Review Article

Anti-Obesity Siddha Medicinal Plants - A Preclinical Review

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ABSTRACT

Obesity is a complex multi factorial preventable disease affecting all age groups of both the sexes. Now one third of world's population is overweight or obese. From 1980 the world-wide prevalence of obesity has become doubled. Overweight and obesity were the 5th foremost causes of death globally. Obesity is associated with many co morbid diseases. Prevalence of obesity with co morbidities is on big alarm throughout the world. Recently in COVID -19 pandemic most of the obese people get affected due to the co morbidities and reduced immunity. The anti-obesity properties of medicinal plants were known from ancient times in traditional Siddha medicine some thousand years ago. Many Siddha medicinal plants showed anti-obesity activities that can be utilized in the management of obesity, through which the complications of obesity can be prevented. Most researches explored the anti-obesity potentials of medicinal plants. *Terminalia chebula, Phyllanthus niruri, zingiber officinale, Piper longum, Curcuma longa, Elettaria cardamomum, Cuminum cyminum, Picrorhiza kurroa, Ipomea turpethum, Tinospora cordifolia, Michelia champaka* are some medicinal plants possess anti-obesity properties that had been indicated in Siddha classical text. The objective of this review is to validate the anti-obesity potentials of Siddha medicinal plants scientifically through various research reports. Due to the presence of Phyto compounds like phenols, flavonoids, terpenoids, alkaloids, anti-oxidants these medicinal plants revealed anti-obesity activities and its anti-obesity mechanism had been proven scientifically through various animal experimental studies collected from many research articles. Modern anti-obesity drugs produce numerous side effects. Regular consumption of Siddha anti-obesity medicinal plants, in the prescribed dose and duration, can induce gradual and sustainable weight loss effectively. Furthermore, in future, there is a need for the development of standardized, safe and effective anti-obesity drugs from medicinal plants and highly economical too. Hence eventually exploration of anti-obesity Siddha medicinal plants will lead to safe and effective treatment for obesity

Keywords: Anti-obesity, Animal studies, Siddha medicinal plants.

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INTRODUCTION

Obesity is a complex multi factorial preventable disease affecting all age groups of both the sexes. Now one third of world's population is overweight or obese. Abnormal or excess fat accumulates in the body results in overweight and obese which presents a high risk to health. Obesity is now prevalent in middle and low income countries.[1] From 1980 the world wide prevalence of obesity has become doubled.[2] Overweight and obesity are the 5th foremost causes of death globally.[3] Obesity is associated with many complications such as Coronary artery disease, Type 2 Diabetes mellitus, osteoarthritis, Gall stones, cancer, Sleep apnea and Alzheimer's disease.[4] Most recent reports indicate that obesity markedly reduces the life expectancy especially of the younger adults.[5] Prevalence of obesity with co morbidities is a big alarm throughout the world. Recently in COVID -19 pandemic most of the obesity people get affected due to the co morbidities and reduced immunity.

In the recent years, medicinal plants have been used in the management of many diseases with minimum or nil side effects.[6] Numerous bioactive compounds with multiple therapeutic activities have been treasured in medicinal plants. Most researches proven the potentials of natural products to counteract the obesity.[7] Many medicinal plants showed anti-obesity properties.[8] Crude extracts and isolated compounds of medicinal plants can be used to induce weight loss and can prevent diet induced obesity.[9] As many as 80% of the world's people depend on traditional medicine for their primary healthcare needs. [10] The importance of traditional medicine has also recognized by World Health Organization (WHO) and has created strategies, guidelines and standards for botanical medicines.

Siddha medicine is the ancient traditional system of medicine originated from Tamilnadu, South of India formed by super human beings called Siddhars. The principle of Siddha system of medicine is not only in curing

the disease, but also in preventing the disease. Many Siddha medicinal plants showed anti-obesity activities that can be utilized in the management of obesity, through which the complications of obesity can be prevented. [11] The anti-obesity property of medicinal plants was known from ancient times in Siddha traditional medicine some thousand years ago. [12]

The traditional system of medicine therapeutically utilized in number of diseases and disorders, but lacks of records on data for safety and efficacy. The objective of this review is to validate anti-obesity potentials of Siddha medicinal plants scientifically that was collected from various animal study research reports. To substantiate the anti-obesity activity for these Siddha medicinal plants, bioactive components and exact anti-obesity mechanism have been compiled from many research articles and verifying the great role of anti-obesity activities of traditional Siddha medicinal plants thus to disclose the promising effects of anti-obesity activities for these medicinal plants as already claimed in the Siddha literature.

Literature Review

Medicinal plants with anti-obesity potentials have been selected from Siddha classical text and the animal study reports reviewed accordingly for these medicinal plants and the associated research reports were collected. Albino rats, Sprague Dawley rats, mice, rabbit were found to be used as hyperlipidemic animal models in many of the research articles. The bioactive compounds exhibiting anti-obesity activities for these Siddha medicinal plants also compiled in this review. Search done by using the terms like anti-hyperlipidemic, medicinal plants, anti-obesity, animal study, preclinical study, natural products by using online data bases like Google scholar, Science direct, Pub Med, Springer, Medline, Elsevier. Based on this topic variety of research and review articles have been searched from the year 1994-2021.

Anti-obesity drugs

From the past few decades, numerous anti-obesity drugs have been approved. Drugs commonly used to control obesity are categorized as follows:

Serotonergic agents- fluoxetine, dexfenfluramine, fenfluramine

Noradrenergic agents- amphetamine, phendimetrazine, phentermine, diethylpropion, pseudoephedrine, phenylpropanolamine, mazindol

Noradrenergic and Serotonergic agents- sibutramine

Pancreatic lipase inhibitor - orlistat.

Centrally acting drugs (anorectic or appetite suppressants)-sibutramine, rimonabant

Suppressive effect on food intake (Promotes feeling of satiety) - Liraglutide, a glucagon-like peptide-1 analogue (incretin mimetic), Exenatide (analogue of the hormone GLP-1), Pramlintide (synthetic analogue of the hormone Amylin).

However, most of the anti-obesity drugs have been withdrawn from the market because of an increased risk of psychiatric disorders and non-fatal myocardial infarction or stroke.[13] A safety clinical trial showed an increased occurrence of Cancer using an anti-obesity drug Lorcaserin.[14] Hence on Feb2020 FDA withdrawn Lorcaserin from the market. The synthetic anti-obesity drugs usually act faster instead considerable changes occur in normal body function but finally could result in side effects.

SIDE EFFECTS OF SYNTHETIC WEIGHT LOSS DRUGS

Table 1: Side Effects of synthetic Weight Loss Drugs [15, 16]

Brand /Drug Name	Drug Category	Common Side Effects
Adipex-P (phentermine)	Appetite suppressant; sympathomimetic amine	Increased blood pressure and heart rate, insomnia, nervousness, restlessness, dependence, abuse or withdrawal may occur with long-term use. When given as a single agent, phentermine is not implicated in valvular heart disease; avoid use at bedtime.
Alli (orlistat): over-the-counter (OTC)	Lipase inhibitor	Oily spotting, gas (flatulence), fecal urgency, soft stools, fecal incontinence; take with a daily multivitamin once-a-day at bedtime.
Bontril PDM (phendimetrazine)	Appetite suppressant; sympathomimetic amine	Increased blood pressure and heart rate, insomnia, nervousness, restlessness, dependence, abuse or withdrawal may occur with long-term use; decreased appetite, avoid use at bedtime.

Brand /Drug Name	Drug Category	Common Side Effects
Contrave (bupropion and naltrexone)	Antidepressant (weak inhibitor of norepinephrine and dopamine) and an opioid antagonist	Nausea, vomiting, headache, fatigue, constipation, dizziness, difficulty sleeping, dry mouth, diarrhea, increased blood pressure, fast heart rate, anxiety, tremor, hot flush, unusual taste.
Desoxyn (methamphetamine)	Appetite suppressant; sympathomimetic amine	High abuse potential and not frequently prescribed; use only if alternative treatments are ineffective; increased blood pressure and heart rate, insomnia, nervousness, restlessness, dependence, abuse or withdrawal may occur with long-term use.
Benzphetamine	Appetite suppressant; sympathomimetic amine	Increased blood pressure and heart rate, insomnia, nervousness, restlessness, dependence, abuse or withdrawal may occur with long-term use; decreased appetite, avoid use at bedtime.
Diethylpropion (generic only)	Appetite suppressant; sympathomimetic amine	Constipation, dry mouth, hypertension, tachycardia, insomnia, nervousness, restlessness, abuse or withdrawal may occur with long-term use, should avoid use at bedtime.
Qsymia (phentermine and topiramate extended-release capsules)	Combination appetite suppressant-seizure drug	Tingling or numbness (paresthesias), dizziness, altered taste, insomnia (difficulty sleeping), constipation, dry mouth. Taken once daily in the morning; Not advisable for pregnant women.
Saxenda (liraglutide)	Glucagon-like peptide-1 (GLP-1) receptor agonist; regulates appetite and food intake; *once-daily* subcutaneous injection.	Nausea and vomiting, diarrhea, constipation, decreased appetite, dizziness, headache, heartburn, fatigue, dizziness, stomach pain, gas, dry mouth, low blood sugar in type 2 diabetes, elevated heart rate, increased lipase.
Xenical (orlistat)	Lipase inhibitor	Oily spotting, gas (flatulence), fecal urgency, soft stools, fecal incontinence; can be taken with a multivitamin daily.
Wegovy (semaglutide)	Glucagon-like peptide-1 (GLP-1) receptor agonist; regulates appetite and food intake; *once-weekly* subcutaneous injection.	Nausea, vomiting, stomach pain, dizziness, stomach flu, diarrhea, headache, feeling bloated, heartburn, tiredness (fatigue), belching, constipation, upset stomach, and gas.

Medicinal plants the source and boon for obesity

Medicinal plants with anti-obesity potentials works as an alternative to synthetic anti-obesity drugs for their safety and effectiveness. Medicinal plants possess multiple phyto chemicals that results in synergistic activity, having multiple molecular targets, and also increases the bioavailability and hence render more benefits than synthetic anti-obesity drugs. Additionally, anti-obesity drugs medicinal plants will produce sustain weight loss. [13] Additionally, Antiobesity medicinal plants will produce sustain weight loss.

Mechanism of weight loss

There are 5 distinct mechanisms for weight loss:

1. Food intake can be reduced either by augmenting the inhibitory effects of anorexigenic signals or factors that suppress food intake or by blocking orexigenic signals.

2. Blocking nutrient absorption in the alimentary canal, particularly, fat.

3. Increasing thermo genesis from the generation of ATP, thereby dissipating extra calories as heat.

4. Modulating fat or protein metabolism or storage by regulating fat synthesis/lipolysis or adipose differentiation /apoptosis. Enhanced fat or protein turnover might reduce body weight by affecting either food intake or energy expenditure.

5. Modulate central controller to regulate body weight or modulating the primary afferent signals regarding fat stores analyzed by the controller. [17] It is an advantage of forcing the endogenous controller to regulate body weight using multiple pathways of energy balance and minimize absorption of fat.

Due to the high morbidity and mortality, various different types of remedies developed for obesity are chemical or biochemical agents. Management and treatment of obesity requires numerous resources including pharmacologic agents, balanced diets, and physical training like exercises. Anti-obesity treatment with lifestyle modification is always challenging. Since modern anti-obesity drugs produce side effects, herbal medicinal therapy is the unique alternative for overweight or obese people. The purpose of this review was to assess and prove that Siddha medicinal plants provide promising alternative treatments in the management and treatment of obesity.

Table 2: Images and Siddha Literary Reports of Anti-Obesity Medicinal Plants

Images of medicinal plants with Siddha Generic name[18]	Siddha Literary reports[19]
Kadukkai *(Terminalia chebula)* 	Contracts the muscle fibres.
Keezhaneli *(Phyllanthus niruri)* 	Contracts the muscle fibres.
Sukku *(Zingiber officinale)* 	Indigestion.
Thippili *(Piper longum)* 	Flatulence.
Manjal *(Curcuma longa)* 	Flatulence.
Elakkai *(Eletaria cardamom)* 	Flatulence.
Seerakam *(Cuminum cyminum)* 	Indigestion.
Kadugarohini *(Piccorhiza kuroa)* 	Dropsy, respiratory diseases.
Sivathai ver *(Ipomea turpethum)* 	Abdominal diseases.
Seenthil *(Tinospora cordifolia)* 	Diabetes, Asthma.
Shenbagapoo *(Michelia champaka)* 	Flatulence.

Table 3: Medicinal plants its animal experimental model, form of administration, dose and its research reports.

Medicinal plants	Form of Administration	Doses	Animal experimental model	Research reports
Terminalia chebula	Powder	200mg/Kg 500mg/Kg	Triton WR- 1339 Induced hyperlipidemic rats	Hypolipidemic.[20]
	Aqueous extract	200mg/Kg	HFD induced rats	Hypolipidemic.[21]
	Aqueous extract	Not mentioned	Cholesterol, atherosclerotic induced rabbit	Hypo cholesterolmic. [22]
Phyllanthus niruri	Alcoholic extracts	200mg/Kg	Triton WR- 1339 Induced hyperlipidemic rats	Lipid lowering action. [23]
	Plant extracts	100mg/Kg	Hyperlipidemic induced rats	Anti hyperlipidemic. [24]
Zingiber officinale	Aqueous extract Intra peritoneally	500mg/Kg	Streptozotocin (STZ) induced diabetic rats	Hypolipidemic, Hypocholesterolmic. [25]
	Ginger powder	100,200, 400 mg/ kg	HFD fed rats	Reduction in TGL, LDL, free fatty acid. [26]
	Extract of Ginger	150mg /kg	Alloxan induced Diabetic rats	Inhibition of TGL,LDL and raised HDL.[27]
Piper longum	Piperine	5mg/kg	Cholesterol induced Sprague dawley rats	Reduces TC , hepatic cholesterol.[28]
	Oil extracts	40mg/kg	Male Sprague dawley rats	Reduces bodyweight, TC, TGL, LDL, VLDL, Fat mass. [29]
Curcuma longa	Curcumin	100mg/kg	Hyper cholesterolmic rat	Hypo cholesterolmic effect. [30]
		347 mg/Kg	Atherosclerotic mice	Decrease in TC, TGL and free radical damage. [31]
	Turmeric powder	1.6 - 3.2mg/Kg	Atherosclerotic rabbit	Decreasing cholesterol, TGL and Free radical damage. [32]
Elletaria cardamomum	Cardamom oil	100 - 200mg/Kg	High Cholesterol induced wistar rats	Marked decrease in TGL (42%), Liver TGL (33%) Cholesterol in cardiac muscle (39%).[33]
Cuminum cyminum	Methanolic extract	1000 mg/Kg	Ovary ectomised rats	Hypolipidemic Anti osteoporotic.[34]
Piccorrhiza kurroa	Aqueous extract	50,100, 200mg/Kg	High fat diet induced mice	Prevents fatty liver. [35]
	Root extract	200mg/Kg	High fat diet induced rat	Inhibition of lipid Peroxidation. [36]
Ipomea turpethum	Methanolic extract of root'	50mg/kg	Streptozotocin (STZ) induced diabetic rats	Antihyperlipidemic. [37]
Tinospora cardifolia	Methanolic extract of stem	100mg/kg	Alloxan induced diabetic male adult rats	Antidyslipidemic. [38]
	Aqueous extract of root	2.5, 5g/Kg	Cholesterol induced adult rats	Hypolipidemic. [39]
	Aqueous extract of root	2.5, 5g/Kg	Male albino rats	Improves Atherogenic index and prevents weight gain. [40]
Michaelia champaka	Methanolic extracts	500mg/Kg	Triton WR- 1339 Induced hyperlipidemic albino rats	Anti hyperlipidemic .[41]

TC- Total cholesterol; TGL- Triglycerides; HDL- High density lipoproteins; LDL- Low density lipoproteins; VLDL- Very low density lipoproteins.

Table 4: Medicinal Plants its Phyto Compounds with Anti-obesity Potentials and its Mechanism of Actions. [42]

Medicinal plants [Botanical name]	Phyto Compounds having anti-obesity potentials	Anti-obesity mechanism
Terminalia chebula	Rutin Quercetin β- Sitosterol .[43]	Anti-obesity activity through these signaling pathways- mitogen-activated protein kinase and adenine monophosphate-activated protein kinase. [44]
Phyllanthus niruri	Rutin Quercetin Kaempferol Phyllanthine. [45]	Due to the increased binding of β-lipoproteins with hepatic LDL receptors, LDL will be reduced. [46]
Zingiber officinale	Gingerol Shagaol Zingiberine Quercetin Sesquiterpene. [47]	Increase Peroxisome Proliferator Receptor activator (PPRAS) dependent gene expression that results in enhancement of Cellular fatty acid catabolism. Hence reduces the body weight and lipid profile. [69] Inhibits the plasma cholesterol and LDL oxidation and suppress the development of atherosclerosis. [48]
Piper longum	Piperine Methyl piperine. [49]	The insulinotropic effect or insulin secretagogue activity of this extract. PlrAqe treated diabetic rats showed decrease in atherogenic index and increase in percentage of protection against atherogenicity. Decrease in athero-genicindexis due to increase in HDL-C levels after the treatment. HDL-C is known to play an important role in the transport of cholesterol from peripheral cells to the liver by a pathway termed reverse cholesterol transport the insulinotropic effect or insulin secretagogue activity of this extract. PlrAqe treated diabetic rats showed decrease in atherogenic index and increase in percentage of protection against atherogenicity. Decrease in athero-Genicindex is due to increase in HDL-C levels after the treatment. HDL-C is known to play an important role in the transport of cholesterol from peripheral cells to the liver by a pathway termed reverse cholesterol transport HDL is known to play an important role in the transport of cholesterol from peripheral cells to the liver by a pathway termed as reverse cholesterol transport, and which is considered to be a cardio protective lipid. [50]
Curcuma longa	Curcumin. [51,52]	Augmenting hormone-sensitive lipase and adipose triglyceride lipase mRNA levels and decreases perilipin mRNA level, results in lipolysis. In adipose tissue, curcumin inhibits macrophage infiltration and nuclear factor κB activation induced by inflammatory agents. [53] Cardiovascular Effects Turmeric's protective effects on the cardiovascular system include lowering cholesterol and triglyceride levels, decreasing susceptibility of low-density lipoprotein (LDL) to lipid peroxidation, and inhibiting platelet aggregation. These effects have been noted even with low doses of turmeric. A study of 18 atherosclerotic rabbits given low-dose (1.6–3.2 mg/kg body weight daily) turmeric extract demonstrated decreased susceptibility of LDL to lipid peroxidation, in addition to lower plasma cholesterol and triglyceride levels. The higher dose did not decrease lipid peroxidation of LDL, but cholesterol and triglyceride level decreases were noted, although to a lesser degree than with the lower dose. Turmeric extract's effect on cholesterol levels may be due to decreased cholesterol uptake in the intestines and increased conversion of cholesterol to bile acids in the liver. Inhibition of platelet aggregation by C. longa constituents are thought to be via potentiation of prostacyclin synthesis and inhibition of thromboxane synthesis. Gastrointestinal Effects.

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Elletaria cardamomum	Sesquiterpene Quercetin Kaempferol. [54,55]	Reduction of ALT, AST, ALP, Lipid per oxidation and improved anti-oxidants like SOD, GSH, catalase. [56,57]
Cuminum cyminum	Cuminaldehyde, Phenols. [58]	Reduction and prevention of mesenteric fat and epididymal fat deposition. [59]
Piccorrhiza kurroa	Picroside I Picroside II Picrorhizin Kutkisterol. [61]	Effective in regulating fat metabolism in the liver. [60]
Ipomea turpethum	Coumarin Turpethin. [62]	Beneficial in treating fatty liver and improving fat metabolism in the liver. It works effectively against obesity by decreasing excessive body fat. [63]
Tinospora cardifolia	Berberine Tinosporine. [64]	Powerful reduction in serum and tissue cholesterol, phospholipids and free fatty acids . [65]
Michelia champaka	Quercetin β- Sitosterol. [66]	Reduction in the level of serum cholesterol, LDL, VLDL and triglycerides in the Triton treated animals and also marked in the increase in the HDL. [67]

ALT- Alanine Transaminase; AST- Aspartate Transaminase; ALP- Alkaline Phosphatase; SOD- Super Oxide Dismutase (catalase); GSH- Glutathione (catalase); kB- Pathway for Nuclear factor, signaling in the cytoplasm and mitochondria.

Anti-obesity potentials of Siddha medicinal plants

Terminalia chebula

Antioxidant compounds like phloroglucinol and pyrogallol which synergistically works together to modify lipid profile. *Terminalia chebula* against experimental induced acetaminophen (APAP) toxicity on rats, exhibited good hepato and nephro protection against APAP toxicity. [21]

Terminalia chebula, Piper longum, Curcuma longa showed anti arthritic activity. Hence these medicinal plants also reduces arthritis common in obese individuals. [77]

Phyllanthus niruri

Water decotion of leaf and seed of *Phyllanthus niruri* is reputably used for the management of diabetes mellitus, obesity, hyperlipidemia. Extracts of seeds and leaves caused significant and dose related decrease in body weight. [68]

Zingiber officinale

Control obesity by inhibiting and reducing of fats build up and weight gain among mice. In 3T3L1 pre adipocyte cells, gingerone exhibited a greater inhibitory effect on adipogenesis. Shagaol also modulated fatty acid metabolism hence attenuating diet-induced obesity. Ginger powder daily for 8 weeks lowered FBS, HbA1C and improved insulin resistance and promotes fat utilisation in human. [69]

Piper longum

Piperine inhibited plasma cholesterol by reduced absorption of intestinal cholesterol via down -regulation of intestinal ACAT2 and MTP.

Cholesterol metabolism is primarily conducted in liver. 50% of daily cholesterol excretion is by the conversion of cholesterol to bile acids in the liver. CYP7A1 is a liver

specific enzyme that catalyzes the biosynthesis of bile acids from cholesterol. Piperine increased the CYP7A1 activity thus induce efficient removal of excessive cholesterol from blood thus markedly increase the level of HDL. Due to the increased level of HDL decreases atherogenic index and is a good Cardioprotective. [70]

Curcuma longa

Curcumin inhibited lipid per oxidation, decrease high cholesterol level like statin and have anti mutagenic activity. Calcium transport was improved and helps to convert calcium homeostasis in the cardiac muscle thus protects the heart from myocardial infarction. Decreases cholesterol uptake from the intestine and thereby increase the conversion of cholesterol to bile acids in the liver. Inhibition of platelet aggregation by inhibiting thromboxane synthesis. [71]

Increased CYP7A1 mRNA levels were also observed in rats treated with curcumin and markedly increase the level of HDL similar to *Piper longum*. Effective in atherosclerosis, TGL, TC, free radical damage. Improving the insulin sensitivity (Anti diabetic), suppress adipogenesis, and improves plasma lipids. [53]

Elletaria cardamomum

Improved the activity of detoxifying enzyme Glutathiaone X-transferase and thereby reduces lipid per oxidation, so having potential cardio protective effect. [72]

Enhance the rate of cholesterol degradation processes or lipoprotein lipase activity, as well as efficient in reducing lipid absorption from the intestines. [73]

Cuminum cyminum

Cumin powder supplementation prevented the fatty liver development and hence lowering mesenteric fat. [58] Cumin powder reduced serum levels of fasting cholesterol, TGL, LDL and reduction in BMI, waist circumference, fat mass. Paraoxanase and arylesterase enzymes increased in serum by ingesting cumin extract which played a protective role against the oxidative modification of plasma lipoproteins and hydrolyses lipid peroxides in human atherosclerotic lesion. [34]

Cuminum cyminum therapeutically used in the treatment of obese patients that reduces the different body fats contents and weight as well. [74]

Piccorrhiza kurroa

Enhancing insulin expression from beta cells of pancreas (Anti diabetic). Acts in preventing the outflow of myocyte creatine kinase and LDH shown in myocardial infarction. Grub about superoxide anions and inhibition of lipid per oxidation. Reverses the loss in body weight in alcohol treated rats. [75]

Action of nucleolar polymerase A was stimulated by Kutkins which causes ribosomal protein synthesis thus regenerative capacity of the liver was stimulated resulting in the formation of new hepatocytes Apocynin, the constituent of Kutaki has potent anti-inflammatory effects which are used in treating arthritis and prevent blockages of arteries by platelets and thus prevents risk of cardiovascular disorders. [76]

Ipomea turpethum

Presence of β-sitosterol, coumarin reduces the total cholesterol level. Effectively reducing the fasting blood glucose level (Antidiabetic) and having various medicinal roles like anti-oxidant, anti-inflammatory, immune modulatory. [77]

Tinospora cardifolia

Involvement of cholesterol absorption at the gastro intestinal tract. Hence reduction in TC, TGL, LDL, VLDL and improve atherogenic index thus Cardio protective and prevents weight gain. [78]

Michelia champaka

Showed reduction in LDL, TGL, VLDL levels and increased HDL level. Hence it is more effective in managing hyperlipidemia. [79]

Hence medicinal plants showed potential alternative treatment for the development of effective and safe anti-obesity drugs. [80] Furthermore all the anti-obesity medicinal plants possess Anti arthritic, Anti diabetic, Anti oxidant, cardio protective activities. Additionally these anti-obesity Siddha medicinal plants prevent the complications of obesity as well.

CONCLUSION

From the above mentioned animal studies, it has been scientifically proven that the medicinal plants specified in the Siddha classical text indicated for the management of obesity clearly revealed anti-obesity activities. Hence obviously these promising findings support the traditional use of Siddha medicinal plants in the management of obesity. Regular ingestion of such potent anti-obesity Siddha medicinal plants in the prescribed dose and duration, induce weight loss gradually and naturally. Large scale clinical and observational studies should be conducted before they can be speaking well off for the long-term management of obesity. Drug Preparation of anti-obesity medicinal plants are economical when compared to preparation of synthetic anti-obesity drugs. In present scenario, for safe and effective treatment, there is a need to develop and screen large number of anti-obesity medicinal plant formulations. In future, the development of standardized, safe and effective anti-obesity medicinal plants provide a boon for obese world. Hence eventually exploration of Siddha medicinal plants will lead to safe and effective treatment for obesity.

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