diabetes but those find difficult to manage the condition with beneficial effects. Awareness regarding side effects have diminished enthusiasm for appetite suppressant drugs, particularly fenfluramine which carry serious risks. Other medications such as phentermine, orlistat, sibutramine are also available but they too cause to unpleasant side effects and hence have some limitations. In surgical field, Gastric bypass bariatric surgery is available as therapeutic modality to treat obesity. It is cost expensive and out of reach of common man. Other adjuvant procedure may be performed but have an unclear utility like visceral fat removal, omentectomy, subcutaneous fat, subcutaneous fat panniculectomy and large volume subcutaneous fat liposuction.

Pathophysiology of the disease

The *kledaka kapha, samana* and *vyanvayu*, *meda* i.e fat and lipid,*medodhatvagni mandata* are main responsible factors. According to Charaka its causative factors mainly exogenous and hereditary component along with its pathology, signs and symptoms, prognosis and management have been narrated in detail. Doshas of Sthaulya, aetiopathogenesis and pathophysiology of excessive hunger and thirst with its complication due to its ignorance. Acharya Sushruta had mentioned the aetiopathogenesis of Sthaulya Roga is an endogenous entity being caused due to *'Dhatvagni Mandya'*. Sthaulya is considered as physical condition of a body. Due to vitiated *Meda Dosha*, as a symptom of disturpt *Medo Vaha Strotas and Rasa Nimitaja* disorders.

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Mitthya yoga, Ayoga and *Atiyoga* of *kala,buddhi and indriya* are the *hetu* for any disease. The proper planning during each of three seasons i.e. *sheeta, ushna* and *varsha* is important otherwise it may lead to genesis of disease. *Pradnyaparadha* i.e. foolish decision regarding health can lead to disease formation. Over stress or unproper stress to five sense organs and its subjective can be responsible for genesis of diseases[6].

These mentioned factors must be considered before manifestation of disease, in order to prevent the condition. These have significance in various lifestyle related diseases like obesity.

Management of disease

Pancharkarma therapy: The Ayurvedic management of the non-communicable diseases can be managed by Pancharkarma therapies along with exercise, diet and regimen. Panchakarma are classical detoxification procedures using herbal medicaments that are beneficial to expel out vitiated doshas from the body and thus helps healing. Pancharkarma therapy mainly includes vamana (Emesis), virechana (Purgation), niroohavasti (Decoction enema), nasya (instillation of medicine through nostrils), and anuvasanavasti (Oil enema).

Various formulations of herbs for performing this therapy had been mentioned in classics for number of diseases. It is helpful in purification and healing of body as well as healthy condition of mind. Usage of the medicated decoctions like triphaladi kwath, Mustakadi kwath in panchakarma procedures are beneficial. Some churna as Haritaki churna, Triphala churna have found effective in skin completion and its diseases.

Physical effects of Panchakarma

1. **Weight Loss:** Panchakarma procedures like Basti (medicated enema) and Udwarthanam (powder massage) help reduce excess fat and promote weight loss.
2. **Improved Metabolism:** Panchakarma enhances metabolic rate, allowing the body to burn calories more efficiently.
3. **Reduced Body Mass Index** (BMI): Regular

Panchakarma treatments have been shown to decrease BMI, indicating a healthier weight-to-height ratio.

Physiological effects of Panchakarma

1. **Improved Insulin Sensitivity**: Panchakarma found to be beneficial to control the NCDs as obesity or diebetis Panchakarma helps regulate blood sugar levels and improve insulin sensitivity, reducing the risk of developing type II diabetes.. Basti of Panchatikta Ksheer have the property of anti-inflammatory, analgesic, antibacterial, antitoxin, antioxidant and antitumor, immunomodulator, hepato-protective and found useful in the management of diabetes mellitus type II [7].

2. **Enhanced Lipid Profile**: Panchakarma treatments have been shown to lower triglycerides, LDL cholesterol, and total cholesterol levels, reducing the risk of cardiovascular disease. Virechana Karma was highly effective in reducing the triglycerides level and Lekhana Basti was highly effective in reducing cholesterol level[8]..
A standard controlled clinical study on Virechana Karma and Lekhana Basti in the management of dyslipidemia (Medoroga) [9].

3**. Reduced Inflammation**: Panchakarma's anti-inflammatory effects help mitigate chronic inflammation, a known contributor to obesity-related diseases. The study found statistical improvements in several symptomatic outcomes, inflammatory markers (IL-6, CRP, NLR), and radiological changes (HRCT scores) [10]. The add-on Ayurveda group showed a better symptomatic response, and faster normalization in inflammatory markers [11].

Long-term effects of Panchakarma

1. **Sustainable Weight Loss**: Panchakarma's focus on lifestyle modifications and sustainable habits promotes long-term weight loss and maintenance.
2. **Improved Overall Health**: Regular Panchakarma treatments have been shown to reduce the risk of obesity-related diseases, such as heart disease, stroke, and certain types of cancer.
3. **Enhanced Quality of Life**: Panchakarma's holistic approach improves physical, mental, and emotional well-being, leading to an enhanced quality of life. Some *kwath* (decoction) like *triphaladi kwath, Mustakadi kwath* are found to be beneficial. Some *churna* (powdered drugs) as Haritaki churna, Triphala churna have mentioned as effective.

Rasayana therapy:

Rejuvenation therapy using some herbs that acts as immunomodular, Adaptogenic and Antioxident can be boon to the indivisuals that is suffering from lifestyle disorders.There are numerous preparation mentioned in ayurvedic text for treatment of Sthaulya and Lekhaneeya properties of dravya i..e. herbs.

Diet and regimen:

In the classical text of Ayurveda, detailed description of dincharya had been mentioned that found helpful to overcome the lifestyle disorder. Three seasons i.e. Summer, winter and summer are rutus that affect the tridoshas,dhatus and hampers the health of individual. A growing body of scientific evidence has demonstrated that lifestyle intervention is an essential component in the treatment of chronic disease that can be as effective as medication but considered to be safe without risks and side effects.
A growing body of scientific evidence has demonstrated that lifesty22le intervention is an essential component in the treatment of chronic disease that can be as effective as medication but considered to be safe without risks and side effects. The description about Dinacharya, Rtucharya, Sadvrtta and Nidra in Ayurveda clearly depicts the importance of a healthy regimen in the prevention and management of many diseaseshara and vihara forms the chief foundation up on which life of individual is founded[12].
It is generally thought that diet has no direct

relationship with diseases.Individual suffering from lifestyle disorder should follow regular exercised, timely eating habits. Consumption of Takra (Buttermilk) as well as Arista (alcoholic medicinal preparation) also found beneficial[13] He should consumption cereals as jewas and wheat[14].

Psychological effects of Panchakarma

1. **Reduced Stress**: Panchakarma's relaxing and rejuvenating effects help reduce stress and anxiety, common triggers for overeating and weight gain.
2. **Improved Mood**: The detoxifying and balancing effects of Panchakarma promote a sense of well-being and improved mood, reducing the likelihood of emotional eating.
3. **Increased Motivation**: Panchakarma's holistic approach empowers individuals to adopt healthier lifestyle habits, increasing motivation to maintain weight loss and overall well-being.

Panchakarma treatment offers a versatile approach to mitigate stress and enhances mental well-being. Approaches within Panchakarma, such as cleansing enemas, Abhyangam and Shirodhara, among others, provide therapeutic benefits in addressing mental illnesses. Panchakarma treatment offers a versatile approach to mitigate stress and enhances mental well-being. Approaches within Panchakarma, such as cleansing enemas, Abhyangam and Shirodhara, among others, provide therapeutic benefits in addressing mental illnesses. Ayurvedic lifestyle promotes physical, mental as well as social health and ultimately leads to symptomatic improvement[15].

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There are numerous preparation mentioned in ayurvedic text for treatment of *sthaulya* and *lekhaneeya* properties of *dravya* (herbs). Hence proper diet, regimen and wise usage of herbal medicaments with opposite *gunas* that of *chikitsabhava* helps to cure the disease. Immunostimulators like hydroxychloroquine, prednisone is prescribed to enhance the immune response against diseased condition and can impair the quality of life of the immunosuppressed patients. Charaka had described different herbal drugs under *mahakashaya* (i.e. the group of herbal drugs) that showed immunomodular response.

Some useful drugs that can be used in Lifestyle disorders

Hence proper diet, regimen and wise usage of herbal medicaments with opposite gunas that of chikitsabhava helps to cure the disease. Immunostimulators like hydroxychloroquine, prednisone are prescribed to enhance the immune response against diseased condition and can impair the quality of life of the immunosuppressed patients . Charaka had described different herbal drugs under mahakashaya that showed immunomodular response. These drugs has proven its efficacy in the present pandemic situation of covid.

The ayurvedic medicines stands best and safe option with above to treat lifestyle disorder which gives long lasting cure. Charaka had mentioned various drugs useful for curing ailments under *'Mahakashaya*' i.e. the specific group of herbal drugs. Some of them common, easily available and found useful are as under explained.

1. *Tinosporo cordifolia (Willd.) Miers*

This is common vine found all over India.

Common Name: Guduhci

Latin Name: *Tinosporo cordifolia (Willd.) Miers.*

Family: Menispermaceae

Synonyms: Avyatha, Amrta, Amrtavalli, Kundali, Guducika, Gundra, Cakrangi, Cakra laksana, Candrahasa, Jivantika, Jvara nasini, Jvarari, Tantrika, Deva nirmita, Dhara, Naga kanyaka, Naga kumarika, Bhişakpriya, Mandali, Madhuparni Rasayani, Vatsadani, Vayastha, Vara, Visalya, Syama, Surakrta, Soma, Somavalli, etc.

Classical categorization: According to Caraka - Vayahsthapana, Daha prasamana, Trishna nigrahan, Triptighna, Stanya Shodhana.

Accordnig to Sushruta - Guḍuchyadi, Patoladi, Valli Pancamūla Kakolyadi, Aragvadhadi.

According to Bhava Prakash Nighantu - Guḍucyadi Varga.

Chemical constituents:

A diterpenoid of columbin type- tinosporin is isolated from plant. Tinosporide and cordifolide, Tinosporidine and ß- sitosterol isolated from stems. Cordifol, heptacosanol and octacosanol reported from the leaves.

reported from the leaves.

A new furanoid diterpene- tinosporide from stems .18-norclerodene glucosie- tinosporaside from stem wood is reported. Five diterpene furan glycosider, viz., cordifolisides A-E and two phenyl propane glycosides are isolated from aqueous extracts.

Isocolumbin, tetrahydropalmatine, magnoflarine and palmatine were isolated from roots.

Rasadi properties[17]:

Rasa: Tikta, Kaṣaya

Guna: Guru,Snigdha

Veerya: Uṣṇa

Vipaka: Madhura

Karma: Tridoşa Samaka, Medhya, Rasayan, Dipaniya, Grahi, Medohara, Kaṇḍughna, Jvara hara, Dahaprashamana

Part used: Stem, Leaves.

Studies found beneficial:

i. The plant popularly known as guduchi an important medicinal plant cultivated throughout the Indian subcontinent. Through centuries, it has been extensively used in various Ayurvedic preparations for the treatment of various ailments[18] .

ii. Tinospora cordifolia through a predominantly immunostimulant effect and also showed Adaptogenic- these plants are capable of protecting against a variety of stressors[19].

iii. Tinospora cordifolia is well known for its immunomodulatory response. Active compounds 11-hydroxymustakone, N-methyl-2-pyrrolidone, Nformylannonain, cordifolioside A, magnoflorine, tinocordiside and syringin has been reported to have potential immunomodulatory and cytotoxic effects[20].

iv. iv. Adaptogenic- these plants are capable of protecting against a variety of stressors [21]

v.Tinospora cordifolia is known as an adaptogen, as it increases the resistance of the body to physical, chemical, and biological stress and builds energy and general vitality[22].

2. Emblica officinalis (Linn)

The medium sized tree is distribution wild or cultivated throughout tropical India.

Common Name: Amalaki

Botanical Name: *Emblicac officinalis (Gaertn)*

Synonym *Phyllanthus emblica (Linn.)*

Family: Euphorbiaceae

Synonyms: Abhaya, Amṛta, Dhatri, Vayastha, Vayasya, Vṛṣya, Tisyaphala, Sitaphala.

Classical categorization:
Accordnig to Caraka- Jvaraghna, Kasaghna, Virecanopaga, Kuṣthaghna, Vayahsthapana.
Accordnig to SuSruta-Amalakyadi, Paruṣakadi, Triphala
Accordnig to Vagbhaṭa -Paruṣakadi
Caraka quoted it as the best among the Vayahsthapana drugs (rejuvinators).
Chemical constituents:
Root- ellagic acid, lupeol, oleanolic aldehyde
Bark- leucodelphinidin, procyanidin, tannin etc.
Fruit- Vit. C, phyllemblin, linolic acid, indole acetic acid and ayxubsm trigaloylglucose, terchebin, corilagin, ellagic acid, phyllemblic acid & salts.
Rasadi properties[23]**:**
Rasa: Amla pradhana, Panca rasa (except lavana)
Veerya: Sheeta
Vipaka: Madhura Guna:Snigdha, Laghu
Karma: Tridoṣa hara,Vayahsthapana, Rasayana, Cakṣusya, Vrsya.
Part used: Pulp and rind of the fruit.
Studies found beneficial:
i.The alkaloid fraction of is a potent enhancer of antigen-specific humoral immune responses[24].
ii.The fruits limit oxidative tissue damage and, hence, prevent or ameliorate disease progression, by supplementing antioxidant defence.It have the ability to modulate basal oxidative markers and enhance endogenous antioxidant defenses in a hepatocyte cell line (HepG2) [25].
iii.Amla fruit has also been demonstrated to possess cytoprotective properties in acute cadmium toxicity[26].
iv.he fruit of amalaka showed Antioxidant activity/ Emblica officinalis through prostaglandin release and anti-oxidative action) [27].
v.Aqueous and alcoholic extracts of amalaka have shown very high reducing power[28].

3.*Piper longum(Linn)*

Common Name: Pimpalli

Botanical Name: *Piper longum(Linn.)*

Family: Piperaceae
Synonyms: Kana, Kṛṣṇa, Kola, Capala, Tikṣṇa Tandula, Magadhi, Vaidehi, Uṣaṇa, Soundi, Pippali etc.
Classical categorization:
Accordnig to Caraka- Urdhvabhagahara, Tryuṣaṇa Dipaniya Kanthya, Asthapanopaga, Sirovirechanopaga, Sitapraśamana, Sula praaamana, Kasahara, Hikkanigrahaṇa, Trptighna, Vamana.
Accordnig to Sushruta- Pippalyadi, Urdhvabhagahara, Trishaṇa (Trikatu), Amalakayadi, Shiirovirechana.
Accordnig to Vagbhaṭa - Pippalyadi.
Chemical constituents:
Essential oil, mono- and sesquiterpenes, caryophyllene. (mainly), piperine, piplartine, piperlongumine, piperlonguminine, pipernonaline, piperundecalidine, pipercide, sesamin, ß-sitosterol; four aristolactams (cepharanone B. aristolactum AII. piperlactum

A and piperolactam B): five 4,5-dioxoaporphines etc.

Rasadi properties[29]:

Rasa: Katu

Guna: Laghu, Snigdha.

Veerya: Uṣhṇa and Sheeta when fresh.

Vipaka: Madhura

Karma: Vata-shleşmahara (Kapha vardhaka when fresh), Dipana, Vrishya, Rasayana.

Part used: Fruit and root.

Studies found beneficial

i**.**Administration of *Piper longum* extract and piperine increased the total WBC count to 142.8 and 138.9%, respectively, in Balb/c mice. Also Bone marrow cellularity and α-esterase positive cells were also increased by the administration of *Piper longum* extract and piperine [30].

ii.Bone marrow cellularity and alpha-esterase positive cells were also increased by the administration of Piper longum extract and piperine [31].

iii.Methanolic extract of *Piper longum* fruits *showed adaptogenic* potential [32].

iv.In vitro studies have shown the role of piperine in relieving oxidative stress by quenching free radicals and reactive oxygen species. It is known to act as an antimutagenic and antitumor agent [33].

4.***Terminalia chebula (Retz.)***

It is a large tree abundantly found in Northern parts of India.

Common Name: Haritaki

Botanical Name: *Terminalia chebula (Retz.)*

Family: Combretaceae

Synonyms: Amṛta, Abhaya, Kayastha, Vayastha, Pathya, Vijaya, Siva, Haimavati.

Classical categorization:

Accordnig to Caraka- Jvaraghna, Arsoghna, Kasaghna, Kuşthaghna, Prajasthapana Accordnig to Sushruta- Amalakyadi, Paruṣakadi, Triphala Accordnig to Vagbhaṭa –

Paruṣakadi.

Chemical constituents:

Major chemical constituents of Fruits are anthraquinone glycoside, chebulinic acid, tannic acid, terchebin, vit. C.

Fruit kernel- arachidic, behenic, lindeic, oleic, palmitic & stearic acids.

Flowers- Chebulin.

Rasadi properties[34]:

Rasa: all pancharasa with Kashaya predominantly (except lavan).

Guna: Laghu, Snigdha.

Veerya: Uṣhṇa.

Vipaka: Madhura

Karma: Tridoşahara, Anulömana, Rasayana, Prajasthapana, Cakṣuşya, Hrdya, Lekhana.

Part used: Fruit and its fruit rind.

Studies found beneficial

i.The fruit of Terminalia chebula showed Antioxidant activity[35].

ii.The fruit showed non-specific and specific immunostimulatory properties of the ethanolic extract of T. bellirica fruits[36].

iii.The cytotoxic study revealed the ability of the extracts to be potent compounds for cellular activity which can be modified and controlled by varying the concentration and can be attributed to the presence of various phytochemicals extracted in different solvents based on their polarity that can be modified according to the nature of injury or wound[37].

iv.Terminalia chebula with a high content of phenolic constituents exhibits strong antioxidant and neuroprotective properties in vitro and in-vivo[38].

5.*Commiphora mukul (Hook. ex. Stocks)*

The plant is found in rocky regions of South-West and North Western regions of India well

known as *'Dhupana dravya'*.

Common Name: Guggulu

Botanical Name: *Commiphora mukul (Hook. ex. Stocks)*
Family: Burseraceae

Synonyms: Kousika, Devadhupa, Palamkaṣa, Kanaka, etc.

Classical categorization:

According to Caraka- Sanjnasthapana
Accordnig to Sushruta- Eladi gana
Accordnig to Vagbhaṭa - Eladi gana.

Chemical constituents:

Oleoresin- z-guggulsterone, E-guggulsterone
Gum- guggullignans I & II; guggulu tetrols; mukulol; allylcembrol: c-27 guggulusterols I, II & III; Z-and E- guggulusterol etc.

Rasadi properties[39]:

Rasa: Tikta, katu
Veerya: Uṣhṇa
Vipaka: Katu
Guna: Laghu, Rukṣa, Visada, Sukṣma, Sara (old), Snigdha, Picchila (new) **Karma:** Tridosahara, Rasayana, Vrishya (new), Lekhana (if used old).
Part used: Olceo-resin or gum.

Studies found beneficial

i.gum of *Commiphora mukul* 2g per kg daily by mouth inhibited the rise of cholesterol in serum and tissues and reduced the incidence of atherosclerosis and the body weight gain[40].

ii.The essential oils extracted from guggul exudates can be exploited as a source of antioxidant agent, besides their physicochemical parameters being comparable with the virgin oils[41].

iii.Methanol extract of dried exudate of Commiphora mukul prevents bone resorption in ovariectomized rats[42].

iv.Preliminary clinical trials on 22 patients of hypercholester olaemia associated with obesity, IHD, HTN, DM etc. Guggulu (crude) was administered orally (6.12 mg in 3 divided doses for 15 days to one month. A fall in total serum cholesterol and serum lipid-phosphorus was found in all the cases treated with Guggulu. The body weight of 10 patients of obesity also found to be re duced significantly[43].

v.GU-MCT810 treatment of liver cells resulted in the reduction in low-density lipoprotein cholesterol and increase in the high-density lipoprotein/low-density lipoprotein ratio. Two pregnane derivatives, Z-guggulsterone and E-guggulsterone been shown to lower cholesterol and triglycerides in normal and high-fat-fed rats[44].

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Conflict of Interest: Non *Source of funding:* Nil

Cite this article:

Ayurverdic management of non-communicable disease
Surve P. P., Survase M. R.

Ayurline: International Journal of Research In Indian Medicine 2025; 9(1):01-