

Beneficial Effects of Medicinal Plants Used For the Management of Obesity- A Review

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ABSTRACT

Prevalence of obesity has been increased worldwide over the most recent three years. Lack of physical activity and dietary intake are the major factors contributing obesity. The weight gain and energy imbalance are influenced by many factors such as hormone balance, age, sex and lifestyle modification. High calorie intake than required are deposited as a fat in our body it leads to weight gain. Many drugs designed to treat obesity such as orlistat, sibutramine and metformin but these drugs cause so many side effects. There is a need for the alternative therapy due to side effects of these synthetic drugs. The present study was designed how the medicinal plants used to treat obesity with least side effects. Herbal remedies such as *citrus paradisi*, *Glycyrrhiza glabra*, *Alternanthera sessilis*, *Benicasa hispida*, *punica grantum* *Solanum melongena*, *cinnamaldehyde*, *Tamarindus indica*, *Piper nigrum*, *Allium sativus*, which contain many bioactive compounds such as Naringin, Chlorogenic acid, Gallic acid that plays crucial role in treatment of obesity without side effects.

Key words: Obesity, antiobesity drugs, Medicinal plants, *Citrus paradisi*, Naringin.

INTRODUCTION

Obesity is one of the greatest health threats and is regular health issue among all the population Worldwide. It raised the morbidity and mortality and relates to type 2 diabetes, cancer, stroke, and coronary heart disease. [1] In the health system, the prevention and the treatment of obesity is a big deal. [2] In the developed world prevalence of obesity is frequently raised. Almost 23% of Canadian adults are obese, Further 36% are consider overweight. [3] Obesity is considered as multifactorial diseases even though there is an certain environmental factors and genetic predisposition to obesity which are also implicated. [4] It includes diet, exercise & Sedentary lifestyles, etc. The population in United States has increased in number when

compared with previous forty – five years, with almost three third of children are obese (BMI \geq 95%for age and sex). [5] Various methods have been used to diminish body weight and its barrier for many years. The inadequate results after termination the lifestyle changes bound the physician and researchers to re-evaluate to expose safe alternative therapy for this human health concern. Herbal plants are the best remedy to decrease body fat and body weight. [6] In clinical case study, body fat is usually measured by using a expression that combines height and weight. The magnanimous difference in height and weight of the same person is due to body fat mass. The World Health Organization is a standing Committee and it provide the classification between stoutness and obesity

that applies to both male, female and all grown up age group. [7]

Factors influencing obesity

Stoutness is certifiably not a solitary issue however a heterogeneous gathering of conditions with various causes. Body weight is controlled by an association between hereditary, ecological and psychosocial factors that takes place in the physiological process.

Genetics and Environmental factors

Largeness keeps running in families yet the impact of the genotype on the etiology of corpulence might be constricted or exacerbated by non-genetic factors. Apart from uncommon corpulence related disorders, the hereditary impacts appear to work through powerlessness qualities. Such qualities augment the danger, that build up a trademark that are not basic for its appearance or independent and is adequate to clarify the advancement of an ailment. [8]

Research indicates that 40% to as much as 80% of the variance of BMI can be attributed to genetic factors. It is determined that heritability is as high as 30-40% for factors relevant to energy balance such as body fat distribution, resting metabolic rate, energy expenditure after overeating. In humans, about 250 genetic markers have been illustrated in association with obesity.

Energy expenditure

The examination of the degree of physical movement is comparative in gathering of subjects with a BMI of < 20, 20-25 and 25-35, which shows comparable degrees of ongoing action.

Energy intake

It is astonishing that no immediate relationship has been accounted between the predominance of weight and expanded vitality admission in created countries, given the prepared accessibility of exceedingly satisfactory sustenances. The comprehension of vitality admission in the etiology of stoutness is puzzled by inability to report nourishment admission precisely. Under- announcement is broadly perceived as an element of stoutness, with examinations of vitality admission and

consumption in stout subjects demonstrating a reliable shortage in self-revealed sustenance admission of roughly 30% of the vitality requirements. [9] Fat has a powerless satisfying limit, especially when contrasted with protein and subjects in test circumstances promptly gorge when giving high-fat foods. [10]

Culture

The articulated increment in age-institutionalized pervasiveness of weight (>60% in people) in the naurians in Micronesia and Polynesians in western countries is intently paralled by modifications in diet and lifestyle. [11] A stamped change in BMI is seen now and again in vagrant investigations, where populaces with a typical hereditary legacy live under new and diverse ecological conditions. Pima Indians, for instance, living in the united states are all things considered 25 kg heavier than pima Indians living in Mexico. [12]

Fetal Nutrition

Studies shows that undernutrition of the hatching during intrauterine improvement may decide the later beginning of weight, hypertension and type 2 diabetes autonomous of hereditary legacy. Such a marvel recommends the likelihood of longer term programming of hereditary articulation as outcome of changed intrauterine growth. [13] Barker has estimated that an antagonistic nourishing condition in utero causes absconds in the advancement of body organs prompting a 'modified' powerlessness that associates with later eating regimen and natural worries to cause unmistakable malady numerous decades later. In help of the theory is the finding of an opposite connection among birth weight and systolic circulatory strain in both people in later life, with most noteworthy mean systolic blood weights being seen in those with the most reduced birth weight and most noteworthy current weight. [14]

Food intake

A few patients eat more during the times of substantial exercise or during

pregnancy but can't return to their previous dietary patterns. The expansion of obesity was mainly identified by the sort of food consumed (i.e. sustenance containing sugar and fat). The description of the defective management mechanism of food intake leads to obesity, several routes may causes obesity such as habitual diet and lifestyle changes were the major reason for obesity. [15]

Control of appetite

Craving is the longing to eat and this typically starts nourishment consumption. Following a super, cholecystokinin, bombesin, Glucagon-like peptide1. [16] enterostatin, somatostatin is discharged from the small intestine, glucagon and insulin from the pancreas. The majority of this hormone has been embroiled in the control of obesity.

Causes of Obesity

Expanding rate of weight at a societal level are felt due to effectively accessible a palatable diet, expanded reliance on autos and motorized assembling. [17] An audit recognized ten other conceivable factors to the ongoing increment of stoutness including inadequate sleep, endocrine disruptors, diminished changeability in ambient temperature, diminished rates of smoking,(as smoking smothers appetite),increased utilization of medications that can cause weight gain (eg., atypical antipsychotics), relative expansion in ethnic and age bunches that will in general be heavier, pregnancy at a later age(which may make weakness corpulence in youngsters), epigenetic hazard factor passed on generationally, normal choice for higher BMI. [18]

Diet

Heftiness rates in the US(1971-2000) expanded from 14.5% to 30%. During a similar period, there was an expansion in the normal measure of sustenance expended (normal increment for ladies 335 and 168 calories/day). The vast majority of this additional sustenance vitality was because of the expansion in starches rather than fat utilization. [19]

Sedentary lifestyle

There is an enormous move towards less physically requesting worldwide. Currently, at least 60% of the total population gets lacking activity, because of expanded utilization of motorized transportation and an incredible predominance of work sparing innovation at home. [20]

Genetics

In the same way as other ailments, stoutness is the result of transaction among hereditary and ecological variables polymorphism in different qualities controlling craving and digestion incline to weight when adequate sustenance vitality is available, People with two duplicates of FTO qualities (fat mass and corpulence related quality) have been found by and large to gauge 3-4kg more and have a 1.67 overlay more serious danger of heftiness contrasted with those without the hazard allele. [21]

Medical and Psychiatric illness

Certain physical and restorative sicknesses and Drugs that are used to treat them it can build the danger of heftiness. Therapeutic disease that cause expansion of stoutness hazard incorporate a few uncommon hereditary syndrome (Cohen disorder), just as some congenital or obtained conditions such as hypothyroidism. [22]

Social determinants

Genetic influences are important to recognize obesity. It cannot explain the contemporary dramatic expansion in obesity. Extra energy consumption than strength expenditure leads to weight problems in man of women. The reason of the shifts in these two elements on societal scale is a lot debated. [23] Classifications were less possibly to be obese. In the developed world, populace of excessive social classes had higher prices of weight problems. [24]

Medication

Even though there are numerous capsules prescribed to deal with obesity, many medicines cause weight gain as an unintended effect. Certain anti-depressants, anti-convulsants, diabetes medications, hormones, and most corticosteroids can contribute to obesity. [25] Many drugs results to a sedentary or unhealthy life style that consequently cause weight gain, whilst antidepressants can make an individual to crave for high-energy or sugary foods.

Age

Obesity can materialize at any age, even in young children. [26] But as our age, hormonal modifications and less energetic lifestyle expand the hazard of obesity. In addition, the amount of muscle in our physique tends to decrease with age. This decrease muscle mass leads to a diminish in metabolism. These changes also reduce energy desires and can make it harder to preserve off excess weight.

Medical problems

Obesity can hardly ever be traced to clinical causes, such as Cushing's syndrome, Prader-Willi syndrome. [27] and other illnesses. Some clinical problems, such as arthritis can lead to reduced activity, which might also result in weight gain. A low metabolism is not likely to motive obesity, as is having low thyroid function.

Quit smoking

Quitting smoking is frequently related with weight gain. For a few, it leads to gaining weight as much as higher pounds a week for some months, which can result in obesity. However, quitting smoking is nonetheless a great gain to our health than continuosing. [28]

Physical activity

Active humans require extra calories than much less energetic ones to keep their weight, in last 20 years obesity resulted from the diminished degree of daily body activity. A study undertaken above 40-89 years both men and women are overweight and obese. [29]

Risk factors of obesity

There are 30 medicinal conditions that are related with obesity. People who are

obese are in danger of creating at least one of these medical conditions, causing weakness or in extreme cases, early death. In reality, deaths in the USA are ascribed to weight. The most common stoutness related disease include. Type 2 diabetes, Coronary heart disease, High blood cholesterol, Stroke, Hypertension, Sleep apnea and other breathing problems, Osteoarthritis, Gout, Some forms of cancer (breast, colorectal, endometrial, and kidney), Gallbladder disease. Obesity is also related with

- ❖ Complications of pregnancy
- ❖ Hirsutism (presence of excess body and facial hair)
- ❖ Psychological disorders, such as depression
- ❖ Increased surgical risk
- ❖ Menstrual irregularities
- ❖ Increased mortality

Type 2 diabetes

Type 2 diabetes is the most well-known kind of diabetes. Family ancestry and genes play a key role. Other hazard elements incorporate a low movement level, terrible eating routine, and overabundance body weight around the midriff. In the United States, type 2 diabetes is progressively normal among blacks, Latinos, and American Indians than among whites. [30]

Coronary heart disease

Obesity is probably a free hazard factor for atherosclerosis and Coronary Heart Disease (CHD). [31] Schematic outline of the physiological changes in cardiovascular capacity that go with dynamic weight gain. Expanding body weight is related with an expansion in both fit and fat mass. The related increment in absolute blood volume is thus joined by an increase in stroke volume and cardiovascular yield. The increase in circulatory preload and after burden lead to left ventricular (LV) dilatation and capricious hypertrophy. An increase in fundamental vascular opposition found in some obese people brings about a continued

ascent in circulatory strain (hypertension) and concentric LV hypertrophy.

High blood cholesterol

Youngsters who are overweight are at higher hazard for high triglycerides and low HDL, which might be directly identified with later undesirable cholesterol levels. Childhood LDL levels and weight record (BMI) are emphatically connected with cardiovascular hazard during adulthood. Overweight and obese children who have elevated cholesterol may lead to hypertension, diabetes [32] and different conditions related with metabolic disorder.

Stroke

Overweight and heftiness are known to build pulse. Hypertension is the main source of strokes. Overabundance in weight additionally builds the odds of creating different issues connected to strokes, including elevated cholesterol, high glucose, and coronary illness. [33] Various examinations have detailed a relationship among BMI and stroke.

Gout

Gout is an infection that influences the joints that is brought about by high levels of Uric acid in blood. [34] The overabundance uric acid can form stones that store in the joints. Gout is increasingly basic in overweight individuals sudden weight changes may prompt an assault of gout.

Hypertension

Obesity related arterial hypertension is described by initiation of the thoughtful sensory system, actuation of the renin-angiotensin framework, and sodium maintenance, among different variations from the normal.

Gallbladder disease

Gallbladder infection is one of the most widely recognized careful conditions found in our society. The medical procedure to treat gallbladder illness by expulsion of the gallbladder is known as a cholecystectomy. The risk rate during pregnancy leads to stone formation including obesity depleted HDL cholesterol and the metabolic syndrome. [35]

Osteoarthritis

Osteoarthritis is a typical medical issue that causes pain and solidness in the joints. [36] Osteoarthritis is regularly identified with maturing or to damage, and frequently influences the joints of the hands, knees, hips, and lower back.

Sleep apnea

Weight is the most significant hazard factor for rest apnea. An individual who is overweight may have increasingly fat put away around his or her neck. This may make the aviation route smaller. A small aviation route can make breathing troublesome or (due to wheezing), or breathing may stop by and large for brief timeframes. In addition, fat put around the neck and all through the body may create substances that aggravate. [37]

Complication in pregnancy

Overweight and obesity raise the danger of medical issues for both mother and child that may happen during pregnancy. [38] Pregnant ladies who are overweight or hefty may have an expanded hazard for

- Needing a C-segment and, subsequently, taking more time to recoup in the wake of conceiving an offspring
- Having preeclampsia (hypertension during pregnancy that can cause serious issues for both mother and infant whenever left untreated)
- Developing gestational diabetes (high glucose during pregnancy)

Menstrual abnormalities:

Weight increase and unpredictable periods may show side effects of polycystic ovary disorder (PCOS). [38] As per the National Women's Health Information Center, PCOS is the result of hormone imbalance in the body. The excess of androgens cause the ovaries to grow an incomplete ovum (egg) and stored as an ovarian sore. The loss of ovulation leads to the missed or sporadic menstrual cycle. It is likewise accepted that insulin is identified with PCOS; an excess of insulin can build

the generation of androgens, which additionally cause issues with ovulation.

Hirsutism

Most instances of hirsutism have no fundamental reason; however some may demonstrate the nearness of an increasingly genuine hidden condition, for example, Cushing's disorder. An expected 8% of grown-up ladies in the United States have hirsutism. [39]

Depression

Depression may prompt weight and stoutness may prompt sorrow. The circumstances and logical results of depression and obesity is inadequately seen yet the two are connected. obesity individuals have a 55% possibility of getting discouraged after some time and depressed individuals have a 58% possibility of being obese over the long run. [40]

Prevalence of Obesity

The prevalence of over weight is expanding around the world. Information from the National Health and Nutrition Examination Surveys (NHANES) demonstrate that the percent of the American grown-up populace with obesity (BMI > 30) has expanded from 14.5% (somewhere in the range of 1976 and 1980) to 30.5% (somewhere in the range of 1999 and 2000). The same number of as 64% of U.S. adults 20 years old were overweight (characterized as BMI> 25) between the long stretches of 1999 and 2000. Outrageous corpulence (BMI 40) has additionally expanded and influences 4.7% of the population. [41] As the Consequence of fast industrialization and urbanization prompting ascend in expectations for everyday comforts, prevalence of obesity is quickly rising representing a more noteworthy risk to wellbeing of Indian country. Obesity has achieved plague extents in India in the 21st century, influencing 5% of the nation's population. India is following a pattern of other nations that are consistently expanding.

The stamped increment in the prevalence of overweight and type 2 diabetes generally reflects changes in eating

routine and physical action level because of monetary improvement, industrialization and urbanization. This expansion has presented huge difficulties to Asian social orders and human services. There is a pressing need to make awareness among general society, medicinal services suppliers and furthermore the legislatures on the graveness of the issue of overweight and stoutness, which is a noteworthy reason for some, metabolic clutters influencing the Asian population. The advantages of predictable physical movement and solid eating regimen from the adolescence must be focused. Models arrangement by the administrative strategies in Singapore. [42] are being adopted.

Overweight is the fifth driving reason for worldwide. At any rate 2.8 million grown-ups pass on every year because of being overweight or obesity. [43,44] The prevalence of weight has multiplied somewhere in the range of 1980 and 2008. 65% of the total lives in a nation where overweight and obesity slaughters a greater number of individuals than underweight. [45] An assortment of variables, including diet, hereditary inclination, physical exercises, physiological and behavioural factors, are ensnared as contributing factors to corpulence. [46,47]

Overweight and weight are characterized as strange or unnecessary fat amassing in the body. The weight record (weight/height²) is generally utilized in grown-up population to evaluate overweight and stoutness. World Health Organization (WHO) characterizes overweight as a BMI equivalent to or more than 25, and stoutness as a BMI equivalent to or more than 30.1 The Western Pacific Regional Office of the World Health Organization (WHO) has suggested bringing down the BMI cut off levels for Asian individuals to 23.0 for overweight and 25.0 for heftiness. [48]

Treatment of Obesity

Prevention from obesity has an incredible significance. Obesity prevention should begin in youth. Adolescence and pre-

adult obesity gives a back ground to adulthood weight. In this manner, school, family and society should be educated about well-adjusted sustenance and physical action. Obesity treatment is a vital, long, ceaseless treatment in which the individual should be included viably and decided. Numerous distinction basic ethological elements make the avoidance and treatment of obesity extremely difficult and confused.

The point of the obesity treatment is; to focus on a practical weight reduction, to diminish the danger of related grimness and mortality, to give people a decent eating routine propensity and increment the personal satisfaction. Indeed, even a 10% weight reduction in a half year can forestall the majority of the medical issue brought about by obesity. [48] The strategies utilized in the weight treatment are assembled under 5. [49]

- Medical treatment
- Nutrition (diet) Treatment,
- Behavioural change
- Surgical Treatment
- Exercise

Medical Treatment

The drugs utilized in the obesity treatment are reasonable for the people having low and moderate weight. It is significant for the utilized drugs to have a decided securely as far as wellbeing, to demonstrate an impacts best fit for the weight etiology, to have no significant symptoms in short and long terms and to have no fixation. These sorts of drugs should be utilized with the proposal and under the control of therapeutic specialist. [50]

Drugs used in treatment of obesity:

- ❖ Sibutramine
- ❖ Orlistat
- ❖ Lorcaserin
- ❖ Exenatide
- ❖ Metformin
- ❖ Rimonabant

Sibutramine

Sibutramine (Reductil or Meridia) is an anorectic or hunger suppressant, diminishing the craving to eat. Sibutramine may expand circulatory strain and may cause dry mouth, clogging, migraine, and sleeping disorder. Previously, it was noted by the US that meridian was a harmless medication for battling obesity.

Orlistat

Orlistat is a drug that avoids a portion of the fat being consumed by the body. Craving suppressants like phentermine smother the hunger. They are endorsed uniquely for transient use. Phentermine is never again sold in Europe on account of conceivable connection with heart and lung issues. Orlistat is the main weight reduction drug that is approved for kids. It is intended to be utilized uniquely in kids beyond 12 years old. Orlistat is a lipase inhibitor in intestine and it reduces fat absorption. It is effectively used to reduce weight. [51]

Lorcaserin

Lorcaserin (Belviq) brings about a normal 3.1 kg weight reduction (3% of weight) more noteworthy than fake treatment over a year. [52] Symptoms may incorporate serotonin disorder.

Rimonabant

Rimonabant is a anti-obesity drug. It is cannabinoid (CB1) receptor adversary that demonstrations midway on the cerebrum hence diminishing craving. It may act incidentally by expanding thermogenesis and in this manner expanding vitality use. [53] Weight reduction with Rimonabant has not been demonstrated to be more prominent than other accessible weight – misfortune prescription. Because of safety concerns, mainly Psychiatric in nature, the medication has not got endorsement in the United States or Canada, either as an enemy of weight treatment or as a smoking-discontinuance tranquilize.

Metformin

In individuals with Diabetes mellitus type 2, the medication metformin (Glucophage) can diminish weight. [54]

Metformin constrains the measure of glucose.

Exenatide

Exenatide (Byetta) is a long-acting hormone GLP-1, which the digestion tracts emit because of the presence of sustenance. Among different impacts, GLP-1 defers gastric purging and advances a sentiment of satiety. Some fat individuals are lacking in GLP-1, and eating less junk food diminishes GLP-1 further. ^[55] Byetta is presently accessible as a treatment for diabetes mellitus type 2.

Pramlintide

Pramlintide (Symlin) is a manufactured hormone Amylin, which in ordinary individuals is discharged by the pancreas during eating. Among different impacts, Amylin defers gastric purging and advances a feeling of satiety. Numerous diabetics are insufficient in Amylin. As of now, Symlin is just endorsed to be utilized alongside insulin by type 1 and type 2 diabetes. In any case, Symlin is right now being tried in non-diabetics as a treatment for obesity. ^[56]

Medical Nutrition (diet) Treatment:

Medical Nutrition (Diet) Treatment plays important role in obesity treatment. With medical nutrition (Diet) treatment the following are advised

Diet rules used in obesity treatment ^[57]

Energy: Everyday energy intake of the individual should be diminished in such away to ensure 0.5-1.0 kg weight reduction every week. Individual ought to shed pounds gradually. Energy ought not be given underneath the basal metabolism rate (BMR) or resting metabolism (RMR) of the person.

Protein: 12-15% of the everyday energy intake admission should be given from proteins and best quality of protein sources to be utilized.

Fat: Approximately the 25-30% of day by day energy intake should be given from fat. Other than the measure of the fat, the sort of the fat is significant, as well. The proportion of energy from immersed unsaturated fat

should to be brought down that 10%, from polyunsaturated fat 7-8% and mono unsaturated fat 10-15%. The fat admission shouldn't be extremely decreased to let lipid soluble vitamins (nutrient A, D, E, K) be utilized in the body to the fat amount being over the prescribed amount.

Carbohydrates: Almost 55-60% of day by day energy intake should be provided by starches. Simply starches like sugar ought to be diminished, complex starches like vegetables and entire grains ought to be expanded.

Nutrients and Minerals: Because of low energy consistency, insufficiency of nutrients and minerals (nutrient B, iron and calcium and so forth.) can be found in low calorie eats.

Fiber: Fiber amount must be expanded (25-30 g/day). Vegetables, organic products, vegetables, entire grain flour and Whole grain items are offered as regular fiber sources.

Behavior Change Treatment:

In the control of body weight, behavior change treatment is a sort of treatment intended to change or diminished the negative behaviors related with the nourishment and physical movement which cause unreasonable weight addition to a positive course and simultaneously to make the positive behaviors as the way of life by fortifying them. The means of behavior change treatment are. ^[58]

The control of stimulants:

The point is to maintain a strategic distance to be influenced by stimulants for food intake and increment reasonable stimulants for dietary patterns. This strategy expects to do support by compensating the proper practices concerning weight reduction and its counteractive action. In the continuation of conduct changes required for getting more fit, reinforcement is a partner and empowers the people to appreciate with the exercises other than eating.

Surgical Treatment

Surgical treatment approach in heftiness is essentially isolated into two.

The point is bariatric medical procedure which is for the diminished of vitality admission from foodstuffs, diminished assimilation of foodstuffs from gastrointestinal framework. For these reason strategies, like bypass, gastroplasty, gastric banding and gastric ballon are utilized. In reconstructive medical procedure the point is; to evacuate the present fat tissue confined in different parts of the body. [59]

Physical exercise

It was accounted for that obesity expanded on the planet as a scourge and kept on expanding, simultaneously the significant role of physical action and exercise in the prevention of weight and obesity related medical issues were called upon, Efficient physical action has a significant role in the course of action of energy balance decreased the risk created with obesity and passing rates associated with these risks. [60]

Inspite of the fact that the impact of exercise treatment on accomplishing weight reduction in under discourse,

Herbal management for obesity

Various therapies are used to treat obesity. At present, herbal medicine is an ongoing treatment method. Because, herbs contains more phytochemicals, antioxidant and more beneficial properties to treat various diseases (cardiovascular disease, decreased risk of cancer, stoke, diabetes and preventing obesity) and it provide nutrients to our body through the human diet.

Following herbs are used.

***Glycyrrhiza glabra*:**

Glycyrrhiza glabra L. contains pharmacological properties with more phytochemicals such as glabridin, amino acids, sterols, flavonoids, glycyrrhizin, beta-Glycyrrhetic acid, chalcones. [61,62] Reported that *Glycyrrhiza glabra (L)* has more phytochemical which includes phenols, flavonoids, tannins and terpenoids. They possessed potent antioxidant properties and it can highly scavenge hydroxyl and nitric oxide radicals. This

result shows *Glycyrrhiza glabra* may have the antiobesity potential.

***Punica granatum Leaf*:**

Punica granatum Leaf is used to treat various conditions like parasite infection, ulcers, diarrhea, dysentery, hemorrhage, microbial infections and respiratory pathogens. It has numerous pharmacological activities such as antitumor, antibacterial, astringent, antidiarrheal and antiobesity effect. [63,64] described that ethanolic extract of *Punica granatum (L)* shows the maximum amount of phytochemical present in it. It has effective antioxidant properties and it has been investigated for further properties [65]

***Alternanthera sessilis*:**

A.Sessilis is devoured as a vegetables and act as herbal medicine and it has beneficial properties to treat eye diseases, skin diseases, wound healing and it act against snake bite, diuretic, haematonic, antioxidant. [66] cytotoxic, antipyretic, hepatoprotective. [67] antiulcer, antimicrobial [68] anti-inflammatory [69] and anthelmintic activity. The ethanolic extract of *A.sessilis* is found to have maximum amounts of phytochemicals (alkaloids, flavonoids, tannins, saponins, terpenoids, phenol and carbohydrates) were present. [70]

***Benincasa hispida fruit*:**

It is belongs to the family cucurbitaceae. The fruit of *Benincasa hispida* is an obtained in every season and it is mostly available in India. It has many therapeutic properties to treat cardiogenic, epilepsy, renal diseases, dyspepsia, fever and menstrual disorders. [71] state that the *Benincasa hispida* fruit extract high antioxidant effects on superoxide radical than other radicals. The active fraction and ethanolic extract of *Benincasa hispida* determines to decrease the weight gain in treatment group when compared with high fat diet induced group. [72]

***Carica papaya Leaf*:**

It is belongs to the family *Caricaceae*. Phytochemicals present in carica papaya leaves such as flavonoids, alkaloids, carbohydrates, saponins,

glycosides, phytosterols, phenolics, terpenoids and tannins. Especially, it is prescribed as a tonic for heart. Additionally, it is also prescribed for the treatment of fever, diabetes, pyrexia, syphilis, gonorrhoea, inflammation and dressing foul wounds. [73] [74] showed that the body weight and obesity associated with protein has a better interaction with β - sitosterol a compound present in carica papaya.

Trigonella foenum-graecum:

Trigonella foenum-graecum is a member of *Fabaceae* family. Trigonella Foenum-graecum has anti-diabetic, anti fertility, anticancer, anti-microbial, anti-parasitic, hypocholesterolaemic, lactation stimulant, antioxidant and hair growth promotion properties.

It has more antioxidant activity and it is to treat various diseases. [75] Ethanolic extract of Trigonella seeds has therapeutic properties to treat anti-hyperlipidemic and anti-obesity. [76]

Garcinia cambogia:

It's belongs to the family *Guttiferae*. Hydroxycitric acid (HCA) a complex inhibitor of ATP-citrate lyase present in the fruit of *Garcinia cambogia*, the major enzyme implicate in the biosynthesis of Cholesterol and fatty acids and it initiate weight loss. [77] [78] it is mainly used to treat astringent, demulcent, rheumatism, bowel complaints and purgative. It contain flavonoids, terpenoids, phenols, tannins, glycosides, carbohydrates, saponin, amino acids, sterols and coumarin and it has antioxidant activity to reduced the risk of various diseases [79]

Bauhinia variegata:

It belongs to the family *Caesalpiniaceae*. The phytochemical present in *Bauhinia variegata* such as flavonoids, terpenoids, phenols, tannins, glycosides, carbohydrates, saponin, amino acids, sterols and coumarin. [79] The therapeutic effects of the phytochemical present in *Bauhinia variegata* L contains more antioxidant properties and anti obesity effects.

Achyranthes aspera:

Achyranthes aspera is a plant member of *Amaranthaceae*. Ethanolic extract of *Achyranthes aspera* extract reduces the level of total cholesterol, total lipids, phospholipid and triglycerides at the concentration of 100mg/Kg. Due to the cholesterol reduction may cause increased productions of bile acids is the origin of lowering cholesterol absorption. These may be the evidence that the ethanolic extract of *Achyranthes aspera* has antiobesity properties. [80]

Allium Sativum:

Allium sativum is the family belongs to *Alliaceae*. It has various inhibitory properties of transaminases, lipogenic enzymes, HMG CoA reductase, excretions of Sterol and bile acids. 100mg/Kg/day can reduce the lipid level in high cholesterolic diet induced animal. [80]

Acorus calamus:

Acorus calamus belongs to *Araceae*. The study shows the tannins present in the *Acorus calamus* are mainly involved in the hypolipidemic activity. The dosage of tannins has 10mg/kg reduces the level of triglycerides and serum cholesterol. [80]

Cissus quadrangularis:

It is also called Veld Grape and it belongs to the family *Vitaceae*. It is cultivated in India. *Cissus quadrangularis* decreases the Plasma TBARS and carbonyls that the plant has antiobesity effect and serious reduction of fasting blood glucose level, body mass, body fat, total cholesterol, LDL-cholesterol, triglycerides. [80]

Coleus forskohli:

Coleus forskohlii is the member of *Lamiaceae* (mint). It activate the cell cyclic adenosine monophosphate (cAMP). The main purpose of cAMP is that to initiate the breakdown of animal and human fat cells which is stored in the body, it maintains the heat, it elevates the basal metabolic rate, it elevates the consumptions of body fat. [80]

Gymnema sylvestre:

Gymnema sylvestre is the plant that belongs to the family *Asclepiadaceae*. *G.Sylvestre* leaf extract decrease the level of serum triglyceride (TG), total cholesterol

(TC), very low density lipoprotein (VLDL) and low-density lipoprotein (LDL) cholesterol on the dose dependent manner. The dosage of 100mg/kg weight of extract reduces the Triglycerides and serum total cholesterol. [81]

Camellia sinensis:

Green tea belongs to the family theaceae. Camellia sinensis is a natural relaxant with large amounts of vitamins and flavonoids. It contains phytochemicals such as epigallocatechin gallate, tannins, caffeine, polyphenol, boheic acid, theophylline, theobromine, anthocynin and gallic acid and it has potent antioxidants and antiobesity properties. [82]

Hemidesmus indicus:

Hemidesmus indicus is the plant that belongs to the family Asclepiadaceae. 2-hydroxy 4 methoxy benzoic acid (HMBA) is the compound present in the Hemidesmus indicus that decrease the plasma total cholesterol, triglycerides, lipo proteins, phospholipids and free fatty acids in rodent animals at 200µg/kg dose. [81]

Piper nigrum:

Piper nigrum belongs to the family Piperaceae. It decreases the total cholesterol level, low density lipoprotein (LDL), very low-density lipoprotein (VLDL). It significantly increases the VLDL and plasma lipoprotein, Plasma lecithin cholesterol acyl transferase (LCAT) in high fat induced wistar albino male rat. [83]

Tamarindus indica:

The plant belongs to the family Fabaceae. Depends on the dose dependent manner, the body weight of rat was decreased due to the oral administration of aqueous pulp extract of Tamarindus indica. The weight reduction indicates the decreased food and water intake because of the phytochemical that affect the brai. [84]

Plumbago zelanica:

Plumbago zelanica is the plant that belongs to the family Plumbagenaceae. The combination of ethanolic extract of Plumbago zelanica with vitamin E has decreased serum total cholesterol, LDL cholesterol and triglycerides in

hyperlipidaemic animal. Take chitraka Root extract twice a day with warm water significantly reduces the lipid level in blood and it reduces the hypercholesterolemia by taking the root powder with honey. [83]

Solanum melongena:

Solanum melongena belongs to the family Solanaceae. Flavonoid is the major component present in that plant. S.melongena extract has important role in the actions of hypolipidemic and cholesterol fed animal. Serum Total cholesterol level was decreased by taking a fresh fruit as a diet. [84]

Lagerstroemia speciosa Linn. Leaves:

It is belongs to the family Musaceae. The extract of banana leaves shows decreased diabetic symptoms in diabetic induced mice and it has the therapeutic potential to treat antiobesity effects by the reduced accumulation of triglycerides. [85]

Brassica Oleracea var. capitata:

Cabbage belongs to the family Brassicaceae. Taetic acid is the main component present in cabbage that prohibits the translation of sugar and other carbohydrates in to fat. [82]

Citrus paradisi



Figure : 1 Pink Grapefruit
Source: <https://en.wikipedia.org/wiki/Grapefruit>

Scientific Classification

- Kingdom :** Plantae
- Clade :** Angiosperms
- Order :** Sapindales
- Family :** Rutaceae
- Genus :** Citrus
- Species :** C.× Paradisi
- Binomial name:** Citrus ×Paradisi Macfad.

Source:

<https://en.wikipedia.org/wiki/Grapefruit>

Grapefruit is a generally huge, evergreen citrus tree, *Citrus paradisi*. The term likewise alludes to the round, consumable product of this plant, which develops in little bundles and has a yellow skin (external skin) and regularly a delicious, acidic mash. Grapefruit has a place with the Citrus variety, a taxa of blossoming plants in the family Rutaceae. Different individuals from the family incorporate oranges, lemons, limes, citrons, pomelos (pummelo, pommelo), and mandarins (tangerines). Citrus organic products are an unmistakable berry with the inside parts partitioned into fragments. The quantity of characteristic species is hazy, the same number of the named species are half and halves. The grapefruit is accepted to have emerged from the pomelo or shaddock (*Citrus grandis*) or as a cross breed among pomelo and sweet orange. [86]

Citrus paradisi is one of the most significant member from the family (Rutaceae). It is local to the island of Barbados. It also grown in Isreal, Jordan, Mexico, Asia and Spain. [87] As a comparatively new food, the grapefruit has created advances within the past seventy five years. The sections are ordinarily employe in fruit cups or fruit salads; In gelatin or tarts. In Australia, marmalade is commercial process of grapefruit. It's going to even be made into jelly. The juice is marketed as beverage contemporary dehydrated as powder. It can be produced as a vinegar used as fermented wine. Candied citrus peel is a vital supply of pectin for the preservation of alternative fruits. The peel oil, expressed or distilled is commonly utilized in soft drink flavouring once the removal of fifty of the monoterpenes. [88]

History

The organic product was first recorded in 1750 by Rev. Griffith Hughes portraying examples from Barbados. [89] The natural product was initially named the "forbidden fruit" of Barbados. [90] in contrast

with the "Tree of Knowledge of Good and Evil" in the Garden of Eden [89] As of now, the grapefruit is claimed by some as one of the "Seven Wonders of Barbados" [91]

The grapefruit was known as the shaddock or shattuck until the 1800s. Its present name implies groups of the organic product on the tree, which regularly show up generally like grapes. The name grapefruit previously showed up in English in a work by botanist John Lunan, *Hortus Jamaicanensis* (1814). [86, 89] While the name obviously emerged in light of the fact that the organic product develops in grape-like groups, and can creatively be taken a gander at as grapes when little and green, Lunan had expressed that it was "known by the name of grape-natural product, by virtue of its similarity in flavor to the grape."

Chemical Constituents

Citrus peel is affluent in flavones glycoside and polymethoxyflavone. Result show that high content of naringin present in star ruby grapefruit. In all grapefruit varieties the presence of polymethoxyflavones, nobiletin, tangeretin and hepatomethoxyflavone were ascertained. Grapefruit pulp consist of sizeble level of Vitamin c, Potassium, calcium, folate and iron. The crimson sorts also included beta-carotene and lycopene, and antioxidant. phenolic acid, limonoid, terpenes, monoterpenes, D-glucaric acid and flavonoids including Naringenin and Hesperidin are present. [92]

Phytochemical

Phytochemicals (from Greek phyto, signifying "plant") are synthetic substances delivered by plants through essential or auxiliary metabolism. They generally have organic movement in the plant host and assume a job in plant development or barrier against contenders, pathogens, or predators. Phytochemists think about phytochemicals by first extricating and disconnecting mixes from the cause plant, trailed by characterizing their structure or testing in research center model frameworks, for example, cell societies, in vitro examinations, or in vivo investigations

utilizing lab animals. Challenges in that field incorporate separating explicit mixes and deciding their structures, which are regularly intricate, and distinguishing what explicit phytochemical is essentially in charge of some random organic movement. [93]

A large portion of the phytochemicals however non-nutritive are known to have some illness preventive properties. In this manner they offer protection against pathogen [94] and these strips and pomace are a wellspring of sugars, minerals and natural acids, dietary strands and phenolics which have a wide scope of activities which incorporates cancer prevention agents, antimutagenic, cardio preventive, antibacterial and antiviral activities [95] Polyphenols and cancer prevention agents may have monetary advantage for nourishment processors. In addition the squanders and results of natural products are a bounteous wellspring of cell reinforcement polyphenols and the vegetable preparing in India creates significant amounts of waste, pay and employment. [96]

[97] showed that the *Citrus paradisi* of different extracts confirmed the presence of alkaloids, flavonoids, reducing sugars, Flavanoids, Phenols, Proteins, Amino acids, Saponins, Tannins, Terpenoids and Glycosides. Surprisingly, anthraquinone and steroids was not observed in any of the extracts. However, alkaloids, flavonoids, reducing sugars, Phenols, Amino acids and Terpenoids components are present in three extracts of ethanol, aqueous and ethyl acetate. In quantitative analysis ethanolic extract of *Citrus pradis* possess flavonoids tannins, alkolois, Saponins, Phenol higher amount when compared to aqeous and ethyl acetates.

Naringin

Naringin is a flavanone-7-O-glycoside between the flavanone naringenin and the disaccharide neohesperidose. The flavonoid naringin arise normally in citrus natural products, particularly in grapefruit, where naringin is in charge of the organic

product's unpleasant taste. In business grapefruit juice generation, the chemical naringinase can be utilized to expel naringin. In people naringin is used to the aglycone naringenin (not severe) by naringinase present in the gut. Naringin has a place with the flavonoid family. Flavonoids comprise of 15 carbon particles in 3 rings, 2 of which must be benzene rings associated by a 3 carbon chain. Naringin contains the fundamental flavonoid structure alongside two rhamnose units joined to its aglycone parcel, called naringenin, at the 7-carbon position. The steric deterrent given by the two rhamnose units makes naringin less intense than its aglycone partner, naringenin [98]

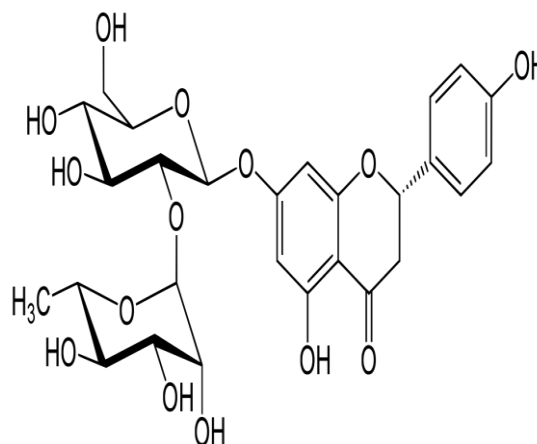


Figure : 2 Structure of Naringin
Source : <https://en.wikipedia.org/wiki/Naringin>.

Metabolism

In people, naringinase is found in the liver and quickly converts naringin into naringenin. This occurs in two stages first, naringin is hydrolyzed by α -L-rhamnosidase action of naringinase to rhamnose and prunin. The prunin formed is then hydrolyzed by β -d-glucosidase action of naringinase into naringenin and glucose. Naringinase is a compound and can be found in plants, yeasts, and organisms. It is industrially appealing because of its debittering properties. [99]

Toxicity

Ingestion of naringin and related flavonoids can likewise influence the intestinal assimilation of specific medications, prompting either an increasing

or decreasing their levels. To keep away from obstruction with medication retention and digestion, the utilization of citrus (particularly grapefruit) and different juices with drugs is exhorted against. [100]

Antioxidant

Antioxidants are agents that repress oxidation. Oxidation is a response that can create free radicals, in this way prompting chain responses that may harm the cells of living things. Cancer prevention agents, for example, thiols or ascorbic acid (nutrient C) end these chain responses. To adjust the oxidative pressure, plants and creatures keep up complex frameworks of covering cell reinforcements, for example, glutathione and proteins (e.g., catalase and superoxide dismutase), delivered inside, or the dietary cancer prevention agents nutrient C, and nutrient

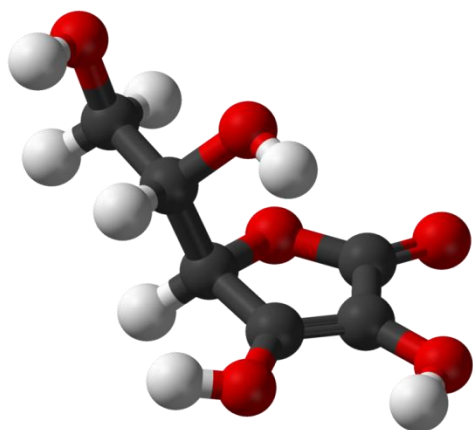


Figure: 3 The structure of the antioxidant vitamin ascorbic acid (vitamin C).

Source: <https://en.wikipedia.org/wiki/Antioxidant>

The receptive oxygen species delivered in cells incorporate hydrogen peroxide (H₂O₂), hypochlorous corrosive (HClO), and free radicals, for example, the hydroxyl radical (\cdot OH) and the superoxide anion (O₂⁻). [101] The hydroxyl radical is especially unsteady and will respond quickly and non-explicitly with most natural particles. This species is delivered from hydrogen peroxide in metal-catalyzed redox responses, for example, the Fenton reaction. [102] Antioxidant is mainly based on scavenging activity of free radical. The most convenient method to evaluate antioxidant

potential are of 2,2-diphenylpicrylhydrazyl(DPPH).

Free radical

Free radicals assume a significant role in mix, climatic science, polymerization, plasma science and numerous other chemical process. In living beings, free radicals, for example, super oxide and nitric oxide and their response items manage numerous processes, for example, control of vascular tone and circulatory strain and so on. They additionally assume a key role in the mediator digestion of different organic mixes. Such radicals can even be delivery people in a procedure named redox signalling.

DPPH Radical Scavenging Activity

The distinctive absorbance of DPPH is at 517 nm. On exposure to radical scavengers. It is significantly reduced by donating H atom to become diamagnetic stable molecule. [103] [104] reported that *citrus paradisi* and Naringin possess good antioxidant capacity when compared with ascorbic acid.

In hydrogen peroxide radical scavenging assay result shows that citrus paradisi and naringin exhibit moderate radical scavenging activity. In hydroxyl Radical scavenging activity ethanolic extract of *citrus paradisi* and naringin inhibit significantly effective. Nitric oxide is not an stable free radical. It involved in many biological process. It may also associated with various diseases It react with oxygen to create stable item nitrate and nitrite through intermediates and high grouping of nitric oxide can be poisonous. [105] [104] reported that Citrus paradise and Naringin effectively reduced the nitric acid from sodium niroprusside.

Superoxide radical scavenging activity it involves many phytochemical and biological reaction. It is one of highly toxic species. [105] [104] reported that Ethanolic extract of *citrus paradise* and Naringin was found markedly scavenged the superoxide radicals.

3T3-L1 cell line

The 3T3-L1 cell line created by green and his collaborators separate in culture into adipocyte like cells. [106] [107] 3T3-L1 is a cell line derived from mouse. 3T3-L1 cell is utilized in organic research on fat tissue. 3T3-L1 cells have a fibroblast like morphology.. 3T3-L1 cells are broadly used to consider adipogenesis. For these reason, many research works have been conducted in 3T3-L1 cells to search for new medical sustenances that hinder adipogenesis Pre-adipocytes separate in monolayer changing their morphological and biochemical qualities during adipocyte development. [108]

Cell Culture and Induction of Differentiation

3T3-L1 pre adipocytes a mouse fibroblast cell line was acquired from National Center for Cell sciences, Pune India. 3T3-L1 preadipocytes were developed in High glucose DMEM enhanced with 10% FBS at 37 °C in a climate containing 5% CO₂. To prompt adipocyte separation, 2-days post-conversion of 3T3-L1 preadipocytes (day 0) were trated with (10 µg/mL insulin, 2.5 µm dexamethasone and 0.5 mM 3-isobutyl-1-methyl-xanthine) alongside with extract for 48 h (day 2). At that point 10 µg/mL insulin was signified (day 4) and media was changed each substitute day with plant concentrates as long as 8 days [109]

Glycerol 3-Phosphate dehydrogenase

Glycerol 3-phosphate dehydrogenase was a cytosolic chemical that catalyze the reversible transformation between dihydroxyacetone phosphate and glycerol 3 phosphate utilizing NAD as a co protein. This was significant in lipid biosynthesis by giving glycerol as a spine to triglyceride blend during adipocytes separation. [110] [111] This procedure may increase the rate of lipogenesis and increment the triglyceride stockpiling within the sight of glycerol 3-phosphate dehydrogenase. [112] [113] reports that the lipolytic activity of ethanol extract of citrus paradisi and naringin decresed the

GPDH activity in concentration dependent manner.

Triglyceride aggregation in 3T3-L1 adipocytes treated with AFBH was examined. GPDH is include in the arrangement of triglyceride and lipid bead development in adipocyte during adipocyte duifferentiation. GPDH is a key compound for unsaturated fat and triacylglycerol amalgamation in adipocyte which increment during separation of preadippocyte into adipocyte. [114] [113] study shows that citrus paradise and naringin are significantly decreased in Triglyceride level when compare to control.

[115] Determined the GPDH action utilizing resveratrol enhanced grape skin separate on the separation of 3T3-L1 adipocytes. 80% ethanol extricate at 200 and 400µg/ml indicated diminished GPDH movement than half ethanol separate. [116] Demonstrated the hindrance of glyceraldehyde 3 phosphate dehydrogenase action at 20 and 40 µM convergence of cinnamaldehyde and 40µM indicated better restraint of GPDH at 40 µM

[117] reported the hindrance of *Irvingia gabonensis* seed separate in 3T3-L1 adipocyte and estimated the restraint of glyceraldehyde 3 phosphate dehydrogenase activity. *Irvingia gabonensis* seed concentrate assumes significant job in the control of GPDH movement.

Oil Red O Staining

Lipid accumulation in separated adipocyte was estimated by oil red recoloring. Cells were washed with phosphate supported saline and cells were fixed with 10% formalin for 1hour and recolored for 30 min with 0.5% oil red stain in 100% isopropanol. Pictures were taken by Olympus magnifying instrument. The stain held by lipid bead was eluted by isopropanol and evaluated by estimating at 510 nm. [113] reported that in Ethanolic extract of citrus paradisi and naringin lipid accumulation was significantly reduced when compared with the control. Reduced number of lipid droplets confirms positive

effect of ethanolic extract citrus paradisi and naringin.

MTT Assay

The MTT examine is a technique to decide the reasonable cell number in expansion and cytotoxicity studies. This test depends on the cleavage of the yellow tetrazolium salt, MTT, to form a soluble formazan product by mitochondrial chemicals. These mitochondrial proteins are equipped for lessening the tetrazolium color MTT 3-(4, 5-dimethylthiazole-2-yl)- 2,5-diphenyl bromide to its insoluble formazan, which has a purple shading. Tetrazolium color examine used to quantify cytotoxicity (loss of suitable cells) are cytostatics viability (shift from expansion to quiet) of potential therapeutic specialists and lethal materials. The measure of formazan delivered is legitimately relative to the quantity of living cells, not dead cell, present during MTT presentation. Since the MTT measure is quick, convenient and efficient, it has turned out to be exceptionally prevalent systems for the evaluation of suitable cells in culture. [113] reports that ethanolic extract of Citrus paradise on viability of 3T3-L1 cell lines shows no toxic effects upto concentration of 500µg Similar to Citrus paradise Naringin also shows significant effect when compared to controls.

[118] reports that Lethariella Cladoniodes extract showed the cell viability in dependent manner. Lethariella Cladoniodes did not have toxicity and it will not affect cell viability when it was treated with 3T3-L1 cell line. [119] studies shows that *Sida rhombifolia* L extracts treats with 3T3-L1 cells shows non-significant in concentration dependent manner when compared with control cells. [120] premediated the cell viability assay using urosolic acid it will not affect the cell viability at 10µM.

CONCLUSION

The present study concluded that the Ethanolic extracts of *citrus paradisi* are rich in phytonutrients and it also act as potential

source of phytochemicals used as a therapeutical agent to prevent many diseases. Naringin is the major compounds which is present in *citrus paradisi*. Result shows that the both Naringin and *citrus paradisi* possess better antioxidant activity and also increase immunity against oxidative stress. It also exerts beneficial effects in *in vitro* Condition.

Conflict: No conflict of interest

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