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# A medicinal plants survey for treatment of obesity

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## ABSTRACT

The present day problem right from young people including all the age groups is obesity. It is not just fatness but is the indication of overweight. The plants with several chemical constituents with in themselves act as the source for the treatment of the obesity with their valuable hypolipidemic and hypocholestroemic agents. Here in, there is a list of plants and main constituents which can be used in the treatment of the obesity by extracting the constituents.

**Key words:** Obesity, herbs, chemical derivatives

## INTRODUCTION

Obesity is simply fatness in a degree higher than overweight, which may even have a worse impact on a person's mental health. The energy intake coming from food that the body does not use is stored as fat. Obesity may be genetic but more often it is simply because of poor diet and lack of exercise in the child. To be more active is the best way to burn more calories and lose weight (www.icobesity.com). In a country like India, obesity is in association with modernization and urbanization. As the people are moving to urban centers and wealth is increasing, the obesity is becoming epidemic. In Northern India obesity was most prevalent in urban populations (male = 5.5%, female = 12.6%), followed by the urban slums (male = 1.9%, female = 7.2%), when compared to rural populations (male = 1.6%, female = 3.8%). Socioeconomic class also had an effect on the rate of obesity, with women of high socioeconomic class having greater rates (10.4%) than that of low socioeconomic class women (0.9%)(Adam et al 2008). Evidence suggests that obesity often has more than one cause of which genetic, environmental, psychological, physiological play an important apart from other factors. Obesity may increase the risk of developing many health problems which include Type diabetes, Heart disease, Stroke, High blood pressure (hypertension), High cholesterol (hypercholesterolemia), Certain cancers, Sleep apnea, Osteoarthritis, Gallbladder disease and gallstones, Fatty liver disease (also called nonalcoholic steatohepatitis or NASH), Gastroesophageal reflux disease (GERD), Gout and Psychological and emotional effect (Arthur Schoenstadt, 2007). The phospholipids, free cholesterol and protein constitute the outer surface of the lipoprotein particles while the inner core contains mostly esterified cholesterol and triglycerides which serve to solubilize and transport cholesterol and triglycerides in the bloodstream. The lipoprotein lipase hydrolyses triacylglycerol components of VLDLs and chylomicrons to free fatty acids and glycerol in the capillaries of adipose tissue and skeletal muscle, of which the free fatty acids are absorbed by the cells and the glycerol is returned via the blood to the liver (and kidneys) and converted to the glycolytic intermediate DHAP.PPARα induces a massive increase in peroxisomal fatty acid oxidation in hepato cytes thus providing a powerful action for the clearance of fat from the serum. Direct activation of PPARγ leads to contribution of lowering TG and FFA levels, and suppresses TNF-α gene expression, which are potential systemic mediators of insulin resistance (Moller 2001). Changes in hepatic LDL-receptor contribute to the elevation in blood cholesterol levels induced by high-cholesterol diets as well as to the reduction that follows hepatic cholesterol depletion (Brown MS 1986). HMG-CoA reductase is the rate limiting enzyme governing cholesterol biosynthesis and the synthesis of other isoprenoids in mammalian cells (Rodwell VW 1976), on which more than 70% of total production of body cholesterol in humans is derived from denovo synthesis. Acyl coenzyme A: cholesterol acyltransferase (ACAT), catalyses the intracellular formation of cholesteryl esters, plays an important role in the intestinal absorption of cholesterol, foam cell formation within the arterial wall and VLDL production in the liver. Food intake and fat deposition are regulated by neurotransmitters peptides, most of the located in the brain, particularly in the hypothalamus and in the gut. This includes peptides that are orexigenic (appetite-stimulating) signals and anorectic peptides. Neuropeptide Y, orexins A and B, galanin, melanin concentrating hormone, and agouti-related peptide all act to stimulate feeding, while alpha-melanocyte stimulating hormone, corticotropin releasing hormone, cholecystokinin, cocaine and amphetamine regulated transcript, neurotensin, glucagons like peptide 1, calcitonin gene related peptide, bombesin and ciliary neurotropic factor have anorectic actions.

From an ancient years to till now, herbals used for the treatment of obesity by different mechanisms. Herbs contain a wide variety of active phytochemicals, such as flavanoids, terpenoids, lignans, polyphenols, saponins, plant sterols and cartenoids, and there is now a lot of interest in herbs that possess hypolipidemic, antiplatelet, anti-tumour and immune stimulating properties (Craig, 1999). Others like Vitamin E, vitamin C, vitamin B6, beta carotene, dehydrolipoic acid, glutathione and coenzyme Q10 (CoQ10, ubiquinone) are inhibiting oxidation of LDL cholesterol. (Alan 1996). In this review we reveal that herbals and its derivatives used for the treatment of obesity and its related diseases/ disorders.

## HERBS AND ITS DERIVATIVES:

***Accanthopanax sessiliflorus:***

Bioactive-guided fractionation of a saponin-rich fraction of the leaves of *Accanthopanax sessiliflorus* led to the isolation of the active lupane-type saponins, sessiloside and chiisanoside, both of which showed strong inhibition of PL in vitro. Further, sessiloside and chiisanoside inhibited lipase activity in a dose-dependent manner, and heir IC50 values were 0.36 and 0.75 mg/ml, respectively (Yoshizumi, K. et al. 2006).

***Antrodia camphorata***

Chin-hsin huang described that the major bioactive compounds of Antrodia camphorata are identified as polysaccharides, triterpenoids, steroids, benzenoids, and maleic/succinic acid derivatives. Therapeutic groups were orally administrated dosages of 0.25 g silymarin/ kg BW and a low dosage of Antrodia camphorata (0.025 g/kg BW) and a high dosage of Antrodia camphorata (0.1 g/kg BW) per day. Antrodia camphorata especially at the high dosage not only showed a hypercholesterolemic effect ($p < 0.05$) but also reduced ($p < 0.05$) hepatic lipids in alcohol-fed rats. Those beneficial effects could be partially attributed to higher ($p<0.05$) fecal cholesterol and bile acid outputs, as well as down regulations ($p<0.05$) of HMG-CoA reductase, sterol regulatory element-binding protein-1c, acetyl-CoA carboxylase, fatty acid synthase, and malic enzyme gene expressions; meanwhile, there was an upregulation of low-density lipoprotein receptor and peroxisome proliferator-activated R gene expression.

***Aesculus* species:**

A mixture of triterpene oligoglycosides (escins) from Japanese horsechest nut (*Aesculus turbinate*) and European horsechest nut seeds (*Aesculus hippocastanum*) have nutraceutical properties associated, potentially, with antidiabetic or anti-obesity effects. Detailed structure activity relationship (SAR) studies of escins and their derivatives deacetylescins and desacylescins, with respect to their PL inhibitory activity, demonstrated that the potency of these compounds was in the order of escins > desacylescins > deacetylescins. Escins Ib (IC50 24 mg/ml) and IIb (IC50 14 mg/ml) with angeloylmoieties were found to be more potent than escins Ia (IC50 48 mg/ml) and IIa (IC50 61 mg/ml) with tigloyl moieties. Escins also have inhibitory effect on the elevation of blood glucose in the order of escins > deacetylescins > desacylescins (Kimura, H. et al. 2006).

***Cajanus cajan***

The effect of (200 mg/kg) stilbenes (Cajanin, Longistylin C, and Longistylin A) containing extract-fraction from C.cajan on lipid metabolism significantly decreased the serum and hepatic total cholesterol, TG, and the LDL cholesterol in hypercholesterolemic (high cholesterol plus cholic acid diet) kunming mice compared to model mice. In the same experiment, HMG-CoA reductase mRNA expression level obviously increased in the hypercholesterolemic mice treated by extract fraction from *C.cajan* of 200 mg/kg/d and simvastatin. Since the mRNA expression of the HMG-CoA reductase is controlled by the negative feedback regulated by serum and liver cholesterol level, the increased HMG CoA reductase expression caused by extract fraction from C.cajan may be a compensatory enhancement secondary to the decrease in serum and liver cholesterol. In case of the LDL-receptor increased the CYP7A1 mRNA expression level is significantly increased and remarkably decreased the serum LDL cholesterol content. This means it decreases the TC concentration by enhancing hepatic LDL-receptor expression (Qing-Feng Luo et al., 2008).

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***Capsicum frutescens***
Studies in rats show that capsaicin, which is derived from C.fructescens enhances catecholamine secretion from the adrenal medulla, resulting in increased oxygen consumption. Enhancement of oxygen consumption and energy expenditure in humans who eat red pepper, which contains capsaicin, has also been reported. The differences in thermogenesis and fat oxidation in 13 Japanese women fed a high-fat diet vs. a diet high in carbohydrate foods, with or without the addition of red pepper. It was found that the addition of red pepper to either type of meal significantly increased both energy expenditure and fat oxidation; the impact was more pronounced in those randomly assigned to receive a high-fat meal.

***Caralluma fimbriata***
The key phytochemical ingredients in Caralluma are pregnane glycosides, flavone glycosides, megastigmane glycosides, bitter principles, saponins and various other flavonoids (Bader et al., 2003). Caralluma fimbriata has a potential appetite suppressing action. While there was no significant effect of Caralluma on BW, there was a significant reduction in waist circumference. The effect of appetite suppression translated into a net effect of a reduction in energy and fat intake and was accompanied by a reduction in intake of less desirable food groups, while the intake of desirable (healthy) food groups remained unchanged (Rebecca Kuriyan et al., 2007)

***Commiphora wightii:***
The resinous sap, harvested from the tree bark by tapping, is extracted to produce guggul. Gugulipid is the purified standardised extract of crude gum guggul, and contains the active guggulsterone components Z-guggulsterone and E-guggulsterone, with cembrenoids, myrrhanone and myrrhanol derivatives. Guggul is used mainly in Ayurvedic medicine and has been traditionally used to treat hypertension, osteoporosis, epilepsy, ulcers, cancer, obesity and rheumatoid arthritis. It is now often used for hyperlipidaemia, but clinical studies have found conflicting results for its lipid-lowering effects. Guggul resin contains a number of compounds including a diterpene hydrocarbon, a diterpene alcohol, Z-gugulsterone, E-gugulsterone, and Gugulsterols I, II and III. Guggul has undergone investigation for its hypolipidemic action (which has been recognized since the vedic ages) and its anti-inflammatory effects (Elizabeth Williamson et al. 2009). Oral administration of guggul produced lower cholesterol levels and lessened serum turbidity. The cholesterol lowering effects have been seen in monkeys kept on a high cholesterol diet, with results comparable to those of Atromid-S. It has a high anti-inflammatory potential against Brownlee's formaldehyde- induced arthritis in albino rats. It is also indicated in rheumatic disorders and obesity (Aditya Sharma, 2006).

***Cyclocarea paliurus:***
Cyclocariosides are dammarane type of triterpene saponins isolated from the leaves of *Cyclocarea paliurus*. The leaves of *C. Paliurus* have been a food source for maritime people for a long time, and are known to have beneficial effects on health and used as a traditional remedy for prevention of hyperglycemia and diabetes mellitus. Three cyclocariosides viz. cyclocarioside A, cyclocarioside IIand cyclocarioside III have been isolated and demonstrated to exhibit an insulin-like activity in adipocytes, in vitro and in vivo. *C. paliurus* extract was shown to inhibit PL activity in a dose-dependent manner at an IC50 value of 9.1 mg/ml. The cyclocariosides are considered to be mainly responsible for these activities of the extract (Kurihara, H. 2003).

***Ephedra sinensis***
**(**The principal alkaloid constituents are ephedrine, pseudoephedrine, and sometimes small amounts of phenylpropanolamine. Other constituents that have been isolated include norpseudoephedrine, methylephedrine, and norephedrine. Early studies showed that ephedrine (derived from the ephedra plant) has thermogenic and anti-obesity properties in rodents. Follow-up double-blind, placebo-controlled trials in humans found that ephedrine compounds in combination with caffeine are effective for helping to treat obesity. As a result, supplements containing ephedra alkaloids became widely available as a stimulant for losing weight and increasing energy. A recent randomized, double-blind trial of 67 human subjects reported that E.sinensis in combination with Paullinia cupana (guarana) promoted short-term weight and fat loss.

***Ficus carica* L.:**
Ficus carica contain a high amount of sugar, pectins, flavonoids and vitamins. Leaves contain phenolic compounds such as flavonoids, a-tocopherol and 3-O-caffeoylquinic acid, with antioxidant capacity and superoxide radical scavenging activity. They contain also organic acids, such as oxalic, citric, malic, quinic, shikimic and fumaric acids. Leaves contain also steroids, triterpenoids and coumarins. The flavonoids contained in the Fig leaf aqueous extract may contribute to the hypolipidemic action, as it has been demonstrated that some flavonoids, such as naringenin, inhibit HMGCoA reductase and ACAT activities in high cholesterol-fed rats. The same study showed that all the aqueous extracts obtained from F. carica leaves could significantly decrease ($p<0.001$) secretion of cholesterol from the liver cell in both stimulated and basal condition which is resemble to the diabetic animals (Fatemi A et al 2007).

***Gardenia jasminoids:***
Crocin is a glycosylated carotenoid, major active constituents of Gardenia jasminoids, exhibited potent hypoTGmic and hypocholesterolemic activities. Crocin competitively and reversibly inhibited PL at an IC50 of 28.63 mmol (Lee, I.A. et al. 2005) and its metabolite crocetin also potently inhibited PL. Crocin and crocetin also showed potent hypolipidemic activity in Triton WR-133 or cornoil induced hyperlipidemic mice (Sheng, et al. 2006).

***Gardenia fructus:***
Geniposide, genipin, crocetin and sennosides contained in G.fructus is known to have choleretia and hypo cholesterolemic activities.

**Glycine max :**
The isoflavones in soya beans consist mainly of genistein and daidzein, with smaller mounts of isoformononetin, ononin, glycetein, desmethyltexasin and others. They are present mainly as glycosides, and the amount varies between the different soya products. Soya beans also contain coumestans (mainly in the sprouts) and phytosterols. The fixed oil from soya beans contains linoleic and linolenic acids. Fermented soya products contain variable amounts of tyramine. There are numerous purported benefits of soya protein; the most well studied being possible reductions in hyperlipidaemia, menopausal symptoms and osteoporosis, and prevention of some cancers (Elizabeth Williamson et al. 2009).

***Hibiscus sabdariffa***
Aqueous extract of dried calyces of H. sabdariffa at 0.8 ml/kg BW showed significant decrease in plasma glucose and cholesterol in rats fed with 99% growers mash and 1% cholesterol. Same results were obtained when rats were subjected to an aqueous extract of H.sabdariffa and zingier officinale at 1ml/Kg BW. Extracts of Hibiscus sabdariffa and zingier officinale apart from being hypocholesterolemic and hypoglycemic, they control blood sugar especially in those prone to diabetes mellitus (Agoreyo FO et al., 2008). Hibiscus extract inhibited significantly the lipid droplet accumulation by MDI (isobutylmethylxanthine, dexamethasone, and insulin) in a dose-dependent manner and attenuated dramatically the protein and mRNA expressions of adipogenic transcriptional factors, C/EBPα and PPARγ, during adipogenesis in 3T3-L1 preadipocytes. The increase of phosphorylation and expression of PI3-K/Akt during adipocytic differentiation was markedly inhibited by treatment with hibiscus extract or PI3-K inhibitors. This suggests that hibiscus extract inhibits the adipocyte differentiation through the modulation of PI3 K/Akt and ERK pathway that play pivotal roles during adipogenesis (Jin-Kyung Kim et al., 2003).

***Myristica fragrans***
The ethanolic extract of this plant extract demonstrated significant hypolipidaemic effects in experimentally induced hyperlipidaemia in rabbits. It lowered the lipoprotein lipid levels, TC, LDL-C and TGs. HDL-C was not significantly affected. TC, HDL and LDL: HDL ratios were also significantly lowered. It lowered the level of TC in the heart and liver and demonstrated platelet antiaggregatory activity (Ram et al 1996). Seed extract administration reduced both TC and LDL-C, lowered the cholesterol/ PPL ratio and elevated the decreased HDL ratio significantly in hypercholesterolemic rabbits. This extract also prevented the accumulation of cholesterol, PPLs and TGs in liver, heart and aorta and dissolved atheromatous plaques of aorta. Fecal excretion of cholesterol and PPL were significantly increased in these rabbits (Sharma A et al 1995).

***Nelumbo nucifera***
Blend tea or extract of leaf of *N. nucifera* has recently been used to treat obesity in China. Active substances were separated from different parts of *N. nucifera* mainly including alkaloids, flavonoids, triterpenoids, polyphenols, steroids and glycosides Alcoholic *Nelumbo nucifera* leaves extract (NNE) had an inhibitory activity on a-amylase and lipase, and these inhibitory activities disappeared by elimination of phenolic compounds from NNE. Extracts of N. nucifera leaves (NNE) inhibited PL with an IC50 value of 0.46 mg/ml. The inhibitory activity was attributed to the phenolic constituents of the leaves. NNE caused a concentration dependent increase in glycerol release due to the break down of oil droplet in adipocytes. This result means that NNE upregulated lipolysis in adipocytes. The lipolitic effect of NNE was mediated by ß-adrenoceptors, because a ß-adrenoceptor antagonist blocked this effect. Stimulation of the ß-adrenoceptor in white adipocytes leads to increased lipolysis, primarily through the production of cAMP and activation of hormone-sensitive lipase and other pathways whereas stimulation of the a2-adrenoceptor leads to increased lipid storage, through the inhibition of cAMP production. Feeding NNE with exercise is beneficial for the suppression of diet-induced obesity. However, this effect of NNE was not shown in the treated group without exercise, suggesting that the anti-obesity effect of NNE requires exercise. Feeding the high-fat diet for 6 weeks produced slight increases in UCP3 mRNA expression in the soleus and gastrocnemius muscles. On the other hand, UCP3 mRNA expression was significantly increased in only the trained group and in the group treated with NNE and exercise and up-regulation of UCP3 mRNA expression in the group treated with NNE and exercise was greater than that in the only trained group. Thus, the up regulation of UCP3 mRNA expression in the mouse skeletal muscle treated with NNE was due to exercising. As a result of increasing themogenesis and lipid metabolism, NNE prevented an increase in BW in the mice fed the high-fat diet (Yuka Ono et al., 2006). Flavonoids from Nelumbo nuficera Gaertn was orally administered once a day after 3 days of alloxan induction at 50 and 200 mg/kg for 28 day, and the results showed that fasting blood glucose, serum TC and TG levels were significantly

decreased, whereas serum HDL-C level were increased. The dosage of 200 mg/kg is more effective than that of 50 mg/kg. These effects may be due to low activity of cholesterol biosynthesis enzymes and or low level of lipolysis which are under the control of insulin (Taoying Zhou et al., 2009).

***Panax japonicus***

The rhizomes of *Panax japonicus* are used as a folk medicine for the treatment of lifestyle-related diseases, such as arteriosclerosis, hyperlipidemia, hypertension and non-insulin dependent diabetes mellitus as a substitute for ginseng roots in China and Japan. Total chikusetsusaponins isolated from *P. japonicus* have been shown to prevent high fat diet-induced increase in BW and fat storage in adipose tissue by preventing intestinal absorption of dietary fat via inhibition of PL activity. Chikusetsusaponin III, chikusetsusaponin IV and 28-deglucosyl-chikusetsusaponins IV and 28-deglucosyl-chikusetsusaponins V were isolated from the total saponin fraction and Chikusetsusaponin III 28-deglucosyl-chikusetsusaponins IV and 28-deglucosyl-chikusetsusaponins V were found to be active at concentrations of 125–500 mg/ml (Han, L.K. et al. 2005).

***Plumbago zeylanica:***

Ethanolic extract (50% v/v) of root, alone and in combination with vitamin E, significantly reduced serum total cholesterol, LDL cholesterol and TG levels in experimentally induced hyperlipidaemic rabbits (Dwivedi S 1997). The plain (single drug) made of chitraka root if taken orally in dosage of 2-3 pills twice a day for about 3 months with luke warm water or butter milk, results in reducing excessive lipid levels in blood i.e. reduces obesity. The root powder taken orally along with honey gradually reduces hypercholesterolemia and improves blood formation (Madhava Chetty et al 2006).

***Salacia reticulate:***

The roots and stems of the plant *S. reticulata* have been used as a supplementary food in Japan to prevent obesity and diabetes. The hot water extract of S. reticulata roots (SRHW) has been reported to inhibit PL in a concentration dependent manner with an IC50 of 264 mg/ml. It was also shown to suppress BW in in vivo rat antiobesity models. SRHW contained a high concentration of polyphenols (24%), including mangiferin, catechins and condensed tannins and were considered to be responsible for the inhibitory effect (Masayuki, Y. et al. 2002).

***Solanum melongena:***

Flavonoids are the active principles in this plant. Flavonoids extracted from the fruits of S. melongena (Brinjal) at a dose of 1mg/100g BW/day showed significant hypolipidemic action in normal and cholesterol fed rats (Sudheesh S et al., 1997). The fresh, ripe fruits of S.melongena and S.gilo significantly reduced serum TC by 65.40% and 52.69% respectively, TG by 47.7 and 27%, LDL cholesterol by 85 and 83% respectively. They also increased significantly serum HDL by 24.7 and 25% respectively leading to increased HDL/LDL cholesterol ratio (3.37 and 3.25 respectively) in hypercholesterolemia induced New Zealand white rabbits by feeding the animals with normal diet supplemented with 1% cholesterol and groundnut oil for 3 weeks. This trend was also similar with liver lipid levels. Histopathological examination of the liver and aorta paraffin section stained with Haematoxylin and Eosine showed fewer lesions. These observations demonstrated that they have strong hypolipidemic effect and is an indication of the possible use of this fruit in the treatment of diseases associated with hyperlipidemia and arteriosclerosis (Odetolal AA et al., 2004).

***Salvia officinalis***

Carnosic acid, an abietan type of diterpene isolated from the methanolic extract of Salvia officinalis leaves that competitively inhibited PL in a concentration-dependant manner with an IC50 value of 12 mg/ml (36 mM) and a Ki of 5.4 mg/ml (16.1 mM). Further, carnosic acid was shown to suppress serumTG elevation in olive oil-loaded mice and epididymal fat weight increase in high fat diet-fed mice. Bioactive-guided fractionation of S. offcinalis also led to the isolation of carnosol, roylenoic acid and 7-methoxyrosmanol and a triterpene oleanolic acid. All these compounds inhibited PL in vitro with an IC50 value of 4.4 mg/ml, 35 mg/ml 32 mg/ml and 83 mg/ml, respectively (Ninomiya, K. et al. 2004).

***Tamarindus indica:***

Oral administration of aqueous pulp extract of T.indica resulted in a dose dependent decrease in body weigh of rats. The decrease in BW may be attributed to the reduction in food and water intake caused by chemicals that affect brain centers involved in satiety and hunger or could have inhibited digestive enzymes or decreased bioavailability of nutrient caused by ant nutritional factors present in plant extract. Dose dependent decrease in BW could also be attributed to the presence of anti nutritional factors like saponins in the extract. Though the rats were fed with diet with adequate protein, the plant extract might not have allowed proper absorption of protein which could account for the decreased BW. The aqueous pulp extract of the plant at 2700-4500mg/kg dose had lowered BW, TC and low density lipoprotein. It had significantly increased TGs and HDLs (Ukwuani AN et al., 2008).

***Thea sinensis* (Oolong Tea)**

Traditionally, oolong tea has been used to prevent obesity and improve lipid metabolism. In a relatively recent trial, oolong tea given to high-fat diet-induced obese mice for 10 weeks was found to prevent obesity and fatty liver typically induced by a high-fat diet. The positive effects of the tea may be due to caffeine stimulation of norepinepherine-induced lipolysis. Of the polyphenols identified from oolong tea, (-)-epigallocatechin 3,5-di-O-gallate (IC50 0.098 mM), prodelphinidin B-2 3,30-di-O-gallate(IC50 0.107 mM), assamicain A (IC50 0.120 mM), oolonghomobisflavan A (IC50 0.048 mM), oolonghomobisflavan B (IC50 0.108 mM), theasinensin D (IC50 0.098 mM), oolongtheanin 30-O-gallate (IC50 0.068 mM), theaflavin (IC50 0.106 mM), and theaflavin 3,30-O-gallate (IC50 0.092 mM) showed the most potent PL inhibitory activities. Furthermore, detailed SAR studies suggested that functional galloyl moieties and the polymerization of flavan-3-ol were required for PL inhibition (Nakai, M. et al. 2005).

***Withania somnifera* (L.)**

The major constituents of the root are steroidal lactones, with several series known as the withanolides (designated A–Y to date), glycowithanolides (sitoindosides), the withasomniferols (A–C), withastramonolide and withaferin A. The extract also contains phytosterols and alkaloids such as ashwagandhine, ashwagandhinine, anahygrine, withasomnine, withaninine and others. It has sedative and anti-inflammatory effects and is used for a wide range of conditions including hypercholesterolaemia (Elizabeth Williamson et al. 2009).

**MISCELLANEOUS:**

**Olive oil**

Research on the monounsaturated fatty acid (MUFA) olive oil and its components suggest it plays an important role in the prevention of heart disease. There are multiple mechanisms by which olive oil might impact the development of atherosclerosis: reduction of hypertension and LDL oxidation, beneficial changes in lipid ratios, and reduction of macrophage uptake of LDL cholesterol (Aviram et al., 1993). Several studies have shown phenolic compounds (PCs) extracted from extra-virgin olive oil significantly inhibited the oxidation of LDL cholesterol (Caruso et al, 1999). In one study PCs from virgin olive oil were compared with single PC components such as tyrosol and oleuropein (polyphenols found in olive leaf and olive oil). They were also compared with probucol, a synthetic antioxidant medication demonstrated to prevent restenosis after balloon angioplasty, as a result of its antioxidant activity. Probucol (a dimer of hydroxytoluene) also inhibited LDL oxidation when compared to alpha-tocopherol and inhibited LDL uptake into atherosclerotic lesions (Haklar et al., 1998). PCs were a more potent inhibitor of oxysterol (oxidized LDL) formation than single PC components or probucol. The IC50 values for oxysterols were approximately 48, 21, 8, and 7.5 mM for tyrosol, probucol, oleuropein, and PCs, respectively. In another study, healthy men were supplemented daily with 50 g olive oil for two weeks. The susceptibility of LDL to oxidation was reduced 73 percent. In addition, macrophage uptake of LDL was reduced 61 percent. Significant reductions in both parameters were observed after only one week. Both oxidation and macrophage uptake of LDL are key factors initiating intimal cell injury, foam cell formation, and ultimately atherosclerosis. While the high ratio of unsaturated to saturated fats found in the Mediterranean diet may contribute to its substantial benefit in CHD, it appears olive oil may be working in other ways as well. The antioxidant activities of its phenolic compounds, shown to inhibit key elements in the pathogenesis of heart disease, are very likely important (Lyn Patrick et al., 2001).

**Fiber**

Preliminary evidence suggests that dietary fiber may be key in regulating circulating insulin levels by slowing nutrient absorption following a meal. According to the multicenter Coronary Artery Risk Development in Young Adults (CARDIA) Study that included 2909 healthy Black and White, 18-to-30-year-old adults, higher insulin levels, which are associated with low-fiber diets, may contribute to excessive weight gain via mechanisms such as alterations in adipose tissue physiology, shunting metabolic fuels from oxidation to storage, and increased appetite.

**L-glutamine**

In a small study of mice that underwent high-fat feeding to induce obesity and insulin resistance, L-glutamine supplementation was shown to reduce BW and attenuate hyperglycemia and hyperinsulinemia. These effects may stem from the action of amino acid on the conversion and storage of consumed energy, rather than from inducing fat malabsorption. Animal studies suggest that glutamine may act as an appetite suppressant. Large-scale clinical trials would be needed to determine if glutamine is useful as an anti-obesity and antidiabetic agent.

**Vitamin C**

A study of 102 obese women and 33 control non-obese women found a negative correlation between degree of obesity and ascorbic acid status, with extreme obesity resulting in the lowest serum ascorbic acid level. It is theorized that a suboptimal supply of certain vitamins, such as ascorbic acid, may decrease metabolic rate and energy expenditure.

**Vitamin D**

Vitamin D insufficiency and secondary hyperparathyroidism have been associated with obesity. A study of healthy, White, obese subjects found that these patients had lower

basal plasma concentrations of 25-hydroxyvitamin D and higher serum parathyroid hormone concentrations when compared to age-matched non-obese control subjects. The results of the study suggest that obesity-associated vitamin D3 insufficiency was likely due to decreased bioavailability of cutaneous and dietary sources of the vitamin D3 because of its deposition in BF compartments. Supplementation with oral vitamin D may correct the vitamin D deficiency associated with obesity.

**Pyruvate**

Pyruvate, a 3-carbon ketoacid produced from phosphoenolpyruvate, has been touted as a BW, fat, and cholesterol reductant. Although early animal studies and later small-scale studies of obese women being fed on metabolic wards offer preliminary evidence that pyruvate may influence weight and fat loss, there is no substantive body of research to date that supports marketing claims, especially those that say pyruvate has been "clinically proven". Further research in this area, however, may be warranted (Sukala 1998).

## CONCLUSION:

Here we discussed the some herbs and its derivatives used for treatment of obesity and its associated health problems, still so many unexposed herbs are there in the world, those are used only in traditional and folk medicine but are not scientifically proved. By this review we bring out list of herbs used for the treatment of obesity, even we hope that it will give a idea for further research in listed herbs and its derivatives as well as new herbs.

## ABBREVIATION:

PL- Pancreatic lipase
BW – Body weight
HDL - High density lipoprotein
HMG- 3 – OH-3-methyl glutaryl
CoA – Coenzyme A
TC- total serum cholesterol
PPL- Phospho llipd
TG- triglyceride
TL – Total lipid
LDL - low density lipoprotein
VLDL- very low density lipoprotein.
LDL-C - low density lipoprotein cholesterol
VLDL-C- very low density lipoprotein-cholesterol.
HDL-C - High density lipoprotein-cholesterol
cAMP - cyclic Adenosine Monophosphate
BF- body fat percentage
FM - fat mass

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