Natural sources as potential therapeutic agent against the Obesity and Type 2 diabetes

Shyam G. Pawar[1], Prajwal S. Ghugase[2], Vinayak A. Katekar[3], Swati P. Deshmukh[4]

[1,2]Department of Pharmacy, Shraddha Institute of Pharmacy, Washim, Maharashtra, India.
[3] Department of Quality Assurance, Shraddha Institute of Pharmacy, Washim, Maharashtra, India
[4]Department of Pharmacology, Shraddha Institute of Pharmacy, Washim, Maharashtra, India.

Abstract

Type 2 diabetes mellitus (T2DM) is the most widespread form of diabetes in the world. T2DM is a chronic endocrine disorder characterized by hyperglycaemia, insulin resistance, and increased hepatic glucose production. Natural medicinal substances can be used to treat type 2 diabetes. polyphenols, resveratrol, curcumin, Rutinin, tannins, lignans, Black currant, carrot, Cinnamon are some of them. Some studies indicate that chlorophyll may have potential anti-obesity effects by modulating lipid metabolism and adipocyte differentiation..Omega-3 fatty acids: Some microalgae, such as those used in algae-based dietary supplements, are rich in omega-3 fatty acids, including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA)..Omega-3 fatty acids have a combined anti-inflammatory effect and can play a role in regulating metabolism and reducing fat accumulation. Protein and fiber: Algae, especially certain microalgae, can be a good source of protein and fiber. Protein and fiber increase satiety and help people feel full and satisfied, which can help with weight management.

Keywords: Type 2 Diabetes Mellitus, Obesity, Natural sources

Introduction: Type 2 diabetes mellitus(T2DM) is the most wide form of diabetes across all mainlands. According to the World Health Organization, the number of people with this complaint will increase nearly two-fold in the coming 10 times. T2DM is a habitual endocrine complaint characterized by hyperglycaemia, insulin resistance, ineffective insulin stashing by the pancreas, and increased hepatic glucose product. An important point of diabetes is hyperlipidaemia, which results from the use of lipids rather of glucose. Cases with T2DM are at a advanced threat of microvascular complications(e.g., diabetic retinopathy, nephropathy, and neuropathy) and macrovascular bones (similar as cardiovascular complaint, stroke, and supplemental roadway complaint) than thenon-diabetic population. Other clinical conditions associated with T2DM include diabetic bottom and reduced resistance to colorful infections. The clinical consequences of hyperglycaemia are polyuria, weight loss(occasionally with polyphagia), and blurred vision.

A natural medicinal substance used in the treatment of type 2 diabetes. **Polyphenol:**

Polyphenols are polyhydroxyphenols defined as plant secondary metabolites used to protect against ultraviolet radiation or pathogen aggression in plants. They are responsible for bitterness, astringency, color, taste, smell and resistance to oxidation in plants. They are often considered natural phytochemicals. Polyphenols are found in fruits, vegetables and products made from them, such as cereals and drinks. Tijjan et al. introduced the following classes of polyphenols: phenols, stilbenes, flavonoids, tannins and lignans.

They affect a number of cellular metabolic processes, such as preventing cellular apoptosis and reducing enzymes such as lipoxygenase and telomerase. Their consumption can improve protection against various diseases such as cancer, cardiovascular disease, osteoporosis and neurodegenerative disorders. T2DM is one of the most studied diseases that can be influenced by polyphenols belonging to the group of non-flavonoid polyphenols, resveratrol, curcumin, tannins, Lignans.

Resveratrol :

Resveratrol (trans-3,5, -trihydroxystilbene) is a phytoalexin, a plant-derived stilbene with anti-inflammatory, anti-carcinogenic, anti-cartilage, anti-aging properties and the ability to support endothelial cells. It can improve insulin sensitivity in T2DM patients, diet-induced obese mice and rats, and Zucker diabetic fatty acid (ZDF) rats. Resveratrol activates the deacetylase sirtuins , mainly the productive, highly conserved NAD-dependent lysine acylase SIRT1. SIRT1 is a potential pharmacological agent to target insulin resistance in T2DM. In addition, resveratrol has antioxidant properties and can protect cells from oxidative stress. It also reduces the risk of diabetic neuropathy and interacts with the receptor. Another beneficial effect of resveratrol is the reduction of hyperlipidemia and dyslipidemia. Bo et al. shows its ability to prevent bone loss in patients with T2DM. Grapes, berries and peanuts are important sources of resveratrol.

Curcumin:

: Curcumin is the yellow component of the rhizome of the turmeric plant (Curcuma longa). It has antioxidant, anti-inflammatory, antimicrobial, immunomodulatory, antitumor, hypoglycemic and rheumatic effects. It also has a positive impact on the cardiovascular, renal, and hepatic systems.The mechanism of curcumin action is possible via the inhibition of lipid peroxidation and the reduction of inflammatory cytokine levels. These conditions support pancreatic cell viability . Curcumin is also able to inhibit the activity of alpha-amylase and alpha-glucosidase, which results in the absorption of carbohydrates or nutrients in the small intestine. In addition, the study conducted showed its possible use in bone regeneration in high glucose concentrations. On the other hand, this natural supplement has poor bioavailability

Rutin:

Rutin is a plant glycoside. It is a strong antioxidant that can eliminate free radicals and prevent lipid peroxidation. It also has anti-inflammatory and anti-carcinogenic properties, as well as heart muscle and liver protection. Its anti-diabetic and anti-inflammatory properties include lowering blood glucose, modulating insulin secretion, improving dyslipidemic conditions, preventing AGE formation and positively influencing signaling pathways. Rutin is found in fruits and fruit peels, especially citrus fruits such as oranges, grapefruits, lemons and limes. However, it can also be found in other foods such as buckwheat, onions, apples, tea and red wine.

Garlic:

Garlic (Allium sativum) is a flowering plant that grows from bulbs. Its consumption has beneficial anticoagulant, antioxidant, antihyperlipidemic and blood pressure effects. The active ingredients of garlic against diabetes are allicin and hydrogen sulfide. Addition of garlic increases insulin secretion and sensitivity in animals]. Conversely, studies showing its hypoglycemic effects in humans are conflicting. A meta-analysis by Hou et al. showed that postprandial blood glucose levels were reduced in subjects consuming garlic, while Emami et al. showed opposite results. Possible side effects of consuming garlic include allergic contact dermatitis, allergic conjunctivitis, rhinitis, swelling, headache, dizziness and profuse sweating.

Black currant:

Black currant is a medium-sized shrub that is cultivated for its edible fruits (berries). The berries contain many anthocyanins, mainly delphinidin-3-rutinoside, but also cyanidin-3-rutinoside, delphinidin-3-glucoside and cyanidin-3-glucoside, as well as condensed tannins (proanthocyanides), oligomeric and polymeric chains. flavan-3-ols. Various blackcurrant extracts and beverages can lower blood glucose, improve glucose tolerance in obese mice and rats, and lower postprandial blood glucose in humans with T2DM. Their action is mediated by inhibition of alpha-glucosidase and alpha-amylase activity. Black currants have similar effects to alpha-glucosidase inhibitors; they slow down the digestion of carbohydrates and prevent the absorption of glucose in the intestine. They can also enhance the effect of acarbose. In addition, black currants have phytoestrogen effects and may have positive effects on bone structure, which may also indicate a beneficial effect on diabetic bone damage. mountain ash Sorbus (Sorbus aucuparia) is cultivated both as an ornamental plant and as a fruit. The active ingredients of the berries are ascorbic acid, carotenoids, flavonoids, anthocyanins and phenolic acids, which have demonstrated anti-hyperlipidemia, anti-inflammatory and anti-diabetic effects. Like black currants, sorbal berries can also inhibit the activity of alpha-glucosidase, slow down the absorption of carbohydrates in the small intestine and improve the effect of acarbose. Grussu et al. demonstrated their ability to inhibit alpha-amylase in vitro. Since acarbose has adverse side effects, the addition of sorbitol may be a similar compensation, but further research is needed.

Carrot:

Carrot (Daucus carota Linn.) is a beet belonging to the Apiaceae family. Selenium, vitamins (such as A, B, C, and E), flavonoids, and glutathione are generally considered biologically active substances in carrots. The roots have anti-inflammatory and antioxidant properties. In addition, they contain a lot of fiber related to cholesterol metabolism and carotenoids, corresponding to antioxidant capacity. According to Khaki et al., co-supplementation of carrot seeds and ginger reduced diabetic nephropathy in STZ-induced diabetic rats. Carrot seed consumption reduced serum total cholesterol, triglycerides and LDL cholesterol in STZ-induced diabetic rats. Kumar et al. demonstrated the antidiabetic, hematin- and anticholesterolemic effects of carrot juice supplementation in alloxan-induced diabetic rats

Cinnamon: Cinnamon is a popular spice attained from the inner dinghy of trees in the rubric Cinnamomum. There are several species in this rubric, but the two most common types of cinnamon are Cinnamomum verum(Ceylon cinnamon) and Cinnamomum Cassia(Cassia cinnamon). Then are some possible ways that cinnamon may be involved in the treatment of diabetes More insulin perceptivity Some studies have shown that cinnamon can ameliorate insulin perceptivity by making cells more sensitive to insulin and easing the uptake of glucose from the bloodstream. bettered insulin perceptivity is a crucial factor in the treatment of type 2 diabetes. Lower blood sugar Cinnamon can help lower blood sugar by adding glucose metabolism and reducing insulin resistance. This could potentially contribute to better blood sugar control in diabetics. Anti-inflammatory parcels habitual inflammation is related to insulin resistance and the development of type 2 diabetes. Cinnamon has anti-inflammatory parcels and can have a positive effect on insulin perceptivity by reducing inflammation. Antioxidant Cinnamon is rich in antioxidants that can help neutralize oxidative stress. Oxidative stress plays a part in the development and progression of diabetes- related complications, and antioxidants may have a defensive effect. Delayed gastric evacuating Cinnamon can delay gastric evacuating, performing in a more gradational release of glucose into the bloodstream after a mess. This can help help unforeseen harpoons in blood sugar.

Berberine: Berberine has been shown to increase the perceptivity of cells to insulin, which means it can help the body respond to insulin more effectively. Insulin perceptivity is pivotal for regulating blood sugar,

and perfecting it can profit people with insulin resistance, a common point of type 2 diabetes. Lower blood sugar Studies have shown that berberine can help lower blood sugar through several different mechanisms. It can increase cellular glucose, reduce liver glucose and ameliorate insulin signaling. Effect on glucose metabolism Berberine has been reported to affect colorful aspects of glucose metabolism. It can spark an enzyme called AMP- actuated protein kinase(AMPK), which plays a part in regulating cellular energy. AMPK activation can increase cellular glucose uptake and ameliorate energy balance. Anti-inflammatory parcels habitual inflammation increas the chances of type 2 diabetes and associated to insuline resistance. Berberine hasanti-inflammatory parcels and can help reduce inflammation, which improves insulin perceptivity.

Natural potential therapeutic agent used in treatment of obesity

Introduction

Causes of obesity:

Diet and nutrition :Eating high- calorie foods, especially reused foods, sugars, and unhealthy fats can contribute to weight gain. Physical inactivity a sedentary life characterized by a lack of regular physical exertion is a major cause of obesity. ultramodern conveniences and technology have reduced energy consumption.

Genetics: Genetics factors can play a part in an existent's vulnerability to obesity. Some people may have a inheritable predilection that makes them more prone to weight gain.

Environmental factors: The terrain, including openings for healthy food choices and physical exertion, can impact obesity. Socioeconomic factors similar as income and education may also play a part.

Psychological factors: Emotional and psychological factors similar as stress, depression and trauma can lead to gluttony and unhealthy eating habits.

Symptoms of obesity:

Weight gain : The most egregious symptom of obesity is weight,generally measured by body mass indicator(BMI).

Body fat distribution: obesity frequently results in an abnormal distribution of body fat, with redundant fat accumulating around the tummy, hips and shanks.

Shortness of breath and fatigue: Carrying redundant weight strains the respiratory and cardiovascular systems, causing briefness of breath and fatigue indeed with minimum physical exertion.

Joint and back pain: Increased stress on joints, especially in the knees and lower back, can beget pain and discomfort. Insulin resistance obesity is nearly related to insulin resistance, which can contribute to type 2 diabetes.

Different medicines used to treat obesity.

Caffeine : Caffeine, a natural goad set up in coffee, tea, and certain salutary supplements, has been studied for its implicit part in the treatment of weight gain and obesity. Although caffeine has some goods that could theoretically support weight loss, it's important to approach these findings with caution, as individual responses may vary and long- term goods may not be completely understood.

Increased Metabolism: Caffeine has been shown to temporarily increase metabolism and increase fat oxidation. This means your body can burn further calories, which can help you lose weight.

Appetite repression: Some studies suggest that caffeine can have a mild appetite suppressing effect, reducing food input. Ameliorate physical performance Caffeine can ameliorate physical performance by adding adrenaline situations and marshaling adipose acids from adipose towel. It can ameliorate performance and burn calories during exercise.

Thermogenesis: Caffeine has been associated with increased thermogenesis, which is the product of heat in the body. This process can help burn calories.

Forskolin:

Forskolin from Coleus barbatus forskolin Forskolin is a labdanum diterpene isolated from the roots of Coleus forskohlii Briq of the Labiatae family from India, while Plectranthus barbatus and Coleus forskalaei (Lamiaceae) are the most abundant species containing forskolin. Forskolin acts directly on the enzyme adenylate cyclase, which increases cAMP levels and ultimately leads to lipolysis, or the breakdown of fats in adipose tissue. Later, the fatty acids released from the adipose tissue depot also trigger thermogenesis and the increase of lean tissue. In general, forskolin can cause fat loss without loss of muscle mass.

Ephedrine:

Ephedrine is a sympathomimetic amine with stimulant properties and has been used in the past for a variety of purposes, including as a decongestant and bronchodilator. It has also been studied for its potential role in weight loss and obesity treatment. However, the use of ephedrine in weight management is controversial, and it is important to note that its sale and use is restricted or banned in many countries for safety reasons.

Appetite suppression: Ephedrine can have an appetite suppressant effect that reduces food intake. This is thought to be mediated by its effects on certain neurotransmitters in the brain.

Increased Metabolism: Ephedrine has been shown to stimulate the central nervous system, which increases heart rate and metabolism. This can lead to burning more calories, which can promote weight loss.

Enhanced thermogenesis: Ephedrine can promote thermogenesis, the process by which the body produces heat. This is thought to be related to increased energy consumption and fat burning.

Algae:

Seaweed, also known as kelp, has gained attention for its potential health benefits, including supporting weight management. Although research is ongoing and not all aspects are fully understood, several properties of seaweed may influence its potential role in the treatment of obesity. It is important to note that seaweed is not a panacea for obesity and a holistic approach to weight management, including a healthy diet and regular exercise, is still essential.

The possible effect of algae in the treatment of obesity:

Fiber content: Many seaweeds are high in fiber, which can promote feelings of fullness and satiety. This can help reduce overall caloric intake by promoting satiety after a meal.

Low calorie density: Algae are often low in calories and energy density. Adding them to your diet can add volume and flavor without significantly increasing your caloric intake.

Iodine content: Some algae are good sources of iodine, an important mineral that plays a role in thyroid function. The thyroid gland regulates metabolism and adequate levels of iodine are important to maintain a healthy metabolism.

Bioactive compounds: Algae contain various bioactive compounds such as polyphenols, phlorotannins and fucoxanthin, which have antioxidant and anti inflammatory properties. These compounds can have metabolic effects and contribute to overall health.

Modulation of intestinal microbiota: Some studies show that algae can have a positive effect on the composition of the intestinal microbiota. A healthy gut microbiome is increasingly recognized as part of metabolic health and weight regulation.

The potential anti-obesity effect of various algal compounds has been investigated. Algae, including algae and microalgae, are rich sources of bioactive compounds that can influence metabolic processes and promote weight management. Here are some algae compounds that have been studied for their anti-obesity properties:

Algae compounds with anti-obesity effects:

Fucoxanthin: Fucoxanthin is a carotenoid with antioxidant properties found in seaweed such as wakame and hijiki. Research shows that fucoxanthin can stimulate the expression of genes related to fat oxidation and thermogenesis, which can help reduce fat tissue.

Phlorotannins: These are polyphenolic compounds found in seaweed. Phlorotannins have antioxidant and anti-inflammatory properties, and some studies show that they can inhibit enzymes involved in fat digestion and absorption, which can reduce fat absorption in the digestive tract.

Alginate: Alginate is a polysaccharide found in the cell walls of brown algae. Its potential role in weight management has been studied due to its ability to form a gel-like substance in the stomach that can promote satiety and reduce appetite.

Fucoidans: Fucoidans are sulfated polysaccharides found in seaweed. They have been studied for various health benefits, including potential anti-obesity effects. Fucoidans can affect lipid metabolism and adipocyte differentiation, which can reduce fat accumulation.

Chlorophyll: Chlorophyll is a green pigment found in microalgae, including spirulina and chlorella. Some studies indicate that chlorophyll may have potential anti-obesity effects by modulating lipid metabolism and adipocyte differentiation.

Omega-3 fatty acids: Some microalgae, such as those used in algae-based dietary supplements, are rich in omega-3 fatty acids, including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA). Omega-3 fatty acids have a combined anti-inflammatory effect and can play a role in regulating metabolism and reducing fat accumulation.

Protein and fiber: Algae, especially certain microalgae, can be a good source of protein and fiber. Protein and fiber increase satiety and help people feel full and satisfied, which can help with weight management.

Conclusion:

The treatment of type 2 diabetes mellitus (T2DM) has seen promising developments with the use of natural medicinal substances such as polyphenols, including resveratrol, curcumin, and rutin. These substances have shown potential in managing T2DM, exhibiting antioxidant, anti-inflammatory, and glucose-lowering properties. Their incorporation into treatment approaches holds significant promise for mitigating the complications associated with T2DM.nnMoving on to the treatment of obesity, several natural therapeutic agents have shown potential in supporting weight management. Caffeine, forskolin, and algae compounds have been studied for their effects on metabolism, appetite suppression, and fat oxidation. Additionally, the various bioactive compounds found in algae such as fucoxanthin, phlorotannins, alginate, and fucoidans have demonstrated anti-obesity effects.As the research on these natural therapeutic agents continues, it is imperative to adopt a holistic approach to the treatment of T2DM and obesity, integrating these findings into comprehensive healthcare strategies.

References

1.Adisakwattana S. (2017). Cinnamic acid and its derivatives: Mechanisms for prevention and management of diabetes and its complications. *Nutrients* 9 (2), 163. 10.3390/nu9020163

2.Agarwal K. C. (1996). Therapeutic actions of garlic constituents. *Med. Res. Rev.* 16 (1), 111–124. 10.1002/(SICI)1098-1128(199601)16:1<111:AID-MED4>3.0.CO;2-5

3.Ahmadi N., Nabavi V., Hajsadeghi F., Zeb I., Flores F., Ebrahimi R., et al. (2013). Aged garlic extract with supplement is associated with increase in Brown adipose, decrease in white adipose tissue and predict lack of progression in coronary atherosclerosis. *Int. J. Cardiol.* 168 (3), 2310–2314. 10.1016/j.ijcard.2013.01.182

4.Aipire A., Mahabati M., Cai S., Wei X., Yuan P., Aimaier A., et al. (2020). The immunostimulatory activity of polysaccharides from Glycyrrhiza uralensis. *PeerJ* 8, e8294. 10.7717/peerj.8294
5.Aron P. M., Kennedy J. A. (2008). Flavan-3-ols: Nature, occurrence and biological activity. *Mol. Nutr. food Res.* 52 (1), 79–104. 10.1002/mnfr.200700137
6.Ashraf R., Aamir K., Shaikh A. R., Ahmed T. (2005). Effects of garlic on dyslipidemia in patients with type 2 diabetes mellitus. *J. Ayub Med. Coll. Abbottabad* 17 (3), 60–64.
7.Bader A., Braca A., De Tommasi N., Morelli I. (2003). Further constituents from Caralluma negevensis. *Phytochemistry* 62, 1277–1281. 10.1016/s0031-9422(02)00678-7
8.Milibari, A.A.; Matuure, E.Y.; Gadah, E.M. Prevalence, Determinants and Prevention of Type 2 Diabetes Mellitus (T2DM) in Arabic Countries: A Systematic Review Study. *Health Sci. J.* **2020**, *14*, 1–8
9.Olokoba, A.B.; Obateru, O.A.; Olokoba, L.B. Type 2 Diabetes Mellitus: A Review of Current Trends. *Oman Med. J.* **2012**, *27*, 269–273.
10.Deshmukh, C.; Jain, A.; Nahata, B. Diabetes Mellitus: A Review. *Int. J. Pure Appl. Biosci.* **2015**, *3*, 224–230
11.Ghodsi, M.; Larijani, B.; Keshtkar, A.A.; Nasli-Esfahani, E.; Alatab, S.; Mohajeri-Tehrani, M.R. Mechanisms Involved in Altered Bone Metabolism in Diabetes: A Narrative Review. *J. Diabetes Metab. Disord.* **2016**, *15*, 52
12.Kaku, K. Pathophysiology of Type 2 Diabetes and Its Treatment Policy. *Jpn. Med. Assoc. J.* **2010**, *53*, 41–46.
13.Sales, C.H.; de Fatima Campos Pedrosa, L. Magnesium and Diabetes Mellitus: Their Relation. *Clin. Nutr. Edinb. Scotl.* **2006**, *25*, 554–562
14.Martiniakova, M.; Blahova, J.; Kovacova, V.; Babikova, M.; Mondockova, V.; Kalafova, A.; Capcarova, M.; Omelka, R. Bee Bread Can Alleviate Lipid Abnormalities and Impaired Bone Morphology in Obese Zucker Diabetic Rats. *Molecules* **2021**, *26*, 2616.
15.Rendell, M. The Role of Sulphonylureas in the Management of Type 2 Diabetes Mellitus. *Drugs* **2004**, *64*, 1339–1358.
16.Nathan, D.M.; Buse, J.B.; Davidson, M.B.; Ferrannini, E.; Holman, R.R.; Sherwin, R.; Zinman, B. Medical Management of Hyperglycemia in Type 2 Diabetes: A Consensus Algorithm for the Initiation and Adjustment of Therapy: A Consensus Statement of the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetes Care* **2009**, *32*, 193–203.