

Anti-Obesity Activity of Medicinal Plants: A Review

Muhammad Akram*

Department of Eastern Medicine and Surgery, University of Poonch, Pakistan

***Corresponding author:** Muhammad Akram, Department of Eastern Medicine and Surgery, University of Poonch, Rawalakot, Azad Jammu and Kashmir, Pakistan. Email: makram_0451@hotmail.com

Published Date: March 24, 2017

ABSTRACT

In traditional medicine, medicinal plants are used to treat obesity. The aim of the present study is to document medicinal plants that have been proved for their anti-obesity activity. Bibliographic investigation was carried out by analyzing classical text books and peer reviewed papers, consulting worldwide accepted scientific databases. Plants/their parts/extracts traditionally used for obesity have been considered as anti-obesity agents. The different systems of medicines have their different ways for the assessment of obesity as well as its treatment. In this article, a list of medicinal plants with proven anti-obesity and related beneficial effects and of herbal drugs used in treatment of obesity is compiled. This review suggests that medicinal plants regulate the lipid metabolism and can be prescribed to treat obesity. Their results are magnificent and considerable. However their mechanisms of actions are still on the way.

Keywords: Obesity; Treatment of obesity; Medicinal plants; Literature review

INTRODUCTION

Obesity is an abnormal increase in body weight due to excessive fat deposition. It is a condition in which excess body fat has accumulated to the extent that may have adverse health effects, leading to a reduction in life expectancy and / or increased health problems. If the daily caloric intake is in perfect balance with the energy requirements, mature healthy individuals maintain a constant body weight. Dietary restriction and exercise plays an important role in reducing weight. People should learn more about nutrition and educational programs should be appropriate for each level. Nutrition education programs should include children and elders [1]. A convenient and reliable indicator of the body fat is the body mass index (**BMI**) which is body weight (in kilograms) divided by the square of height (in meters). Values above 25 are abnormal. Individuals with values of 25-30 are overweight and those values > 30 are obese [2]. In the United States, 55% of the populations are overweight and 22% are obese [3]. The incidence of obesity is also increasing in other countries [4-5]. Obesity is a problem because of its complications (Figure. 1). It is associated accelerated atherosclerosis and an increased incidence of gallbladder and other diseases. Its association with type 2 diabetes is especially striking [6]. As weight increases, insulin resistance increases and frank diabetes mellitus appears. At least in some cases, glucose tolerance is restored when weight is lost. In addition, the mortality rates from many kinds of cancer are increased in obese individuals [7]. The causes of the high incidence of obesity in the general population are probably multiple [8-11]. Death rate is increasing due to cardiovascular diseases [12]. A study shows that exercise and calorie restriction reduces body weight in obese female [13]. In one study it has been observed that hyperinsulinemia is cause of obesity [14]. Leeuw (2003) studied that health education has an important role to play in teaching people how to reduce overweight [15]. A constructive approach would be to identify those children at risk of becoming obese and to find ways of preventing it. Herbal medicine decrease LDL (low density lipoprotein). LDL has tendency to deposit in form of plaque leading to atherosclerotic conditions [16-18]. Most patients recognize their own problems, although often they are unaware of the main foods cause obesity. Many symptoms are related to psychological problems, e.g. in women who cannot find fashionable clothes to wear [19-21]. Some herbal medicines are useful in increasing HDL (high density cholesterol) that is good cholesterol and prevent from cardiovascular disorders such as angina and myocardial infarction. Many of ingredients have antioxidant activity and study shows that herbal medicines having antioxidant activity are helpful in decreasing body weight and keep the body health and also are helpful in enhancing immunity power that is the basic theme of Unani medicine. Medicinal plants have phytochemicals that are involved in various biochemical functions in the body (Figure 2). Banerjee et al (2006) reported the anti-hyperlipidemic affect of *Carica papaya* L. in sprague dawley rats [22]. Tsuda et al (2003) reported the dietary cyaniding 3-O-b Dglucoside-rich purple corn colour prevents obesity and ameliorates hyperglycemia in mice [23]. Bishayee et al (1994) reported the hypolipidaemic and antiatherosclerotic effects of oral *Gymnema sylvestre* R. Br. Leaf extract in albino rats fed on a high fat diet [24]. Kim (2010)

reported the anti-adipogenic effects of Garcinia extract on the lipid droplet accumulation and the expression of transcription factor [25]. Alarcon-Aguilar et al (2007) reported the efficacy of *Hibiscus sabdariffa* on obesity in MSG mice [26].



Figure 1: Medical Complications of Obesity.



Figure 2: Phytochemicals from medicinal Plants.

PLANTS USED IN OBESITY

Vaccinium ashei [27], *Ibervillea sonorae* [28], *Stellaria media* [29], *Irvingia gabonensis* [30], *Salicis radialis*, *Rubi fructus*, *Corni fructus*, *Geranium nepalense* [31], *Baccharis articulate*, *Campomanesia xanthocarpa*, *Cuphea carthagenensis*, *Cynara scolymus*, *Hibiscus sabdariffa*, *Ilex paraguariensis*, *Achyrocline satureioides*, *Baccharis trimera*, *Campomanesia xanthocarpa* [32], *Peucedanum japonicum* [33], *Afromomum meleguetta*, *Pilanthus acmella* [34], *Citrus sunki* [35]. *Acacia arabica*, *Acacia catechu*, *Achyranthus aspera*, *Aconitum heterophyllum*, *Acorus calamus*, *Adathoda vasica*, *Aloe vera*, *Alstonia scholaris*, *Ananas comosus*, *Anthocephalus chinensis*, *Azadirachta indica*, *Berberis aristata*, *Betula utilis*, *Calatropis gigantean*, *Calicarpa macrophylla*, *Capsicum annum*, *Cassia tora*, *Cedrus deodara*, *Cinnamomum zeylanicum*, *Cissampelos pareira*, *Clerodendrum phlomidis*, *Cocus nucifera*, *Coriandum sativum*, *Costus speciosus*, *Cuminum cyminium*, *Desmostachya bipinnata*, *Dolichos biflorus*, *Embelia ribes*, *Embllica officinalis*, *Euphobia nerifolia*, *Ferula nortex*, *Ficus glomerata*, *Ficus lacor*, *Ficus religiosa*, *Ficus rumphii*, *Garcinia indica*, *Gymnema sylvestre*, *Holarrhena antidysentrica*, *Innula racemosa*, *Marsdenia tenacissima*, *Momordica charantia*, *Moringa oleifera*, *Ougenia dalbergioides*, *Picrorhiza kurroa*, *Piper chaba*, *Piper longum*, *Piper nigrum*, *Plumbago zeylanica*, *Pongamia pinnata*, *Pterocarpus marsupeum*, *Randia dumetorum*, *Santalum album*, *Saussurea lappa*, *Sphaeranthus indicus*, *Stereosprum sauevalens*, *Symplocos racemosa*, *Terminalia arjuna*, *Terminalia bellerica*, *Terminalia chebula*, *Terminalia tomentosa*, *Thea sinensis*, *Tinospora cordifolia*, *Trachyspermum ammi*, *Tragia involucrate*, *Tribulus terrestris*, *Valeriana jatamansi*, *Zingiber officinale*, *Ziziphus mauritiana*, *Punica granatum*, *Lysimachia foenum-graecum* [36].

MEDICINAL PLANTS HAVING ANTI-OBESITY ACTIVITY

Capparis decidua (Capparaceae)

This plant has hypolipidemic activity that is evident from study of Purohit et al (2005) [37]. In this study, serum cholesterol level was increased by high fat diet in rabbits. Ethanol extract of plant was used for study. Dose of extract was 500mg/kg body weight. This dose was effective in reducing total cholesterol content in aorta was also reduced by use of this extract. This study indicated hypolipidemic activity of plant extract.

Zingiber officinale

Zingiber officinale Roscoe inhibits the hydrolysis of triolein emulsified with phosphatidylcholine by pancreatic lipase *in vitro* and it reduces the elevation of rat plasma triacylglycerol levels. *Zingiber officinale* Roscoe inhibits the intestinal absorption of dietary fat by inhibiting its hydrolysis. Anti-obesity effects of *Zingiber officinale* Roscoe has been investigated in high-fat diet mice. Study indicate that the anti-obesity effect of aqueous extract of *Z. officinale* Roscoe in mice fed a high-fat diet is due to the inhibition of intestinal absorption of dietary fat by the active compounds of *Z. officinale* Roscoe [38].

Moringa oleifera

Chumark et al (2008) reported the hypolipidaemic and antiatherosclerotic activities of water extract of *Moringa oleifera* Lam. leaves. This plant is used to treat hypercholesterolemia. A study has been conducted to investigate the efficacy of this to lower cholesterol. This study was conducted *in vitro*, in which Cu²⁺-induced low-density lipoprotein (**LDL**) oxidation was inhibited. Hypocholesterolemic effect was observed in rabbits. Duration of treatment was twelve weeks. Atherosclerotic plaque formation was reduced and cholesterol level was decreased significantly. This efficacy was comparable to simvastatin. This study indicated that plant has lipid lowering effect and can be effective in obesity and cardiovascular disorders [39].

Commiphora mukul

Sharma and his colleagues conducted a study to investigate the hypolipidemic activity of plant in rodent models. Guggulsterone effect was investigated in hyperlipidemia. High fat diet was given to four groups of animal for four weeks. Cholesterol level was increased in high fat induced models as compared to control group. When extract was administered to test groups. Cholesterol level was decreased in extract treated models. This study indicated that plant has hypolipidemic activity and can be prescribed to treat obesity [40].

Ganoderma lucidum

Berger et al (2011) reported the cholesterol lowering properties of *Ganoderma lucidum* *in vitro*, *ex vivo* and in hamsters and Minipigs. It is apparent that oxygenated lanosterol derivatives in *Ganoderma lucidum* are responsible for its efficacy to lower cholesterol by decreasing cholesterol synthesis. Fibrous components and glucans in *Ganoderma lucidum* cause excretion of fecal neutral sterols and bile acids that affect cholesterol absorption and bile acid recycling and contribute to lowering of cholesterol [41].

Eugenia jambolana

Ravi et al (2005) reported the antihyperlipidemic effect of *Eugenia jambolana* seed kernel on streptozotocin-induced diabetes in rats. Hypolipidemic activity of *Eugenia jambolana* is due to the presence of flavonoids, saponins, glycosides and triterpenoids in the extract [42].

Allium sativum Linn

A study was conducted by Bordia et al, (2008), garlic was administered to thirty patients with coronary artery disease that was the study group and other thirty patients received placebo that is a control group. Various parameters were checked after 45 and ninety days of treatment with garlic. There was significant reduction in triglycerides and total cholesterol and HDL level was increased [43].

Cassia tora Linn

There were three groups of male Sprague-Dawley rats that were fed. Study duration was 5 weeks. Normal diet was given to one group. High cholesterol diet was administered to 2nd group. High-cholesterol diet with 5% SFC was given to 3rd group. There was significant reduction in serum cholesterol level in 3rd group as compared to 2nd group. Significant increase in high-density lipoprotein cholesterol level was observed in 3rd group also. Liver total cholesterol and triglyceride levels were also decreased in 3rd group. Fecal bile acid and lipid excretion was significantly increased in 3rd group. This study shows that soluble fiber of *Cassia tora* increases fecal lipid excretion and may result in reduction of serum and hepatic lipid concentrations in rats [44].

Morus alba L

Hypolipidemic and antioxidant effects of *Morus alba* L. fruit in hyperlipidaemia rats have been reported. Hypolipidemic activity of *Morus alba* L is through a strengthening of low-density lipoprotein receptor (**LDLR**) gene expression and the clearance ability of low density lipoproteins (**LDL**) and a reduction of lipid biosynthesis. Therefore, the *Morus alba* L could be used as a natural agent against hyperlipidemia [45].

Emblica officinalis

Ritu et al (1996) reported the hypolipidemic effect of fruit juice of *Emblica officinalis* in cholesterol-fed rabbits [46]. Flavonoids from *Emblica officinalis* effectively reduce lipid levels in serum and tissues of rats induced hyperlipidemia. Hepatic HMG CoA reductase activity was significantly inhibited in rats fed *E. officinalis* flavonoids. The mechanism of hypolipidemic action is by the concerted action of inhibition of synthesis and enhancement of degradation [47].

Garcinia cambogia

Saito, (2005) reported that *Garcinia cambogia* is effective in suppressing fat accumulation in developing male Zucker obese rats [48]. Flavonoids from this plant cause reduction in beta-hydroxy beta-methyl glutaryl coenzyme A reductase, glucose-6-phosphate dehydrogenase and isocitrate dehydrogenase and increase in lipoprotein lipase and plasma lecithin cholesterol acyl transferase. It increases level of fecal bile acids and neutral sterols. Lipid lowering efficacy of this plant is probably due to reduction in rate of lipogenesis and higher rate of degradation [49].

Coriandrum sativum

Lal et al (2004) reported the hypolipidemic effect of *Coriandrum sativum* L. in triton-induced hyperlipidemic rats. According to this study, increased degradation of cholesterol into bile acids and fecal neutral sterols appear to represent hypocholesterolemic effect of this plant [50].

Costus speciosus

Eliza et al (2009) reported the hypoglycemic and hypolipidemic effect of costunolide isolated from *Costus speciosus* (Koen ex. Retz.) Sm. in streptozotocin-induced diabetic rats. It reduces plasma total lipid, cholesterol and triglyceride and improves hepatic antioxidant enzyme activities [51].

Eclipta prostrata

Anti-hyperlipidemic activity of plant was tested in albino rats and compared to standard drugs. Serum lipid profile of control and drug treated rats was assessed after treatment. Significant hypolipidemic activity of plant extract was observed [52].

Cinnamomum zeylanicum

It has lipid lowering efficacy and has prescribed to treat hypercholesterolemia. *C. zeylanicum* bark powder methanol extract equivalent to 0.75g/kg bark powder and simvastatin (0.6 mg/kg b. wt.) are equieffective in treating hyperlipidaemia [53].

Carica papaya Linn

Anti-hyperlipidemic activity of *Carica papaya* extract was investigated in albino rats that were diabetic due to administration of alloxan monohydrate (120 mg/kg, i.p.). There were total 6 groups of rats and each group contains 6 rats. First group was as non-diabetic control. 2nd group was diabetic control. 3rd group serves as standard. 0.1 mg/kg/day of glibenclamide were administered to standard group. *Carica papaya* extract was given to group 4, 5, and 6 at dose of 100, 200, and 400 mg/kg body weight. Blood samples were analyzed for lipid profile on day 21. There was significant reduction in serum lipid profile at dose of 400mg/kg body weight. This study indicates that *Carica papaya* extract is effective in lowering lipid level in diabetic rats [54].

COMPOUND FORMULATION USED IN OBESITY

Safoof Mohazzil

This is a Unani formulation containing Badiyan (*Foeniculum vulgare* Mill seed), Nankhuah (*Carum capticum* seed), Zeera Siyah (*Carum carvi* seed), Lac Maghsool (*Coccus lacca* purified), Marzanjosh (*Origanum vulgare* herb), Boora armani (*Arminium bole*). This is prescribed in hyperlipidemia and obesity [55].

Durr-e- Ser: Garlic Pearls

Garlic pearls contain ingredients which are essential for health, like vitamin B and C, mineral salts, sulphur and volatile oil, all found in garlic and well preserved in these pearls. Garlic pearls are the best curative for gastrointestinal ailments, chest congestion and blood disorders and obesity. They maintain blood pressure at a reasonable level [56].

Herbal coded formulation (Debese) and obesity

Riaz et al, (2011) investigated the efficacy of herbal medicine in comparison with allopathic for treatment of obesity. One hundred patients were randomly selected for study. Half patients were treated with herbal coded formulation Debese and half with allopathic medicine. Body mass index, waist circumference and triceps skin fold were measured before and after treatment. As a conclusion, it was found that herbal coded formulation Debese is more effective in the treatment of obesity [57].

CONCLUSION

Medicinal plants have played an important role in the treatment of obesity in past and will continue to do so in the future. The use of medicinal plants to treat diseases had been started in ancient times. Medicinal plants used in the Unani system of medicine must be scientifically tested in order to isolate its bioactive compounds that are responsible for their activity to treat diseases. Wide variety of medicinal herbs possesses potent anti-obesity activity. The present review summarizes the important medicinal herbs which had been used to treat obesity

Table 1: Medicinal plants proved as anti-obesity agents.

Plant name	Family	Part used	Chemical constituents	Traditional uses	Pharmacological activity	References
<i>Capparis decidua</i>	Capparaceae	Fruit, twig, root, bark	Pentacosane, alkaloids, stachydrine, capparidisine, capparisine and tricontanol	Gas trouble, constipation, pyorrhea, insomnia, epilepsy and obesity	Antioxidant, antidiabetic and anti-obesity	58-60
<i>Zingiber officinale</i>	Zingiberaceae	Rhizome	Gingerol, geranial, borneol, alpha curcumin, alpha zingiberene, beta sesquiphellandrene and 6-gingesulfonic acid	Piles, nausea, vomiting, rheumatism, headache, lumbago, cancer and obesity	Stomachic, aphrodisiac, tonic, anthelmintic, carminative, anti-diabetic and anti-obesity	61-63
<i>Moringa oleifera</i>	Moringaceae.	Leaves	Thiocarbate glycosides, acetylated carbamate, amino acids, moringine, tocopherol, Vitamin A, C, B, kaempferol, quercetin, beta sitosterol, sulphur, resin, mucilage, spirochin and pterygosperrin	Premature ejaculation, spermatorrhoea, intestinal worms, gonorrhoea, elephantiasis, dropsy and obesity	Anti-inflammatory, nerve tonic, stimulant, anthelmintic and anti-obesity	64-65
<i>Commiphora mukul</i>	Burseraceae	Resin	Myrcene, dimyrcene, polymyrcene, guggulsterol, guggulsterone, comphorene, cembrene, mukul and sitosterol	Inflammation, ulcers, paralysis, gout, rheumatism, asthma and obesity	Fibrinolytic and anti-obesity	66-67
<i>Ganoderma lucidum</i>	Ganodermataceae	Fruit	Ganoderic acid, ergosta-7, 22-diene-3beta-yl pentadecanoate, methyl ganoderate A and B, ganoderic acid C2 and G, ergosterol peroxide, ergosta-7, 22-diene-3beta, 5alpha, 6beta-triol	Wounds, peptic ulcer, inflammation and obesity	Anti-cancer, anti-parasitic, antimicrobial, anti-oxidant, anti-inflammatory, woundhealer and anti-obesity	68-69

<i>Eugenia jambolana</i>	Myrtaceae	Bark, seeds, leaves and fruits	Chemical constituents are friedelin, sitosterol, betulinic acid, jambolin, myricetin, kaempferol, isoquercetin, quercetin, ellagic acid, oleonic acid, diglycosides and cyanidin	Cancer, hyperglycemia, hyperlipidemia, inflammation and obesity	Antidiabetic, antiulcer, cytotoxic, antiviral and anti-obesity	70
<i>Allium sativum</i> Linn	Liliaceae	Bulb	Chemical constituents are allin, allistatin I, allistatin II and garlicin	Diabetes, helminthiasis, chronic colitis, respiratory tract diseases and obesity	Anthelmintic, expectorant, rubefacient, vesicant and anti-obesity	71-73
<i>Cassia tora</i> Linn	Cesalpiniaceae	Roots, seeds and leaves	Triterpenes, flavonoids, obtusifolin, flavonoids, toralactone, torachryson, physcion, chrysophanol, xanthone derivatives, emodine, rubrofusarin, 1, 8 dihydroxyanthraquinone	Ringworms, foul ulcers, cheloid tumors, leprosy, psoriasis, hyperlipidemia and obesity	Purifier, purgatives, expectorant, deterrent, antioxidant and obesity	74-76
<i>Morus alba</i> L	Moraceae	Fruit	Tannins, quercetin 3-glucoside, alkaloids, Dihydroxynortropane and 1-deoxynojirimycin	Edema, wheezing, cough, pyrexia, headache, vertigo, insomnia and obesity	Antimicrobial, antioxidant, nephroprotective, anti-HIV, antihyperglycemic, skin tonic and anti-obesity	77
<i>Emblica officinalis</i>	Phyllanthaceae	Fruit	Gallic acid, tannins, ellagic acid, fixed oils, minerals, vitamins, amino acids and flavonoids like quercetin and rutin	Diabetes mellitus, cancer and obesity	Hepatoprotective, antidiabetic, anti-tumor, anti-obesity	78
<i>Garcinia cambogia</i>	Clusiaceae	Fruit	Xanthenes, benzophenones, organic acids and amino acids	Hyperlipidemia, diabetes, inflammation, cancer and obesity	Antirheumatic, hypolipidemic, antidiabetic, anticancer, hepatoprotective and anti-obesity	79
<i>Coriandrum sativum</i>	Umbelliferae	Seeds	Volatile oil, fixed oil, protein, linalool, coriandryl, borneol, geraniol, pinene, camphene, limonene, terpinolene, camphor, borneol and terpineal	Flatulence, indigestion, vomiting, spermatorrhea, leucorrhoea and obesity	Stimulant, antipyretic, anthelmintic, aromatic, carminative and anti-obesity	80-82
<i>Eclipta prostrata</i>	Compositae	Leaves and stem.	Sterols, wedelolactone, stigmasterol, terthienyl methanol, b amyirin, 7-dsmethyl wedelolactone, 7 glucoside, wedelic acid, apigenin, leuteolin and glucosides	Anorexia, tuberculosis, peptic ulcer, HIV and anti-obesity	Hepatoprotective, hypolipidemic and anti-oxidant	83-84
<i>Costus speciosus</i>	Costaceae	Roots	Saponins, tigoninin, diosgenin, amyirin sterate and lupeol	Hyperlipidemia, inflammation and obesity	Stringent, stimulant, digestive, anthelmintic, depurative, aphrodisiac and anti-obesity	85-87
<i>Cinnamomum zeylanicum</i>	Lauraceae	Dried inner bark	Volatile oil, cinnamic acid, caryophylline, cymene, pinene, phellandrene, cuminaldehyde, cinamaldehyde, eugenol, resin, tannin, starch and mucilage	Diabetes mellitus, cardiovascular disorders and obesity	Antioxidant, antidiabetic and anti-obesity	88

<i>Carica papaya</i> Linn	Caricaceae	Leaves	Papain, pectins, carotenoids pigments, carpine, carpasemine, carposide, chymopapain, carotene, vitamin C, B, caricin, protein carbohydrate and fatty acids	Intestinal worms, general debility, amenorrhoea, constipation, dyspepsia, hypertension and obesity	Antipyretic, antidiabetic, anti-sickling, gastroprotective, anti-bacterial, antimalarial, laxative and anti-obesity	89-91
<i>Cudrania tricuspidata</i>	Moraceae	Fruits	Flavonoids, polyphenols, 6-8 diprenylgenistein	Obesity, inflammation and cancer	Anti-obesity, antioxidant and anticancer	92
<i>Carum carvi</i>	Apiaceae	Seeds	Volatile phenolic compounds, fatty acids and essential oils	Intestinal spasm, stomach ache, burping and flatulence	Anti-obesity, anti-cancer, antimicrobial and antioxidant	93
<i>Bauhinia purpurea</i>	Leguminosae	Bark	Isoliquiritigenin 2'-methyl ether, Bauhiniastatin-1, prracemosol B and kaempferol	Obesity, piles, leprosy and asthma	Antiobesity, hypotensive, anti-platelet and anti-ulcer	94

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