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Management of Type-2 Diabetes mellitus with Chanaka yoga as a Nutraceutical substance

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ABSTRACT

Prevention of occurrence or development of diabetes complications by providing a good metabolic control could only be achieved through diabetic patients' training. The aim of the study is to determine the effects of Ayurvedic Nutraceuticals, which is going with the treatment of patients with type-2 diabetes on nutrition knowledge and consumption habits. Chanaka Yoga is the formulation of Chanaka, Haridra, Daruharidra, Amalaki Haritaki and Bibhitaki. As in many research papers have shown the Anti-Diabetic effect of describing herbs in Chanaka Yoga. Fibre presents in bengal gram especially pectin may lower cholesterol levels by absorbing bile acids. Sodium curcuminate present in Haridra causes an increase in total excretion of bile salts, bilirubin and cholesterol. The extract of Berberis aristata (root) has strong potential to regulate glucose homeostasis through decreased gluconeogenesis. Amalki decreased synthesis of cholesterol and enhanced reverse cholesterol transport by elevating HDL-C level. Aqueous extract of Haritaki reduced the elevated blood glucose and increase in glycosylated hemoglobin. The plant extracts of Bibhitaki decreased the serum levels of total cholesterol, triglycerides, low density lipoprotein cholesterol, urea, uric acid and creatinine.

Keywords: Nutraceuticals, Diabetes, Complication, Herbs, Chanaka Yoga.

INTRODUCTION

The World Health Organization (WHO) defines diabetes mellitus (DM) as a degenerative and chronic disease that occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use insulin. [1] It is a disorder of the metabolism of carbohydrates, fats, and lipids, which is characterized by a high fasting blood sugar. [2] It manifests as chronic hyperglycemia and leads to the development of diabetes specific micro vascular pathology in the retina, glomerulus and peripheral nerve culminating into serious complications affecting the eyes, kidneys and arteries. [3,4] Diabetes mellitus is a systemic metabolic disease characterized by hyperglycemia, hyperlipidemia, hyper amino-acidemia, and hypo insulinaemia it leads to decrease in insulin, secretion and insulin action in developing countries products are expensive and not easily accessible. [5] Diabetes is a heterogeneous metabolic disorder characterized by altering carbohydrate, lipid,

and protein metabolism, which causes hyperglycemia resulting from insufficient insulin secretion, insulin action or both. [6] It is one of the refractory diseases identified by Indian Council of Medical Research for which an alternative medicine is a need for the treatment. Some reasons like stress, rapid development of cities, and substantial increase in purchasing power, lifestyle, ease and metro life have lead to health issues and higher number of people suffering from these diseases. [7]

WHO statistics show that worldwide 347 million people have diabetes and 80% of diabetic deaths occur in low and middle income countries. [1] According to the International Diabetes Federation, India is ranked second only to China in the list of top ten countries for a number of people with diabetes. [8] In Africa, it is estimated that about 19.8 million adults have diabetes with Nigeria and South Africa having 3.9 and 2.6 million, respectively. It is estimated that by 2035, the percentage of diabetic patients in Africa would cross an alarming figure of 58% [8]. India is the world's second most populous country, having more people with type 2 diabetes than in any other nation as the disease prevails in both genders and all age groups. [9, 10] According to recent estimates, approximately in the year 2030, 438 million people (7.8%) of the adult population, is expected to have diabetes. [11] Type 2 diabetes, is the major form of diabetes, accounting for 9095% of all diabetic cases [12] and nearly half of all patients suffering from the disease are older than 65 years of age. [13] It is a complicated and divergent disease which in addition to blood sugar control requires the management of lipid parameters, blood pressure and thrombotic factors. [14]

The current treatments for DM include the use of insulin and synthetic drugs such as sulfonylurea, metformin, alphaglucosidase inhibitors and thiazolidinedione's in addition to lifestyle adjustments. . Currently available therapies for diabetes include insulin and various oral antidiabetic agents such as sulfonylureas, biguanides, α-glucosidase inhibitors and glinides. These synthetic drugs are valuable, but restricted by their limited action, pharmacokinetic properties, secondary failure rates and accompanying side effects like hypoglycemia, damage to liver, lactic acidosis, diarrhea, abdominal pain, weight loss and loss of appetite [13,15-17]. The treatment for diabetes is both difficult and tedious; it is expensive, costly and not affordable by the majority of African and Asian populations. [18]

Diabetes mellitus has become a growing problem in the contemporary world. India has today become the diabetic capital of the world with over 20 million diabetes and this number is likely to increase to 57 million by 2025.[19] Due to the problems associated with the current treatments, a large percentage of the diabetics resort to alternative remedies that are purported to improve glycemic control. [14] The WHO estimated that approximately 80% of the world's population rely mainly on traditional medicines for their primary health care. [20] The screening of medicinal plants for novel bioactive compounds is, therefore, an important goal for scientists. Importantly, the plant based drugs are biodegradable, safe, and cheap, having fewer side effects, in India, China and other ancient traditional medicinal systems in the world, medicinal plants have been the major source of treatment for DM since time immemorial.[21-23]

A number of medicinal plants, traditionally used for over 1000 years named Rasayana are present in herbal preparations of Indian traditional health care systems. The current review focuses on herbal drug preparations and plants used in the treatment of diabetes mellitus, a major crippling disease in the world leading to huge economic losses. [24]

In the Ayurvedic system of medicine a number of formulations are present to treat Diabetes Mellitus with very less side effect and is cost effective. Some of these formulations sometime may be used in nutraceutical form like chawayanprash, vasavleha used as nutraceuticals in respiratory disorders. In this series Chanak yoga used in Diabetes mellitus, It is the formulations of a number of herbal ingredients. [25]. The ingredients of the ***Chanaka Yoga*** are given in the table below.

S.N.	Substance	Botanical Name	Family	Part Used
1	Chanaka	*Cicer arietinum Linn*	Papilionaceae;Fabaceae	Seed
2	Haridra	*Curucuma longa Linn*	Zingiberaceae	Rhizome
3	Daruharidra	*Berberis aristata DC.*	Berberidaceae	Stem
4	Amalaki	*Embilica officinalis Gaerth*	Euphorbiaceae	Fruit pulp
5	Haritaki	*Terminalia chebula Retz.*	Combretaceae	Fruit pulp

6	Bibhitaki	*Terminalia bellirica Roxb*	Combretaceae	Fruit Pulp

ANTI-DIABETIC PLANTS USED IN CHANAKA YOGA COMPOSITION

Cicer arietinum L. (Family: Fabaceae)

Hindi–Chana; English–Bengal gram

Cicer arietinum is cultivated in southern India; it is given for skin and lipid disorders, indigestion, vomiting, diarrhea, Dysmenorrhoea and for fever. [26] The increase in membrane cholesterol of erythrocytes because of hypercholesterolemic diet leads to osmotic fragility, which was reflected in packed cell volume and erythrocyte count. A direct relation in a decrease of allosteric enzyme (Na+-K+) - ATPase (membrane bound enzyme) activity was noticed. This condition was reversed by treating with dietary fiber of Bengal gram. [27] Conflicting reports have appeared concerning the beneficial effect of legume fiber on cholesterogenesis. [28,29] One of the difficulties in assessing the physiological role of fibers relates to the fact that their composition may vary widely. However, it is now fairly well established that dietary fiber is composed of a hydrophilic component and a more hydrophobic or ionic component that have been ascribed to the ability to hydrate or to behave as a weak ion exchange, which can sequester bile acids and other sterols by preventing re-absorption, thereby decreasing body cholesterol stores.[30] Bengal gram fiber exhibited maximum hypocholesterolemic and hypolipidemic effect as the water absorption and holding capacity of the fibre was useful in assessing their hypocholesterolemic effect with bile acids.[31] Menon and Kurup [32] have proposed that the fiber in bengal gram especially pectin may lower cholesterol levels by absorbing bile acids. The consequent loss of bile acids by faecal excretion is then offset by an increase in hepatic conversion of cholesterol into bile acids. The protective role appears to be rendered by the hydroxyl and carboxyl groups of uronic acid present in the pectin molecule. Bengal gram consists of isoflavones Biocharin A and Formononetin in high amounts, which were estrogen-like compounds and most probably the active compounds responsible for lowering serum cholesterol level.[33]

Curcuma longa L. (Family: Zingiberaceae)

Hindi–Haldi; English–Turmeric

Curcuma longa is a rhizomatous perennial herb, a native of East India. The ancient practitioners in India used turmeric as stomachic, tonic and carminative, as antibacterial, antiseptic and as anthelmintic. It is applied as a paste to bruises, wounds and conjunctivitis. [26] Turmeric contains 5% of volatile oil, resin, zingiberaceous starch grains & yellow coloured curcuminoids. The chief components of curcuminoids is known as curcumin. A volatile oil is composed of mono and sesquiterpens such as alpha & beta pinene, alpha- phellandrene, camphor, camphene, zingiberene, alpha & beta curcumenes. [34] It is used as anti- diabetic drug. [35] Rhizome has been reported to contain the important colouring matter curcumin, which belongs to the dicinimolymethane group. It has also been reported that sodium curcuminate isolated from C. longa is an active cholerectic which causes an increase in total excretion of bile salts, bilirubin and cholesterol.[36] The fluidity of the erythrocyte membrane is determined by cholesterol content, fatty acid composition of the membrane phospholipids and the protein matrix. In a hypercholesterolemic situation, the concomitantly higher cholesterol to phospholipids ratio in the blood plasma will have a direct influence on cholesterol transfer from plasma to erythrocytes, resulting in the enrichment of cholesterol in the erythrocyte membrane. [37] The dietary spice principle curcumin (0.2%) given for 8 weeks showed its ability in reversing the deformity and fragility and normalizing the fluidity in the erythrocytes. [38] The hypocholesterolemic activity of curcumin was examined in human hepatoma cell line HepG2. Curcumin treatment caused increase in LDL-receptor mRNA and moderate increase in expression of the sterol regulatory enzyme binding protein (SREBP) genes. But mRNAs of the peroxisome proliferator activated receptor-α (PPAR-α) target genes CD36/fatty acid translocase and fatty acid binding protein 1 were down regulated. These changes in gene expression are consistent with the proposed hypocholesterolemic effect of curcumin. [39]

Berberis aristata DC. (Fam. Berberidaceae)

Hindi- Daruhaldi; English- Indian Barberry

Berberis aristata (Berberidaceae) is used in Indian traditional medicine for treating diabetes mellitus. The Antidiabetic activity of methanolic extract of this

plant has been observed in streptozotocin induced diabetes in adult male Wistar rats. Unlike antidiabetic it is also used in antibacterial, antiperiodic, antidiarrhoeal, ophthalmic, skin diseases etc. [40]
Hypoglycemic effect of B. aristata root was evaluated. Dried and powdered root extracted with water and methanol and crude extract was administrated to normal and alloxan induced diabetic albino rabbit. The results show that B. aristata roots contain potent and orally effective antidiabetic component which either triggers the formation of insulin or shows insulin like effect.[41] Antidiabetic activity was screened in albino wistar rat by inducing diabetes by alloxan and sterptozocin.[42,43]

Diabetic rats were treated with ethanolic extract of B. aristata. The results conclude that ethanolic extract possesses antidiabetic activity. [44] Methanolic and ethanolic extract of stem bark of *B.* [45,46] aristata shows significant antihyperglycemic effect in Alloxan induced diabetic rat. Crude extract was given orally to diabetes induced rats. The antihyperglycemic and antioxidant potential of 50% aqueous ethanolic root extract of Berberis aristata in alloxan induced diabetic rats was found. The extract besides being safe, lowered the blood glucose significantly without any hypoglycemic effect on their control counterparts. The extract of Berberis aristata (root) has strong potential to regulate glucose homeostasis through decreased gluconeogenesis. [47]

Emblica officinalis L. (Family: Euphorbiaceae)

Hindi–Amla; English–Indian gooseberry
Emblica officinalis is a deciduous tree cultivated in hill slopes and plains in the Deccan region, coastal districts and northern parts of India. Leaf, bark and fruit have potential efficacy against diseases such as inflammation, cancer, age-related renal disease, diabetes, anemia, jaundice, diarrhea and peptic ulcer. [48] Amla extract given (10 and 20 mg/kg) to hypercholesterolemic rabbits had the ability to prevent LDL oxidation; besides it decreased synthesis of cholesterol and enhanced reverse cholesterol transport by elevating HDL-C level. [49]

Terminallia chebula Retz. (Fain. Combretaceae)

Hindi- Harrad, English- Myrobalam
Antidiabetic activity Methanolic extract & chloroform extract of T. chebula reduced the blood sugar level in normal and alloxan diabetic rats significantly. [50,51] T. chebula fruit and seeds also exhibited dose dependent reduction in blood glucose of streptozotocin induced diabetic rats, both in short term and long term study. [52,53] Oral administration of 75% methanolic extract of T. chebula (100 mg/kg body weight) reduced the blood sugar level in normal and alloxan diabetic rats significantly within 4 h. Continued daily administration of the drug produced a sustained effect. [54] The chloroform extract of T. chebula seeds (100, 200 and 300 mg/kg body weight) produced dose-dependent reduction in blood glucose of diabetic rats in both short term and long term study (300 mg/kg body weight for 8 weeks). Further, the remarkable renoprotective activity was also observed in T. chebula treated rats. [55] Oral administration of ethanolic extract of fruits of T. chebula (200 mg/kg body weight for 30 days) reduced the levels of blood glucose and glycosylated hemoglobin in streptozotocin (STZ) -induced experimental diabetic rats. [56] In a similar study, aqueous extract of T. chebula (200 mg/kg body weight for two months) reduced the elevated blood glucose and increase in glycosylated hemoglobin. The same dose also showed a marked improvement in controlling the elevated blood lipids as well as decreased serum insulin levels. The in vitro studies with pancreatic islets showed that the insulin release was nearly two times more than that in untreated diabetic animals. The treatment did not have any unfavorable effect on liver and kidney function tests. [57]

Terminalia belerica Roxb (fam. Combretaceae)

Hindi- Bahera, English- Beleric, Mayrobalan
Bibhitaki is svadu (sweet) after metabolism and destroys kasha (cough), netrya (good for eyes), keshya (good for hairs), krimi (parasitic infection) etc. [58] Modern scientific validation proved antibacterial activity of alcoholic extract (80%) of T. Billerica fruit (in DMSO, at 6.25 mg/ml concentration) which inhibits the growth of Pseudomonas aeruginosa, Bacillus stabiles, and Staphylococcus aureus. [58] Ethanolic extract of the fruit (250 mg/ twice daily/one week) exhibited significant hypoglycaemic activity in alloxan diabetic albino rats. [59] Latha P.C.R *et al* .,(2010) investigated that Hexane, Ethylacetate and Methanolic extracts of TB fruit at the doses of 200, 300 and 400 mg/kg, p.o for 60 days to Streptozotocin induced diabetic rats significantly ($p<0.05$) increased the plasma insulin, C-peptide and glucose tolerance levels, body weight, serum total protein. The effect

was more pronounced in the methanol extract treated rats. In addition the plant extracts significantly decreased the serum levels of total cholesterol, triglycerides, low density lipoprotein cholesterol, urea, uric acid and creatinine in diabetic rats. [60]

CONCLUSION

The prevalence of diabetes mellitus continues to rise worldwide and treatment with oral hypoglycemic drugs ends with numerous side effects and huge monetary expenditure. There is increasing demand by patients to use the natural products with antidiabetic activity. This paper has presented various anti-diabetic plants that have been pharmacologically tested and shown to be of some value in the treatment of Diabetes Mellitus. The effects of these plants may delay the development of diabetic complications and correct the metabolic abnormalities. However, more investigations must be carried out to evaluate the mechanism of action of medicinal plants with antidiabetic effect.

Herbs have been used in medical treatment since the beginning of civilization and have become a mainstay of human pharmacotherapy. Based on this, many works were carried out in evaluating the hypocholesterolemic effect of plants and from the reports on their potential effectiveness; it is assumed that the botanicals have a major role to play in the management of hypercholesterolemia. Medicinal plants reviewed here have shown great cholesterol reducing property in normal as well as high fat/cholesterol treated animals, thus showing protective role in the progression of atherosclerosis. More concentration in evaluating the beneficial effects of medicinal plants certainly will help to utilize the Indian biodiversity and traditional knowledge for prospecting novel compounds as pharmacologically effective products to manage hypercholesterolemia.

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