EVALUATION OF ANTI-DIABETIC ACTIVITY BY USING TRADITIONAL MEDICINAL PLANTS

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Abstract

A metabolic condition with numerous aetiologies is diabetes mellitus. In addition to problems in protein, fat, and fat metabolism that impact insulin output and action, it is characterised by persistent hyperglycaemia. Diabetes mellitus results to inappropriate and increased hyperglycaemia conditions. Protein glycation is another main reason for the complications of diabetes Advanced glycation end products are created when proteins are glycated, altering the structure of the protein and its enzymatic activity. In some individuals improper glycaemic control can be brought about by exercise, reduction in body weight, and reducing oral glucose levels. Long term complications of diabetes can lead to loss of vision; neuropathy which leads to renal failure, ulcers in the foot, genitourinary and cardiovascular diseases. One of the main causes of diabetes in the world's population is the absence of modern medical services. The goal of current review is to identify the pharmacological applications of several medicinal plants. Allicin, cysteine, sulfoxide, and s-allyl cysteine sulfoxide, cyaniding glycosides, quercetin, flavonoids, sterols, phenols, prostaglandins, lignin, saponins, anthraquinones, alkaloids, glycosides, steroids, phenolics, and tannins are among the chemical constituents found in high concentration in these medicinal plants. Examples of Medicinal plants which are used for the anti-diabetic activity are Alliumcepa, Alliumsativum, Aloe vera, Momordicacharantia, Ocimumsanctum, Panax ginseng, Cinnamomunverum, Psidium guajava, Brassica juncea, Capsicum annum etc. due to their phytochemical constituents and biologically active components which shows beneficial effects.

Keywords: Anti-diabetic, Invitro, Phytochemical constituents, Hyperglycaemia, Hypoglycaemia, Hyper lipidaemic.

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1. INTRODUCTION

The metabolic condition diabetes mellitus is regarded as having numerous aetiologies. It is characterised by persistent hyperglycaemia, improper protein and lipid metabolism, and abnormalities in insulin secretion and activity. It is one of the most common chronically effecting metabolic disorder to the large proportion approximately of all the countries.

Diabetes mellitus results to inappropriate and increased hyperglycaemia conditions. Patients are more numerous now because of lifestyle changes and numerous other environmental factors.

In the patients of diabetes, insulin is not sufficiently acted on the glucose metabolism which results in the synthesis of larger proportion of glucose in liver by the glucagon. Protein glycation is another main reason for the complications of diabetes. Glycation of proteins leads to production of advanced glycation end products, which will change the structure of proteins and modify their enzymatic action.

There are two classifications of diabetes. types 1 and 2. Diabetes type 1 is brought on by insufficient insulin secretion. Serological autoimmune pathogenic evidence found in pancreatic islets and genetic markers can be used to identify people with this diabetes. Type 2 diabetes is brought on by both inadequate insulin production and resistance to insulin action. Exercise, weight loss, lowering oral glucose levels can all contribute to inappropriate glycaemic management in some people. Long-term diabetic consequences include retinopathy, neuropathy that causes renal failure, Charcot joints, foot ulcers, genitourinary and cardiovascular problems can all result in visual loss.

Plants have long been regarded as one of the most effective sources for treating diabetes. Most of the plants are recommended for therapeutic use for common ailments and diseases. The most important advantage of these medicinal plants is they are easily available and have lesser side effects.

These plants stimulate the glucose uptake and increases the insulin secretion in some cases. They also improve the function of beta cells and helps in regenerating the pancreatic parts. Most of the medicinal plants are preferred because they consist of phytoconstituents like saponins, flavonoids, carotenoids, alkaloids, terpenoids and glycosides. They also consist of biological active components like lignans, coumarins, polyphenols, glucosinolate which shows the beneficial effects.

Examples of traditional medicinal plants are used in treatment of are Rosacanina, cayaritatrifolia, Momordicacharantia, panax ginseng, Alliumcepa, Alliumsativum, Aloe vera, Pterocarpiusmarsupium, OcimumSanctum, Canariumtramdenum, Nigellasativa, Capsicumannum, Coriandrumsativum, caricapapaya, Artocarpus heterophyllus (jackfruit), Cajanuscajan, Sinapisalba, Betavulgaris (Beetroot) Psidiumguajava (guava), Musa (Banana) etc.

2. ANTIDIABETIC ACTIVITY OF VARIOUS MEDICINAL PLANTS

2.1. ALLIUM SATIVUM

The plant Allium Sativum, often known as garlic. It is a member of the Liliaceae family. Over the world, people use allium sativum to lower the risk factors for diabetes and heart disease. So, known as the one of popular herbs. (Joseph eyo et; al 2010). It consists of chemical constituents like allyl propyl disulfide; allicin; cysteine; sulfoxide; and s-allyl cysteine sulfoxide. Along with anti-diabetic activity it shows other pharmacological activities like Antioxidant, Anti-bacterial, Antifungal, Anti protozoal activity. Allium sativum shows anti-diabetic effects by observing hypoglycaemic, hypocholesterolaemic and hypotriglyceridaemic in an invitro method where antidiabetic and hyperlipidaemic effects are produced in Streptozocin induced diabetic rats. The rats which were treated by garlic showed drastically reduced serum glucose levels in comparison to the controlled diabetic rats. (Eidi A et; al 2006) [1]. When diabetic rats were administered with garlic are compared to control rats with diabetes, the percentage reduction in serum glucose levels is decreased by 29%, 68%, and 57%, respectively (Martha Thomson et al.) [2]

2.2. ALLIUM CEPA

Allium cepa is a member of the Liliaceae family. A Biannual or Perennial plant. It is commonly known as Queen of Kitchen due to its highly valued flavour, taste, aroma. It is also known as Onion, pyaz. (Arka Jyoti Chakraborty et; al 2022) [3]. It is widely cultivated and distributed over temperate zones in northern hemisphere. Anti-diabetic activity is because of the chemical constituents like cyaniding glycosides, quercetin, flavonoids, sterols, phenols, prostaglandins, catediols in the bulbs and leaves. Apart from the anti-diabetic activity allium cepa is used for Anti-oxidant activity. (Sohail MN et; al 2011) [4]. Its water extract shows hypoglycaemic and hyperlipidaemic effects on alloxan induced diabetic Rattus novergicus which manages the

diabetes mellitus. (Masood S et; al 2021) [5] The results are for 200mg/kg rat the fasting blood glucose levels reduced by 62.9%, total serum lipids by 27.7% and total serum cholesterol by 20.4%. (Ozougwu, Jevase et; al 2011) [6]

2.3. ALOEVERA

Aloe vera which is known for its medicinal properties being a member of the family of Asphodelaceae. Its common names include Aloe, Aloecapensis, Chirukattali (India), subr (Arabic), Kumari (Sanskrit). (Bawankar Raksha et; al 2014) [7]. Aloe vera is made up of compounds like lignin, saponins, anthraquinones and many other which consists of remedial properties individually. Aloe vera also plays crucial role I the pharmacological activities of anti-inflammatory, antioxidative, anti-tumour, anticancer, and antiseptic. (Perez RM et; al 2020) [8] (Malik JA et; al 2021) [9]. Aloe has potential at lowering HbA1C, fasting blood sugar, and fructosamine in humans. Aloe vera provides antidiabetic effect using UP780 and in order to increase insulin sensitivity in an invitro method of insulin-dependent diabetic mouse with alloxan induction. (Yimam M et; al 2017) [10]. By administration of alloxan-monohydrate intraperi-toneally developed persistent type diabetes. After continuous oral administration for 4 weeks shows decreased levels, after using UP780, fasting blood glucose levels decreased by 35.9%, 17.2%, and 11.6%. (Ayeesha noor et; al 2008) [11].

2.4. MOMORDICA CHARANTIA

The Cucurbitaceae family includes Momordica charantia. It is a Cucurbitaceae flowering vine that is commonly planted in tropical regions including South America, Asia, and India. It acts as natural remedy in the treatment of diabetes, which has bitter taste. (Baby joseph and DJini et; al 2013) [12]. Other names for it include bitter melon, bitter gourd, and karela.

Momordica charantia fruit extract is employed both in vivo and in vitro studies. It shows the activity due to phytosterols, Terpenoids like charantagenins D and charantagenins E, fatty acids, phenolic compounds. (Leung L et; al 2009) [13]. It also shows Anti-bacterial activity. (Abascal K et; al 2005) [14]. The in vitro research indicates that the isolated rat diaphragms' ability to absorb glucose in the physiological solution is reduced in both the presence and absence of insulin. Glucose uptake was 53.81% in the absence of insulin and 47.30% in the presence of insulin. (Liu Z, Gong J et; al 2021) [15] (Mona. Mahmoud et; al 2017).

2.5. OCIMUM SANCTUM

Ocimum sanctum is one of the worlds mostly used traditional medicinal herb, where it belongs to the family Lamiaceae, an annual herb which grows up to 18 inches. It is commonly known as Tulasi and it is of 3 types Rama Tulasi, Shyama Tulasi and Vana Tulasi. (Shanmugam KR et; al 2003) [16]. It acts as antidiabetic agent due to alkaloids, glycosides, steroids, phenolics and tannins. (Somasundaram G et; al 2012) [17] (Ahmad MZ et; al). It shows anti-oxidant, antibacterial, and antipyretic activity. (Mehta V et; al 2016) [18]. Ocimum sanctum shows antidiabetic activity by α glucosidase and α amylase, where dried powder of leaves is used and aqueous extract is prepared and used for invitro method. (Rao SA et; al 2013) [19]. This shows inhibition of α glucosidase in the range of 34.17%-71.45% and α amylase for concentrations between 250 and 1000 g/ml, there was an inhibition range of 1.94%–14.88%. (Raju Patil et; al 2011) [20].

2.6. PANAX GINSENG

The family Araliceae includes Panax ginseng .It also goes by the name Asian ginseng ,one of the most significant folk medicines in Asia, particularly in China, Japan, and Korea. (JaeJoon Wee et; al 2011) [21] Ginseng is used in antidiabetic activity due to its properties like decreasing fasting glucose ,lowering body weight ,increasing glucose utilization and insulin regulation in diabetic patients because of presence of chemical constituents like ginsenosides which is the most unique type,saponins,pectin is a polysaccharide ,polyacetylene, volatile oil like aldehydes,heterocycles,sequiterpenoids.(Begum SA et; al 2019) [22] In the invitro method Panax ginseng berry extract is used which is dissolved in polyvinyl pyrrolidone, evaporated and administered intraperitoneally. The results were the extract reduced serum insulin levels by 40%. (Anoja S. Attele et; al 2002) [23]

2.7. ROSA CANINA

Rosa canina is one of the traditional medicinal plants. It is commonly known as kusuburnu, itburnu. It is mostly used as food and folk remedy in Anatolia. It belongs to family Rosaceae, (Nilufer orhani et; al). It shows antidiabetic activity by significant decrease of serum triglyceride levels and also it improves islets necrotic and regenerated pancreatic islet cells because of the flavonoid's presence, triterpenoids, tannins, polysaccharides fatty acids, organic acids, vitamins, carotenoids, and phenolic substances. Along with Antidiabetic activity it shows antioxidant, antimutagenic, and anticarcinogenic effects. In the invitro method male wistar albino rats were used, which were treated with rosa canina fruit extract. (Fattahi A et; al 2017) [24]. Rosa canina decreased blood sugar level the dosage of 250mg/kg body mass by

59.28mg/dl and the dosage of 500mg/kg body mass by 59.26mg/dl in comparison with control. (Mohsen Taghizadeh et; al 2016) [25].

2.8. PUNICA GRANATUM

Punica granatum is a member of the punicaceae family and is indigenous to several regions of Asia (Iran, Malaysia, and India), America (USA, Peru), Africa, and Europe Aqueous extract of the plant's fruits exhibits hypoglycaemic effects when administered to diabetic wistar rats that have been alloxan-induced. pomegranate was its common name. Pomegranate's phenolic chemicals, which have the potential to be highly effective agents in reducing diabetes risk factors, are particularly responsible for the fruit's antidiabetic properties. The results of this study show that after injecting 120 mg per kg of alloxan monohydrate into diabetic alloxan rats for 24 hours, a raised blood glucose level is seen in the rats (20-92+2.7 mmol/lit) (pomegranate fruit and aqueous extract).

2.9. SALVIA ROSMARINUS

Salvia Rosmarinus is a member of the family, Laminaceae and being from Mediterranean, Asian & some parts of world (South America). Fresh and dried leaves used for therapeutic effect. Both aqueous and alcoholic extract show hypoglycaemic effect which was carried by invitro studies (cell free models, hepatocytes, adipocytes skeletal muscle cells) in vivo animal studies and genetically induced diabetes models Common name was Rosemary. Antidiabetic effect especially because of presence of phenolic constitution, corsonicacid, rosnorinic acid, earnosol& improve diabetes mellitus by regulating glucose metabolism. Rosemary extract and rosemary extract polyphenols cornosic acid and Rosmarinus acid have been shown to possess an insulin-like action Target cells in vitro and extract a considerable antidiabetic impact in various in vivo T2DM animal models.

2.10. CINNAMOMUN VERUM

Cinnamomun verum belongs to family of Lauracea and native of China, srilanka, Indonesia genus of Cinnamomun. Bark is used for anti-diabetic condition. Its Aqueous extract shows antidiabetic effect carried by invitro method using adult albino rats (250-300gm) and alloxan induced diabetic rats. Commonly called as cinnamon nearly 8 species, most common was Cinnamomum zeylcnicum and Cinnamomum cassia. Shows antidiabetic activity due to their lower Coumarin concentration and highest polyphenols levels also inhibit gastro intestinal enzymes, modulating insulin response and sensitivity improve glucose uptake Result Indicate the mean fasting blood glucose level decreased significantly (pc0.08) after 15 days of therapy with aqueous extract (60 mg/kg) taken orally.

2.11. GLYCYRRHIZA GLABRA

Glycyrrhiza glabra is a member of family Fabaceae and original to western Asia, North Africa, South Europe. Root of liquorice used for antidiabetic activity, it's ethanolic extraction shows antidiabetic effect. Carried by invitro (Alpha glucosidase and alpha amylase inhibitory assays). Commonly known as Liquorice, it contains glycyrrhizin (glucoside) exhibit antidiabetic activity Glycyrrhiza inhibits alpha amylase function 65% inhibition is observed in lower concentration 10-20 micro lit.20 micro lit 65%, ,30-50micro lit 70-80% also inhibits alpha glucosidase (which converts starch into sugar).

2.12. TRIGONELLA FOENUM GRECUM

Trigonella foenum grecum belongs family of Fabaceae. Native to southern Europe, the Mediterranean region, and western Asia. Seeds are used to show therapeutic effect it's alcoholic extract shows hypoglycaemic effect by invitro methods when diabetic rats were treated by the seed powder for 21 days (diabetic rats that have been induced with alloxone) with the oral ingestion of seed powder also show hypoglycaemic effect on diosgenin rats for 41 days. Commonly known as Fenugreek (methi seeds) mainly components like diosgenin, galacto mannon responsible for anti-diabetic activity.

2.13. PSIDIUM GUAJAVA.

Psidium guajava often referred to as guava. It relates to Myrtaceae family. Psidium guajava is used to reduce diabetes across the world. It consists of phytochemicals like alkaloids, carbohydrates, tannins, terpenoids. Along with anti-diabetic activity it shows other pharmacological activity like anti-diarrhoeal, anti-cancer, anti-inflammatory, anti-microbial, anti-bacterial, hepato protective, anti-estrogenic. Psidium guajava shows anti-diabetic effect by observing anti-diabetic activity in an invitro method [inhibition of alpha amylase enzyme].In vivo method streptozocin induced diabetic rats .The rats which were treated by guava leaf aqueous extract showed reduced maltase and sucrase levels in the mucosa of the small intestine of diabetic rat. 50% of maltase and sucrase levels are reduced (Mitchell s et; al 2008) [26].

2.14. BRASSICA JUNCEA

Its scientific name is Brassica juncea, or mustard. It belongs to the Cruciferae or Brassicaceae family. It consists of chemicals gallic acid, vanillic acid,

caffeic acid. Other pharmacological activities of mustard are anti-depressant, anti-inflammatory, anti-viral, anti-oxidative, anti-bacterial. Brassica juncea water extract shows anti-diabetic effect by in vivo method streptozotocin induced diabetic rat. Serum insulin levels were reduced in rats. (Lin LZ, Sun J et; al 2011) [27].

2.15. CORIANDRUM SATIVUM

Coriandrum sativum is a member of Apiaceae family. Which is commonly called as coriander, dhaniya. It contains bioactive components like flavonoids, terpenes, terpenoids, fatty acids, coumarins, tannins. (Laribi B, Kouki K et; al 2015) [28]. Other pharmacological activities are anti-microbial, anti-oxidative, anti-depressant, anti-inflammatory, anti-mutagenic. Ethanolic extract of coriander shows hypoglycaemic activity. In vivo method for anti-diabetic activity is carried out in male Swiss-webster mice. Invitro method is inhibition of alpha glucosidase enzyme. (Nadeem M et; al2013) [29]. Alpha glucosidase enzyme was reduced after injecting ethanolic extract of coriander and beta pancreatic cells are regenerated and their activity is improved. (Roberfroid MB et; al 1999) [30].

2.16. MUSA BALBISIANA COLLA

Musa balbisiana colla commonly known as banana. It belongs to family Musaceae. Musa balbisiana colla is commonly found in India, south east Asia, northern Australia. Phytochemical constituents of banana are phenolics, carotenoids, biogenic amines, phytosterols. Other therapeutic activities of banana are antioxidative, anti-cancer, anti-inflammatory, and anti-microbial. Ethanolic extract of banana shows anti diabetic activity. For anti-diabetic action in vitro method was inhibition of carbohydrate hydrolysing enzymes. (Mukundam borah, Swarna Moni das et; al 2017)

2.17. CAPSICUM ANNUM.

Capsicum annum L belongs to family Solanaceae. Synonyms of capsicum annum L are capsicum, bell peppers, sweet pepper. Capsicums are native to the Caribbean, northern South America, and southern North America. (Imran M, Butt MS et; al) [31]. Other pharmacological activities of capsicum are anti-cancer, anti-arthritis, anti-oxidative, cardioprotective activity, neuroprotective activity. It contains active constituents like flavonoids, carotenoids, phenolics, vitamins, saponins. Ethanolic extract shows anti-diabetic activity. In vivo method used for anti-diabetic was inhibition of alpha amylase enzyme. Streptozotocin induced diabetes rat was the in vivo method. Phytoconstituents present in capsicum shows excellent anti-diabetic activity. (Blanco-Ríos AK et; al 2013) [32].

3.RESULTS AND DISCUSSION

PLANT NAME	FAMILY	USEFUL PART	CHEMICAL CONSTITUENTS
Allium SativumLinn.	Liliaceae	Bulbs and Leaves	Alkyl Propyl, disulphide, Allicin, Cysteine, Sulfoxide, S-allylcysteine sulfoxide
Allium Cepa Linn.	Liliaceae	Bulbs	Cyaniding Glycosides, prostaglandins, Flavonoids, Sterols, phenols
Aloe vera Linn.	Asphodelaceae	Leaves	Polysaccharides, sugars, minerals, Lipids, Phenolic compounds, salicylic acid, lignin, Amino acids.
Momordica Charantia Linn	Cucurbitaceae	Fruit	Phytosterols, Terpenoids Fatty acids, phenolic compounds
Ocimum Sanctum Linn.	Lamiaceae	Leaves, stem	Alkaloids, Glycosides, Steroids, Phenolics, Tannins.
Panax Ginseng Linn.	Araliceae	Fruit	Pectin, Ginsenosides, saponin, Aldehydes, sesquiterpenoids.
Rosa Canina Linn	Rosaceae	Fruit	fatty acids, organic acids, carotenoids, vitamins, polysaccharides, triterpenes, and tannins
Punica Granatum Linn.	punicaceae	Fruit	Carbohydrates, flavonoids, quinines Glycosides, steroids, Phyto steroids Anthraquinone.
Salvia Rosmarinus			Phenols, flavonoids, salvianolic

Linn.	Lamiaceae	Leaves	acids, polyphenols, terpenoids.
Cinnamomun verum Linn	Lauraceae	Bark, Leaves	Cinnamaldehyde, eugenol, palmitic acid, caryophyllene, benzyl benzoate
Glycyrrhiza glabra Linn.	Fabaceae	Root	Glycyrrhizin, glycyrrhetic acid,isoliquiritin,isoflavones.
Trigonella foenum grecum Linn.	Fabaceae	Seeds	Pyridoxine, calcium pantothenate, biotin

4.CONCLUSION

The majority of the traditional medicinal plants that we utilize on a daily basis are excellent resources for the management of diabetes.

The ethnobotanical community is much more interested in medicinal plants that are used to treat hyperglycemic conditions because these plants are recognized to have many plant components with significant therapeutic effects. and because different plants have thought to have differential degrees of both hypoglycemic and anti-hyperglycemic activity.

The key ingredient in all modern medications, particularly in rural regions, is plant-based preparations. This is because:

- They are readily accessible.
- lower price
- Least harmful consequences
- In addition, the majority of plants contain a variety of bioactive substances with powerful pharmacological effects but no negative side effects. Therapy using conventional plants, usually referred to as herbal formulations, is crucial for naturally lowering diabetic complications. Moreover, traditional medicinal plants are needed to treat diabetes in underdeveloped nations, specifically to lower the economic burden that the populace bears from the use of standard dosage forms.

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Data availability

No data was used for the research described in the article.

Declaration of Competing Interest

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