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HERBAL DRUGS USED IN THE TREATMENT OF HYPERTENSION AND DIABETES – AN OVERVIEW

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ABSTRACT

Medicinal plants are the natural gift to human lives which promotes the disease free healthy life. Herbal medicines are in great demand in the developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, higher safety margins and lesser costs. There is good interest in traditional medicines because of an estimation of lower incidence of side effects. The World Health Organization (WHO) estimates that 80 percent of the world's population presently uses herbal medicines for some aspect of primary health care. Several medicinal plants have been described to be beneficial for cardiac ailments in Ayurveda - the origin of Indian system of Medicine. This review aimed to provide a summary on the botanical characterization, vernacular names, chemical Constituents, Traditional uses of the natural herbs which are used in the treatment of Hypertension and diabetes.

KEYWORDS: Medicinal Plants, Anti-hypertensive plants, Anti-diabetic plants, Herbal Plants, Medicinal treatment.

No: of Tables: 2 **No: of References: 130**

INTRODUCTION

Since ancient days, in look for the treatment of the illness, the individuals sought for medication in nature attributable to having lesser facet effects on the body. The beginnings of the medicinal plants' use were spontaneous, as is that the case with animals. (1) In view of the actual fact that at that time there wasn't sufficient data either regarding the explanations for the sicknesses or regarding that plant and the way it can be used as a cure, everything was supported expertise. In time, the explanations for the usage of specific healthful plants for treatment of sure diseases were being discovered therefore, the healthful plants usage bit by bit abandoned the empiric framework and have become based on explicatory facts. (2)

The use of herbal medicines continues to expand rapidly across the world with many people now resorting to these products for treatment of various health challenges in different national healthcare settings. (3) In developed and developing countries natural therapies are being used, and these herbal remedies are being available not only in drug stores, but now also in food stores and supermarkets. It is estimated that up to 4 billion people living in the developing world which rely on herbal medicinal products as a primary source of healthcare and traditional medical practice which involves the use of herbs is viewed as an integral part of the culture in those communities. (4-5)

The use of herbal remedies has also been widely used in many developed countries with alternative medicines and now it becomes the mainstream in the UK, Europe, as well as in North America and Australia. In fact, the places like the UK have a historical tradition of using herbal medicines, the use is also widespread and well established in some other European countries. (6-7)

In these developed countries, the most important reasons for seeking natural therapy is the belief that it will promote the healthier living. Herbal medicines are often viewed as a moderate approach to healing and individuals who use them as home remedies and over-the-counter drugs spend huge amount of money (in excess of billions of dollars) on herbal products. (8)

HYPERTENSION:

Hypertension is still remains an uncontrolled disease in India, mainly because of the condition which develops silently and remains undetected for a long time. According to the World Health Organization (WHO), one in every three individuals above the age of 18 years has high blood pressure. (9) There are five types of hypertension which includes Primary hypertension, Secondary hypertension, malignant hypertension, resistant hypertension, isolated systolic hypertension. Primary Hypertension is identified in the absence of a known secondary cause. Approximately around 90-95% of adults with hypertension have primary hypertension, whereas secondary hypertension accounts for around 5-10% of the cases. Secondary form of hypertension,

such as primary hyperaldosteronism. (10) Resistant hypertension is the high blood pressure which does not respond well to the aggressive medical treatment. Resistant hypertension increases the risk of heart attack, stroke and kidney failure. (11) Malignant hypertension is high blood pressure which develops rapidly and causes the organ damage. Normal human blood pressure is 80/120. A person with malignant hypertension has a blood pressure which is above 180/120. Malignant hypertension is a case of medical emergency. (12)

Isolated systolic hypertension happens when the diastolic blood pressure is less than (80mm Hg) and the systolic blood pressure is (130 mm Hg) or higher. Isolated systolic hypertension is most common in people older than age 65. Prevalence of hypertension in the US adult population is much high. (13-14) There are some factors which increases the risk of hypertension. These include ± age (above 40 years), family history of blood pressure, stress, high salt intake, smoking, heavy alcohol intake, chronic diseases (heart, kidney diseases etc. (15)

Hypertension mainly develops as you grow older. The primary cause of high blood pressure remains unknown in almost 90% of the cases. But there are several secondary causes of hypertension such as: kidney disorders, disease such as diabetes, having blockage in arteries, irrational use of medicines like pain killers, supplements, thyroid problems, heavy alcohol intake, and sleep disorders. High blood pressure is a silent killer and does not have any symptoms as such headache, breathlessness, nosebleed, vision problem, increased heart rate. (16)

In this study, we are focusing on the medicinal or herbal plants which are present in nature and used from ancient times for their benefits and have potency to treat Hypertension and Diabetes. Table 1enlist the names of plants having potent anti-hypertension and anti-diabetic effects.

Plants used for the treatment of Hypertension
Rauwolfia
Garlic
Lotus
Ginseng
Jalbhrahmi
St. John's wort
Bhringraj
Punarnava
Amla
Ashwagandha
Arjun
Olive leaf
Yarrow
Black Cumin seeds
Hibiscus

Table 1: Plants used for the treatment of Hypertension

LIST OF MEDICINAL PLANTS WHICH ARE USED IN THE TREATMENT OF HYPERTENSION

1.Rauwolfia *(Rauwolfia serpentine)* is an evergreen shrub which belongs to the family *Apocynaceae* and having small pink or white flowers. (17) The plant leaves are usually pale green in color which is 7 to 10cm long and 3 to 5cm wide. Leaves are elliptical in shape. More than 100 species are available in Rauwolfia genus. (18)

Vernacular names

English: Snakeroot, Sepent wood
Hindi: Chandrabhaga, Chota chand, Sarpagandha
Sanskrit: Chandrika, Chundrika, Patalguruda, Sarpagandha
French: Arbre aux serpents
German: Indische Schlangenwurzel, Rauwolfie, Schlangenholz

Chemical Constituent of Rauwolfia: Rauwolfia contains different phytochemicals, including alcohols, sugars and glycosides, fatty acids, flavonoids, phytosterols, oleoresins, steroids, tannins, and alkaloids. The alkaloids of rauwolifa are classified in the following types: a) Indole Alkaloids b) indoline alkaloids c) indolenine alkaloids d) oxyindole alkaloids e) Pseudo indoxy alkaloids. (19)

The most important alkaloids which are mainly found in the plants are indole alkaloids. Around 30% Indole Alkaloids have been reported in drug and the content of total alkaloids in rauwolfia roots have been ranges between 0.7- 3% which further depend upon the source. (20) Indole alkaloids are a group of nitrogenous compounds that are derived from the amino acid tryptophan. All parts of the plant, including the stem and leaves, contain indole alkaloids, but they are found in high concentration in the bark of the root. The other alkaloids which are present in the drugs are reserpinine, Yohimbine,serpentine, ajmalicine etc. (21)

Antihypertensive effect of Rauwolfia: Rauwolfia alkaloids work by controlling nerve endings along certain pathways which affects the heart and blood vessels, lowering blood pressure. Rauwolfia decreases the level of catecholamines and serotonin from nerves in the central nervous system. It also prevents the reuptake of norepinephrine at the storage sites which allows the enzymatic destruction of neuronal transmitter and is also used to treat the mild essential hypertension and it may be effective for the severe hypertension. (22) Deserpine is also used as an antihypertensive and tranquilliser.Rescinnamine is also used as an antihypertensive but sometime it causes mental depression in higher dose.

The Rauwolfia constituent ajmaline not only lowers blood pressure, but also shows a potent antiarrhythmic effect. Studies have shown that ajmaline specifically depresses intraventricular conduction, suggesting this would be particularly effective in the treatment of re-entrant ventricular arrhythmias and uses in the treatment of circulatory diseases, in relief of

obstruction of normal cerebral blood flow. (23) Syrosingopine shows the peripheral effect which is similar to the reserpine. It shows less sedative actions and is used for the treatment of moderate and mild hypertension. (24)

2. Garlic *(Alium sativum)*

Garlic (*Allium sativum*) is a perennial flowering plant growing from a bulb which belongs to the family Liliaceae. It produces pink to purple flower in to month from July to September and leaves are flat and are 1.5 to 2.5cm wide with an acute apex. (25) Garlic has been used as a spices, food, and medicine for over 5,000 years, and is one of the earliest documented herbs which are used for treatment of disease. (26)

Vernacular Names

English: Garlic, Poorman's treacle
Hindi: Lahasun
Sanskrit: Rasona, Yovanesta
Spanish: Ajo
German: Knoblauch, Lauch

Chemical Constituents of Garlic

Chemical constituent of the plant show which shows sulfur compounds such as Allicin, ajoenes, vinyldithiins, sulfides, diallyl trisulfide .Although allicin (diallyl-dithiosulfinate) is the most important alkaloid which is generally claimed to be responsible for their beneficial effects. Alliin, is the main cysteine sulfoxide is transformed to allicin by allinase enzyme after cutting off the garlic and breaking down the parenchyma. (27) S-propyl-cysteine-sulfoxide (PCSO), allicin and S-methyl cysteine-sulfoxide (MCSO) are the main odoriferous molecules of freshly milled garlic homogenate. (28)

Antihypertensive effect of Garlic:

In one study the Aqueous Garlic xtract (AGE) caused a decrease in blood pressure and bradycardia by direct mechanism not involving the cholinergic pathway, suggesting a likely involvement of peripheral mechanism for hypotension. (29) Another study showed that AGE prevents oxidative stress, systolic blood pressure, aortic NAD(P)H oxidase activity and vascular remodeling in rats with metabolic syndrome. It has been also shown that preparations of garlic may be tentatively used as an adjunct agent in treatment of arterial hypertension because of its hypolipemic and antioxidant properties. Aqueous garlic extracts prevent oxidative stress and vascular remodeling in an experimental model of metabolic syndrome. (30)

3. Lotus

It is obtained from Nelumbo nucifera, which belongs to Family *Nymphaeaceae*. (31) All parts of N. nucifera have several medicinal uses. The leaf, rhizome, seed and flower are traditionally used for the treatment of pharyngopathy, pectoralgia, small pox, dysentery, cough, haematemesis, epistaxis,, hyperlipidaemia, fever, cholera, hepatopathy and hyperdipsia. In Ayurveda this plant is also used as a diuretic and anthelmintic and in

the treatment of, vomiting, leprosy, skin diseases and nervous exhaustion. (32)

Vernacular Names

Hindi: Kamal, Pundarika
English: Lotus, Sacred Lotus
Sanskrit: Pankaja, Padma
Telgu: Tamara

Chemical constituents of Lotus: The seeds of lotus are rich in asparagin, fat, protein, starch and tannin. The lotus seed comprises three parts and that are integuments, plumule, and cotyledons. (33) Six non-phenolic bases was identified: roemerine, nuciferine, anonaine, pronuciferine, N-nornuciferine and liriodenine and two phenolic bases, armepavine and N-methyl-coclaurine , were also found in N. nucifera leaf extract. (34)

Antihypertensive effect of lotus:

It helps in blood regulation. The presence of significant levels of potassium in lotus roots ensures a balance between fluids in the body and thus it prevents the excessive sodium from affecting the bloodstream. It relaxes the blood vessels and further prevents contraction and rigidity, increasing blood circulation. In lotus roots iron is present which helps in smooth blood circulation

4. Ginseng

Ginseng is the dried root of the various species of Panax, like Panax ginseng(Korean ginseng), Panax notoginseng(Chinese ginseng), Panax quinquefolium(American ginseng) and Panax japonica (Japanese) which belongs to the family *Araliaceae*. (35) It mainly grows in Korea, China and Russia. Commercially Ginseng is cultivated in Korea, China, Canada,U.S and Japan. In India Ginseng is cultivated in Arunachal Pradesh and Kohima.

Chemical Constituent: Ginseng is a mixture of the several saponin glycosides which belongs to the triterpenoid group and ginseng oils, ginseng phytosterol, carbohydrates, sugar etc. They are further grouped as Ginsenosides, Panaxosides and Chikusetsusaponin. Ginseng also contains the algycone moiety as Panaxosides. Panaxosides on decomposition gives oleanolic acid, Panaxadiol and panaxatriol. (36)

Antihypertensive effect of Ginseng:

Panax ginseng, is a naturally occurring compound which is used from several thousand years and it is one of the most popular herbs in the world due to its therapeutic effects on modulating the immune system and cardiovascular functions. (37) Some studies on Panax ginseng have confirmed its effect on regulating blood pressure. On higher dose Panax ginseng has hypotensive effect in healthy people and on lower dose, Panax ginseng can elevate the blood Pressure. Ginseng also enhances the power to

overcome from the exhaustion and illness. (38)

5. Jalbhrahmi

It is obtained from the herb of Centella asiaticaHydrocotyl asiatica and belongs to the family Umbelliferae. Leaves are bigger and long petiolate and are of 1.5-6.5cm in diameter. It is a tropical medicinal plant. (39)

Vernacular name of Jalbhrami

English: Pennyweed, Indian Pennywort
Hindi: Ballari, Brahmi
Sanskrit:Bhandi
Nepali: Brahmabuti
Telgu: Mandukaparni

Chemical constituent: Jalbrahmi contains saponins namely asiaticoside and madecassoside. On hydrolysis it gives asiatic acid and madecassic. They also contain brahmoside and bramhinoside. On hydrolysis it gives brahmic acid, isobrahmic acid, arabinose, glucose and rhamnose. (40)

Antihypertensive effect of Jalbrahmi:

Jalbrahmi reduced both systolic and diastolic blood pressure levels by releasing nitric oxide, which helps in dilatation of blood vessels, resulting in improved blood flow and lower blood pressure. (41)

6. St. John's wort

It is a flowering herb which is obtained from Hypericum perforatumwhich belongs to the family *Hypericaceae*. It consists of 400 species of herbs and shrubs having yellow or coppery flowers with four to five petals, numerous stamens, and a single pistil. (41)

Vernacular Name

Hindi: Choli phulya
English: Perforate St John's Wort
Tamil: Vettai pakku

Chemical Constituents: Studies have shown around seven active medicinal compounds and the most common classes include naphthodianthrones, phloroglucinols, and flavonoids (such as phenylpropanes, flavonol glycosides, and biflavones), as well as essential oils. Two other constituents' hypericin and hyperforin were identified in other studies. (42)

Antihypertensive effect of St. John's wort:

St. John's Wort has a long history of herbal treatment for a variety of ailments. Over the past 20 years, it has become a mainstream alternative treatment for depression, as well as holding promise as a therapy for cancer, inflammation, bacterial and viral infections, and other disorders. (43)

7. Bhingaraj

It is a small branched perennial herbaceous plant obtained from Eclipta alba,belongs to the family of Asteraceae. In India, it usually grows as a natural weed, in Himalayas and commonly found in the regions of upper northern plains. (44)

VernacularNames:

Hindi: Balari, Bhangra, Bhringraj, Bhengra, Mochkand.
Gujrati: Bhangro, Dadhal, Kalobhangro
Canarase: Ajagara, Garagadasoppu, Kadigga-garaga
Marathi: Bhangra, Maka
Sanskrit: Bhringraj, Markara, Pitripriya, Sunilaka, Keshrangana

Chemical constituents: The plant contains the alkaloid ecliptine with some other chemical compounds as wedelic acid, apigenin wedelolactone, etc. The leaves contain stigmasterol, wedelolactone, demethylwedelolactone. (45) The roots are abundant in hentriacontanol and heptacosanol. Roots also contain polyacetylene which is a substitute of thiophenes.The aerial part contains a phytosterol, P-amyrin in the n-hexane extract of phytosterol, a glucoside of a triterpenic acid and wedelolactone in the polar solvent extract. (46)

Antihypertensive effect of Bhringraj:

Bhringraj tea helps in detoxifying the body and it provide the energy to the brain by increasing the supply of oxygen. By massaging the scalp with the Bhringraj oil, which will provide the calming effects on the mind and body and makes it Stress free. (47)

8. Punarnava (Hogweed)

It is obtained from dried herbs of *Boerhaavia diffusa* belongs to the family *Nyctaginaceae*. It is mainly found in India and Sri Lanka. (48)

Vernacular name

English-Spreading hogweed
Hindi-Snathikari
Sanskrit: Punarnava, Raktakanda
Tamil Mukaratee-kirei
Marathi-Tambadivasu
Canarese Kommegida

Chemical constituents: Punarnava contains various secondary metabolites, such as flavonoid glycosides (Quercetin, kaempferol), isoflavonoids (2'-O-Methyl abronisoflavone), steroids (ecdysteroid), alkaloids, and phenolic (Punarnavoside)and lignan glycosides(Syringaresinol mono-*β*-*D*-glucoside). (49)

Antihypertensive effect of Punarnava:

Punarnava is a species of flowering plant that contains a host of medicinal advantages. As per Ayurveda, Punarnava is a plant which usually acts on six Ayurvedic dhatus (tissues) including blood, muscles, nerves, reproductive organs, plasma and fat. It possesses the significnat antihypertensive properties which help to keep the high blood pressure in check. Moreover, it is a diuretic, and helps increase renal blood flow that further contributes to its antihypertensive actions. (50)

9. Amla

Amla is obtained from *Emblica officinalis*which belongs to the family of *Euphorbiaceae* and is also known as *Phyllanthus emblica* or Indian gooseberry. Amla is a native to India. (51)

Vernacular names

English: Emblic myrobalan, Indian Goose berry
Sanskrit: Aamalaki
Hindi: Amla

Chemical constituents: It contains several chemical constituents like tannins, alkaloids and phenols. Among all hydrolysable tannins are Emblicanin A and B, Geraniine. (52) Alkaloids are Phallantine, Phyllembine, and Phyllantidine. Gallic acid and ellagic acids are the example of the phenolic compounds. (53)

Antihypertensive effect of Amla:

Amla is very effective in lowering blood pressure. Amla is the best fruits in preventing heart failure and advanced stage problems like hypertension. It is a rich source of Vitamin C, thus it helps in widening the blood vessel and reducing blood cholesterol levels. Alma is a good Cardio Tonic and its mild stimulant action on heart help to control blood pressure. (54)

10. Ashwagandha

It is obtained from dried roots and stem bases of *Withania somnifera* belongs to the family *Solanaceae*. This plant usually grows in the subtropical region of India. (55)

Vernacular names

Sanskrit: Ashwagandha, Turangi-gandha
English: Winter Cherry
Hindi: Punir, asgandh

Chemical constituents: The main Chemical constituents of Withania are steroidal lactones and alkaloids. Leaves contain the steroidal lactones which are commonly known as withanolides and it has C28 Steroidal nucleus and having 6 membered lactone biologically active chemical constituents are alkaloids (ashwagandhine, cuscohygrine, tropine etc) and the other alkaloids are somniferine,tropine,somniferinine, withanine etc. (56)

Antihypertensive effect of Ashwagandha:

Ashwagandha promotes restorative sleep and balances energies in the body to reduce insomnia and boost energy and stamina. It is also used to regulate the human blood pressure. (57)

11. Arjun

It is obtained from the dried stem bark of *Terminalia arjuna* belongs to the family *Combretaceae*. The tree of Arjuna is very common in Indian Peninsula and is very common in chota Nagpur region. It usually grows in the dense forest. (58)

Vernacular Names

Hindi: Arjun

Chemical Constituents: The main chemical constituents of Arjuna are present in stem bark(Arjunin, Arjunic Acid , Arjungenin, terminic acid),root bark (arjunolic acid, oleanic acid), fruits(Arjunic acid, Arjunone, Arachidic stearate, Cerasidin, Ellagic acid, Fridelin, Gallic acid, Hentriacontane, Methyl oleaolate, Myristyl oleate, β-Sitisterol), leaves (flavanoids,

glycosides)and seeds (galactopyranoside). (59)

Antihypertensive effect of Arjuna:

Arjuna is one of the most famous herbs known today. It has many effective medicinal uses especially for the heart and circulatory system which make it such a valuable herbal component in the treatment of heart problems in Ayurveda. The bark of Arjuna is also used as a cardiotonic which reduces the angina frequency. (60)

12. Olive leaf

It is obtained from the two varieties *Olea europaea*, Olea africana which belongs to the family *Oleaceae* and it contains around 24 genus and 900 species. (61) Because of their bitter taste it is not used as a natural fruit but is consumed as olive oil and table olives. (62)

Vernacular names

English: Olive tree
Hindi: Jaitun,Julipe, Saidun

Chemical constituents: It consists of various chemicl constituents such as flavonoids, flavone, flavanones,glycosides, iridoids, iridane glycosides, secoiridoids, secoiridoid glycosides, biophenols,triterpenes, benzoic acid derivatives, sterols, sugars, and various types of secondary metabolites from its different parts. (63) Some Phenolic compounds are present in almost all parts of olives such as flavonoids, secoiridoids, and secoiridoid glycosides. (64)

Antihypertensive effect of olive leaf:

In vivo assays verified that olive leaf reduces the blood pressure. A prophylactic blood pressure reducing action of the olive leaf extract has been shown in a preclinical study with rats treated with L-NAME. (65) In humans Antihypertensive and cholesterol-lowering actions of the olive leaf extract have been confirmed. (66) Another study depicts that the ethanolic or choloroform extract of olive leaves shows a slow reduction in blood pressure in the moderate hypertension after their prolonged use. (67)

13. Yarrow

It is a flowering plant which is obtained from *Achillea millefolium* which belong to the family *Asteraceae*. Stem, leaves and flower part of Yarrow has been used to various medicinal purposes. (68) Yarrows are resistant to drought that is why it is planted to the combat soil erosion. (69)

Vernacular Names

English:Common Yarrow, Sneezewort, Soldier's friend, Thousand-leaf
Hindi: Gandrain, Puthkanda, Bhut Kesi

Chemical constituents: Chemical constituents of Yarrow contains Alkaloids (betonicine, stachydrine, trigonelline), Coumarins, Flavonoids (apigenin, luteolin, quercitin), Salicylic acid,Sesquiterpene lactones (achillin, achillicin), Polyacetylenes,Volatile oil with variable content (linalool, camphor, sabinene, chamazulene),Triterpene, Tannins, Sterols and plant acids. (70)

Antihypertensive effect of Yarrow:

The control of Hypertension is an important factor in the management of cardiovascular diseases. Several studies showed that yarrow exhibits a high angiotensin converting enzyme inhibition, hence it is used in the treatment of hypertension. (71)

14. Black Cumin seeds

It is an annual flowering plant which is obtained from *Nigella sativa* which belongs to the family *Ranunculaceae*. (72) Apart from its use in medicines it is used in Indian Kitchens as a flavoring additive in pickles and breads. (73)

Vernacular names

English: Black Seed, Fennel flower, Nutmeg flower, Onion seed, Black cumin
Hindi: Kalaunji

Chemical constituents: Its main constituents are cuminaldehyde and cuminic alcohol. Other important aroma compounds of roasted cumin are the substituted pyrazines, 2-ethoxy-3-isopropylpyrazin, and 2-methoxy-3-methylpyrazine. Other components are safranol, γ-terpinene, p-cymene, and β-pinene. (74) Cumin seeds are nutritionally rich so they provide high amount of fats, protein, and dietary fibre. Cuminaldehyde, cymene, and terpenoids are the major volatile components of cumin. Cumin has a strong flavor. Its warm aroma is due to its essential oil content. (75)

Antihypertensive effects of Black Cumin Seeds:

The antihypertensive effect of black cumin seed oil appears to be mediated by a reduction in cardiac oxidative stress and angiotensin-converting enzyme activity,with an increase in cardiac heme oxygenase-1 activity and a prevention of plasma nitric oxide loss. Thus, black cumin seed oil might be beneficial for controlling hypertension. (76)

15. Hibiscus

It is obtained from *Hibiscus sabdariffa* which belongs to the family *Malvaceae*. This annual herb usually grows to 1.5 m and it produces elegant red flowers. (77) The flowers are collected when they are slightly immature. The Hibiscus plant is native to America and Africa. The plant is used for its many medicinal uses. (78)

Vernacular name

English:China Rose, Chinese hibiscus
Hindi: Gurhal

Chemical Constituents: Hibiscus flowers contain various polyphenols, including flavonols, anthocyanins, proanthocyanidins, and other pigments. (79) Malic acid, citric acid, oxalic acid, tartaric acids and stearic acid have been identified and are, along with 15% to 28% of hibiscic or hibiscus acid, most likely contribute to the tartness of the herb and its teas. The oil is rich in gamma tocopherol. (80) The saturated fatty acids (palmitic and stearic) and unsaturated fatty acids (oleic and linoleic) contents

have been described. The seeds and flowers contain high amounts of crude oil, ash, protein and carbohydrate. High amounts of arginine, aspartic acid, and glutamic acid were found in the protein isolated from the seed. (81)

Antihypertensive effect of Hibiscus:

Several studies have concluded that hibiscus tea may reduce both systolic and diastolic blood pressure.

In a study, hibiscus tea or placebo were given to 65 people with high blood pressure. Results have shown that after six weeks, those who drank hibiscus tea had a significant reduction in systolic blood pressure, compared to the placebo. (82) Similarly, a 2015 review of five studies found that hibiscus tea lowered both systolic and diastolic blood pressure. (83)

DIABETES: Diabetes is a chronic disease which occurs when the pancreas is no longer able to make insulin, or when the body cannot make good use of the insulin it produces. Insulin is a hormone which is made up in pancreas that acts like a key to let glucose from the food we eat pass from the blood stream into the cells in the body to produce energy. Insulin helps the glucose to get into the cells. If is not being able to produce insulin or use it effectively, it leads to increase the glucose levels in the blood which is known as hyperglycaemia. The long-term high glucose levels are associated with the damage to the body and failure of the various organs and tissues

Diabetes mellitus (DM) is an endocrinological disorder. It is a combination of heterogeneous disorders which commonly present with the episodes of hyperglycemia and glucose intolerance, as a result of lack of insulin, defective insulin action, or both. Such complications arise due to derangements in the regulatory systems for storage and mobilization of metabolic fuels, including the catabolism and anabolism of carbohydrate, lipids and proteins emanating from defective insulin secretion, insulin action, or both. (84)

Diabetes insipidus (DI) is a hereditary or acquired condition which disrupts the normal life of persons with the condition; disruption is due to increased thirst and passing of large volumes of urine, even at night. DI is a rare disorder which occurs when a person's kidney's pass an abnormal large volume of urine that is insipid, dilute and odorless. In most people, the kidneys pass about 1 to 2 quarts of urine a day. People who are suffering from diabetes insipidus, the kidneys can pass 3 to 20 quarts of urine in a day. As a result, person with diabetes insipidus may feel the need to drink large amounts of liquids. (85)

Classification of diabetes mellitus is based on its etiology and clinical presentation.

As such, there are four types or classes of diabetes mellitus:

- Type 1diabetes
- Type 2 diabetes
- Gestational diabetes, and
- Other specific types.

Type 1 diabetes is said to account for only a minority of the total burden of diabetes in a population although it is the major type of the diabetes in younger age groups at majority of well-to-do countries. The incidence of type 1 diabetes is increasing in both rich and poor countries. (86)

Type II diabetes is the most typical Diabetes Mellitus. In type II, the body is capable to produce insulin but body become resistant to insulin and thus it is ineffective. By the time, insulin levels could subsequently turned out insufficient. The cause of high blood glucose levels are both the insulin resistance and deficiency. (87)

Gestational diabetes mellitus (GDM) is a type of Diabetes Mellitus which usually determine in the second or third trimester of pregnancy that is not clearly overt diabetes. GDM is a provisional disorder which happens in pregnancy and brings enduring danger of type II diabetes. (88)Other specific types include the wide variety of relatively uncommon conditions, primarily specific genetically defined forms of diabetes or diabetes associated with other diseases or drug use. Less common types include monogenic diabetes, and cystic fibrosis-related diabetes. (89) Table 2 enlists various medicinal plants having anti-diabetic activity.

Plants used for the treatment of Diabetes
Fenugreek
Gymnema
Cinnamon
Neem
Bitter melon
Aloe-vera
Palash
Ginger

Table 2: Plants used for the treatment of Diabetes

Herbal plants which are used in the treatment of diabetes mellitus

1.Fenugreek

Fenugreek is an annual herb which is obtained from *Trigonella foenum-graecum*, which belongs to the family *Fabacecae*. If it grows more, can develop sickle shaped pods including 10-20 brownish seeds 3x4 mm in dimensions with leaves consisting of three small obovate to oblong leaflets. (90)

Vernacular name

English: Fenugreek, Sickle Fruit fenugreek, greek hay
Hindi: Methi

Chemical constituents: The main chemical constituents of Fenugreek are saponins, nicotinic acid,coumarinscopoletin, trigonelline and feenugreekine. (91) Fenugreek leaf is used as a green, leafy vegetable which is a good source of calcium, iron, β-carotene and several vitamins. Fenugreek seed is good source of protein (20-30%) high in tryptophan and lysine; free amino acids (4-hydroxyisoleucine, arginine, lysine, histidine); (25.8%), fat (6.53%), ash content (3.26%), crude fibre (6.28%), energy (394.46 Kcal/100 g seed) and moisture (11.76%). (92) It contains lecithin, choline, minerals, B. Complex, iron, Phosphates, PABA (Para-Amino Benzoic Acid) and vitamins A and D. The significance of T. foenum-graecum seeds is due to the defatted part, with high quality fibre including steroidal saponins and protein comparable to those of soybean. (93)

Antidiabetic effect of Fenugreek:

Fenugreek seeds help in controlling the blood sugar level in the patients and shows antidiabetic activity. The blood sugar lowering effect of fenugreek seeds can be attributed to Galactomannan which is made up of galactose and mannose. A soluble kind of fibre is also present in the seeds.It slows down the rate of absorption of carbohydrates into blood thus preventing the spikes in blood sugar levels. (94) Insulin sensitivity helps in improves the insulin action at cellular level and hence will improved the HbA1c level by utilizing the glucose in the peripheral tissues, thereby helps in maintaining the blood glucose level. (95)

2. Gymnema

It is a perennial herb which is obtained from *Gymnema Sylvestre* which belongs to the family *Asclepiadaceae*, and it is slow growing herb which is mainly found in India. The genus is classified into the 40 different species like G. montanum, G. yunnanense, and G. inodorum have medicinal properties. (96)
The plant is a large, more or less pubescent, woody climber. The leaves are opposite, usually ovate (1.25 – 2.0 inch x 0.5-1.25 inch). Flowers are small in size and yellow in color. (97)

Vernacular names

English: Periploca of the wood
Hindi: Gurmar,Gudmar, Jangli urad

Chemical constituents: The leaf part of Gymnema contains triterpene saponin which belongs to oleanane and dammarane class. The major constituents like gymnemic acids and gymnemasaponins are the members of oleanane type of saponins while gymnemasides are dammarane saponins. (98) Other chemical constituents include flavones, anthraquinones, tartaric acid,pentatriacontane, phytin, resins, formic acid, butyric acid, lupeol, β-amyrin related glycosides, stigmasterol, and calcium oxalate. The presence of alkaloids had been detected in plant extracts. Leaves also contain acidic glycosides and anthraquinones and their derivatives. The secondary metabolites in Gymnema includes a group of nine closely related

acidic glycosides, in which the main are gymnemic acid and the further series are gymnemic acid I, II, III, IV, V, VI, and VII. (99)

Antidiabetic effect of Gymnema:

The first scientific confirmation of *Gymnema sylvestre* role in human diabetics came almost a century back when it showed that the leaves of Gymnema can reduce the urine glucose in diabetics. (100) In an animal study, a scientist have investigated that Gymnema leaf powder had positive and encouraging effects over the blood glucose levels. No adverse effect was observed on the health of the subjects and thus, it can thus be concluded that gurmar powder is effective in lowering the fasting as well as postprandial blood glucose levels. (101) Moreover, one more scientist had investigated the anti-hyperglycemic action of a crude saponin fraction and five triterpeneglycosides derived from the methanol extracts of G. sylvestre. (102)

3.Cinnamon

It is obtained from the inner bark of trees from the *Cinnamomum zeylanicum* (CZ) and Cinnamon cassia belongs to the family *Lauraceae*. Cinnamon, the evergreen tree of tropical area, is a native of Sri Lanka and Malabar Coast of India. (103)

Vernacular names

Hindi: Dalchini
English: True Cinnamon

Chemical Constituents: Cinnamon consists of a variety of resinous compounds, which includes Cinnamaldehyde, Cinnamate, Cinnamic acid, and essential oils. (104) Thepresence of wide ranges of essential oils, such as trans-cinnamaldehyde, cinnamyl acetate, eugenol, caryophyllene oxide, L-bornyl acetate, E-nerolidol, a-cubebene, a-terpineol, terpinolene.other phytoconstituents which are present in cinnamon are ferulic acids, caffeic, gallic acid vanillic, protocatechuic and p-coumaric along with the polyphenols. (105)

Antidiabetic effect of Cinnamon:

The hypoglycemic activity of cinnamon in poorly controlled patients with type 2 diabetics was being proved by Al- Yasiry. The participants were given about 0.5 g of crude cinnamon 15 mins after every meal for the total of 1.5 g daily for 3 months. They found that HbA1c decreased from 9.54+ 0.96 pre-treatment to 8.22 + 0.65 post treatment (P< 0.01). (106)

Akilen studied the usage of Cinnamon cassia in type 2 diabetes. Participants were given a total of 2g daily ingestion of 2 g of cinnamon each day was found to significantly reduce the HbA1c level, p < 0.0521R. (107)

4.Neem

It is obtained from *Azadirachta indica* which belongs to the family *Meliaceae*.

(108) Neem is the fast growing evergreen tree which is commonly in India, Africa and America. Due to its medicinal values it is used in Ayurvedic medicine for more than 4000 years. The flowers are white in color and have semi-sweet, olive-sized fruit. The seed from inside is rich in oil with tremendous medicinal and botanical properties. (109)

Vernacular names

Hindi: Neem

Chemical Constituents: Neem consists of various chemical constituents including nimbin, nimbidin, nimbolide, and limonoids. Quercetin and β-sitosterol were first polyphenolic flavonoid which is purified from fresh leaves of neem and were known to produce antifungaland antibacterial activities. (110) Leaves contain mixture of compounds which includes, nimbanene, ascorbic acid, 6-desacetylnimbinene, nimbandiol, nimbolide, n-hexacosanol and different amino acids, and nimbiol and several other types of ingredients. (111)

Antidiabetic effect of Neem:

In a study it has been showed that, the extract of neem has been evaluated for its anti-diabetic activities and showed a great result in decreasing the glucose level. Higher dose of neem extract showed significant decrease in blood sugar level and it reduced blood sugar level by 54% as comparison to control. Furthermore, the effects of neem kernel powder and glibenclamide either separately or in combination were used as an antidiabetic agent on the laboratory animals. The results revealed that these two agents either separately or in combination significantly decrease the concentration of serum glucose, lipids, and activities of serum enzymes. (112)

5.Bitter melon

It is obtained from *Momordica charantia*, a flowering vine which belongs to the family *Cucurbitaceae*. It is a climbing perennial herb and bears elongated fruits with a lumpy surface. (113)

Vernacular names

English:Bitter Gourd
Hindi: Karela, kathilla, poraru

Chemical constituents: Bitter melon fruits consist of saponins, alkaloids, glycosides, reducing sugars, resins, fixed oil, free acids and phenolic compounds. (114) In alkaloids it includes charantin, charine, cryptoxanthin, cucurbitins, cucurbitacins, cucurbitanes, cycloartenols, diosgenin, elaeostearic acids, erythrodiol, galacturonic acids,, momorcharasides, momordenol, momordicin, momordicinin, momordicosides, momordin, momordolo, multiflorenol, myristic acid, nerolidol, oleanolic acid, oleic acid, peptides, petroselinic acid, polypeptides, proteins, rosmarinic acid, rubixanthin, steroidal glycosides, stigmasta-diols, stigmasterol, taraxerol, trypsin inhibitors, uracil, v-insulin, verbascoside, vicine, serine, glutamic acid. The fruit pulp has soluble pectin but there is no free pectic acid. (115)

Antidiabetic effect of Bitter melon:

Charantin is a typical cucurbitane type triterpenoid in bitter melon and it is a potential substance with antidiabetic properties. Scientist demonstrated that charantin could be used to treat diabetes and can be potentially replace treatment. (116) Insulin plays a vital role in stimulating the uptake of glucose by the different cells of the body for energy production. M. charantia and its extracts have been reported to exert the hypoglycemic effect. (117)

6. Aloe Vera

It is obtained from *Aloe barbadensis* belongs to the family *Liliaceae*. There are 550 species are present in the world. The plant matures when it is about 4 years old and has a life span of about 12 years. The leaves are up to 0.5 m long and 8–10 cm across at the base, tapering to a point, with saw-like teeth along their margins. In a transverse section, the plant shows a slightly concave appearance on the adaxial surface and distinctly convex appearance on the lower abaxial surface. (118)

Vernacular names

English: Aloe Vera, Medicinal aloe, Burn plant
Hindi: Gheekumari

Chemical constituents: There are 200 different types of molecules in aloe vera . The aloe vera leaf gel contains around 98% water. On dry matter aloe gel consists of polysaccharides (55%), sugars (17%), minerals (16%), proteins (7%), lipids (4%) and phenolic compounds (1%). (119) The aloe vera gel contains many vitamins including the important antioxidant vitamins A, C and E,thiamine, niacin, Vitamin B2 (riboflavin), choline andfolic acid are also present. In animal source cyanocobalamin is present in it. Carbohydrates are derived from mucilage layer of the plant under the rind, surrounding the inner parenchyma or gel. Xylose and Rhamnose are also present in it. (120)

Antidiabetic effect of Aloe Vera:

According to various studies done before, taking aloe vera as an oral supplement can significantly reduce the level of glucose in the blood (46.6 mg/dl), as well as reducing HbA1c (1.05%), or glycated hemoglobin, which indicates the average blood glucose level over the previous three months.

Aloe vera stimulates the secretion of the insulin, which is particularly very useful for people who are suffering from diabetes. Research concluded that Patients with blood sugar levels of 200mg/dl will be most benefitted from the effects of aloe vera. (121)

7. Palash

It is obtained from *Butea monosperma* which belongs to the family *leguminosae/papilioneae*. (122) The flowers of Palash yielded are red or orange dye which is used as a coloring agent and as an insecticide. It is an erect tree with a height of 12-15 m and irregular branches

bark rough, ash coloured, and young parts downy. (123)

Vernacular names

Hindi: Dhak, Palas, Tesu, palaash
English: Bastard Teak, Bengal Kino

Chemical constituents: The leaves of Palash contain Glucoside, Kino-oil containing linoleic acid and oleic acid,palmitic and lignoceric acid. (124) The major glycosides are Butrin, cyanidin, lupeol,histidine, medicarpin, shelloic acid, miroestrol, palasimide. Flower of palash contains monospermoside and isomonospermoside, aureoles, flavonoids and steroids, triterpene, butin, isobutrin, isocoreopsin, sulphurein. A nitrogenous acidic compound, along with palasonin are present in seeds and it also contains monospermoside plant proteinase and polypeptidase. (125)

Antidiabetic effect of Palash

The ethanolic extract of Palash Significantly improves the glucose tolerance and it causes the reduction in blood glucose level in alloxan-induced diabetic rats in Single dose treatment. (126) Ethanolic extract of seeds exhibits the significant antidiabetic, hypolipidemic and antiperoxidative effects in non-insulin dependent diabetes mellitus rats. Palash seeds at the dose of exhibits significant antidiabetic, hypolipaemic and antiperoxidative effects in non-insulin dependent diabetes mellitus rats. (127)

8. Ginger

It consists of the rhizomes of *Zingiber officinale*, which belongs to the Family *Zingiberaceae*. Rhizomes of dried ginger are irregular in shape, branched or palmate. (128) Their color varies from dark yellow or light brown to pale buff. It contains about 2 percent essential oil which is the principal component is zingiberene and the pungent principle of the spice is zingerone.(129)

Vernacular names

English: Ginger
Hindi: Adrak

Chemical constituents: Ginger contains 1 to 2% volatile oil, and 5 to 8%, resinous mass and starch. Volatile oil consists of zingiberene 6% sesquiterpenes hydrocarbon zingiberol a sesquiterpenes alcohol and besaabolene and is responsible for aromatic smell. Other chemical constituents which are present in ginger are Gingirol, a yellow oily liquid and it yields gingirone a ketone and a aliphatic aldehyde. Shagaol is formed by the loss of water from gingerol.If it is boiled with 5% potassium hydroxide or other alkalies the pungency of ginger and gingerol are destroyed. (130)

Antidiabetic effect of ginger:

Lamuchi-Deli evaluated the effects of the hydroalcoholic extract of ginger on arginase I activity and expression in the retina of streptozotocin-induced diabetic rats. The study showed that the blood glucose concentration was decreased, arginase I activity and expression was

significantly (P < 0.05) down regulated and the extract was reduced significantly during the elevation in body weight in diabetic rats compared to the untreated diabetic controls (P < 0.01). Serum insulin was also increased in diabetic rats which were treated with 400 mg/kg of the extract compared to diabetic controls (P < 0.05). The study concluded that the ginger may be a promising therapeutic option for treating the diabetes-induced vascular disorders. (130)

CONCLUSION

Nowadays Lifestyle has been changed, including diet, exercise, and stress management, may contribute significantly to lowering of blood pressure and increasing the blood glucose level. Various Supplements such as potassium, magnesium, omega- 3 fatty acids, amino acids such as Aarginine and taurine, and vitamins C and E have been widely used in the treatment of cardiovascular disease, including hypertension. They have proven beneficial in reducing blood pressure and improving the heart functions. Among the most researched and frequently utilized for hypertension are Arjuna, Olive leaf, Yarrow, Black cumin seeds, Indian snakeroot, and Garlic.

Diabetes mellitus is a most common endocrine disorder, which affects millions of people across the world. It is a group of metabolic diseases which is characterized by hyperglycemia results from defects in insulin secretion, insulin action, or both. The increase in resistance and populations of patients at some risk, in conjunction with the restricted number of commercially available drugs for diabetes that still present have many side effects and also problems like unwanted hypoglycemic effect are the cause to shift the research towards traditionally available medicine which have low side effect and wide range of bio activity.

From this review article, it may be useful to the health professionals, scientists and scholars to develop evidence-based alternative medicine to cure hypertension and diabetes problem using various herbal preparation. Extracts which are isolated from the natural resources plays a significant role in the treatment various disorders.

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