Chapter-33

Pharmacological Evaluation of Medicinal Plants in Diabetes Mellitus

Authors

Sanjeev Kumar Vidyarthi
Assistant Professor
Department of Botany, Dr. L.K.V.D College
Tajpur, Samastipur- 848130, India
Email Id-skvpat25@gmail.com

Kumari Sushma Saroj
Assistant Professor
Department of Zoology, Dr. L.K.V.D College
Tajpur, Samastipur- 848130, India

Hari Mohan Prasad Singh
Assistant Professor
Department of Chemistry, Dr. L.K.V.D College
Tajpur, Samastipur- 848130, India

Abstract

Plants were utilized as medicinal assets in ancient times. Traditional remedies such as Chinese, Ayurvedic and folk medicine heavily relied on natural products. It is worth noting that a significant portion of the global population still relies on herbal remedies. The number of individuals with diabetes is projected to rise from 371 million in 2012 to 463 million by 2030. However, modern medicines often have adverse effects on patients, whereas herbal medicines tend to have fewer negative outcomes. This is due to the presence of secondary metabolites in plants, such as alkaloids, flavonoids, tannins, and steroids, which offer various beneficial effects on health. Medicinal plants possess great potential in treating various illnesses due to the presence of therapeutically important phytochemicals. Diabetes, being a critical metabolic disease, has numerous pharmaceutical options available to alleviate its

symptoms. Diabetic patients commonly turn to natural remedies for the treatment of diabetes mellitus. Most studies have focused on hydro-methanolic extracts to achieve a higher yield percentage. Some of the medicinal plants used include *Achyranthes aspera*, *Anacardium occidentale*, *Argemone Mexicana*, *Azadirachta indica*, and *Boerhaavia diffusa*. Furthermore, further research is recommended to validate the use of these medicinal plants as antidiabetic agents.

Keywords: Diabetes, Secondary Metabolites, Medicinal Plants

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1. INTRODUCTION

Diabetes mellitus, normally called diabetes, is a set of metabolic disorders characterized using hyperglycemia because of the faulty manufacturing, motion, or secretion of insulin [1]. Diabetes is the most common metabolic disorder affecting populations in all geographical regions of the world. Although no successful treatment has been found for Diabetes mellitus, it may be controlled using insulin, eating regimen changes, and traditional or artificial drugs. Notwithstanding their efficacy, synthetic drugs often gift detrimental aspects and consequences to patients and are especially high-priced and hard to obtain. Therefore, there have been increasing studies regarding conventional medicinal flowers to look for alternative hypoglycemic drugs [2, 3].

The maximum common forms of diabetes are type 1, type 2, and gestational diabetes [4]. Kind 1 diabetes is an autoimmune ailment, in which beta cells inside the pancreas are destroyed by using the immune device, resulting in absolute insulin deficiency, even as type 2 diabetes results from insulin resistance and the progressive loss of insulin secretion. In contrast, gestational diabetes takes place in the course of pregnancy [5]. Kind 2 DM is the most common fitness burden, mainly inside the aged population, affecting about 25% of human beings over the age of sixty-five years as of 2021, with the variety of affected humans anticipated to grow extensively over the next decades owing to accelerated lifestyles expectancy [6].

Vegetation generates secondary metabolites consisting of alkaloids, flavonoids, tannins, terpenoids, ferulic acid, and so on, which have demonstrated hypoglycemic activity. The inhibition of alpha-glucosidase by alkaloids results in lowered blood glucose by reducing glucose delivery through the intestinal epithelium. Flavonoids smother glucose ranges and increment hepatic glucose pastime, likely by upgrading affront dispatch from pancreatic

islets. Saponins, triterpenoids, and steroidal glycosides fortify affront dispatch and piece the arrangement of glucose interior of the circulatory system. Polysaccharides develop serum affront levels, make strides in glucose resilience, and decrease blood glucose ranges [7].

2. MEDICINAL PLANTS USED IN DIABETES

Achyranthes aspera, also known as the devil's whip, belongs to the Amaranthaceae family. It is believed that the roots of this plant have medicinal properties and can be used to treat jaundice [8]. This plant contains various chemicals such as alkaloids, oleanolic acid, β-sitosterol, saponins, D-glucuronic acid, quercetin-3-O-β-D-galactoside dihydroxy ketone, fatty alcohols, benzoquinone, hydroquinone, aaron, eugenol, and more. It is known to have hepatoprotective, laxative, anti-asthmatic, and anti-allergic effects [9]. Additionally, *Achyranthes aspera* may have antidiabetic effects by either reducing glucose absorption from the intestines or increasing glucose excretion from the blood [10].

Anacardium occidentale, commonly referred to as cashew nut or locally known as Kaju Badam, belongs to the Anacardiaceae family. The bark of this plant is known to possess hypoglycemic and antihypertensive properties and has been traditionally used to treat diabetes in African countries. Consumption of herbal leaves from this plant has also been associated with improving diabetes-related kidney problems by reducing the levels of mucopolysaccharides [11]. The stems, leaves, and bark of *Anacardium occidentale* are rich in phenols, saponins, flavonoids, nutrients, and selenium. It also contains various other substances that exhibit antibacterial, antimutagenic, and antifungal effects [12].

Argemone mexicana, commonly known as Mexican cactus poppy or locally as sialcanta plant, is an herb belonging to the Papaveraceae family. The roots, stems, and latex of this plant are used as a diuretic and for the treatment of skin diseases, jaundice, and diabetes [13]. The medicinal consumption of its root stalk, curry, emulsion, and juice is also practiced [14]. It also contains amino acids, fatty acids, tannins, saponins, flavonoids, and phytosterols [15]. It has been found to have analgesic, antidiabetic, anthelmintic, antioxidant, anti-inflammatory, antibacterial, antimutagenic, and anticancer properties [16]. Although the roots and other parts of the plant are usually non-toxic [17]. Therefore, *Argemone mexicana* has a wide range of therapeutic potential, but care must be taken when using its seeds [18]. Although the roots and other parts of the plant are usually non-toxic [19]. Therefore, *Argemone mexicana* has a wide range of therapeutic potential, but care must be taken when using its seeds [20].

Azadirachta indica, locally called neem, is a plant of the Meliaceae family [21]. This tree is commonly found in South Asia and Africa. The leaves, bark, oil, flowers, fruits, and gum are used to treat heart disease, cancer, diabetes, and high blood pressure [22]. *Azadirachta Indica* plants contain phenols, flavonoids, saponins, tannins, alkaloids, glycosides, carbohydrates, triterpenoids, beta-sitosterol, ferulic acid, and more. It has been suggested that it has antibacterial, antioxidant, and hepatoprotective properties [23,24, 25]. *Azadirachta indica* leaf extract exhibits antihyperglycemic effects by increasing the expression of insulin receptor protein, insulin receptor substrate 1, and its tyrosine phosphorylation (Tyr632), as well as the action of AKT and GLUT4 proteins [26].

Boerhaavia diffusa, also referred to as ragweed, is a species of flowering plant inside the Nyctaginaceae family. Various elements of the plant, in particular the roots, have been associated with anti-diabetic, anti-cancer, gastroprotective, and hepatoprotective homes. The plant contains steroids such as ecdysteroids, alkaloids, lignan glycosides, phenolic glycosides, flavonoids, isoflavonoids rotenoids, and many others. [27]. The ethanol extract of *Boerhaavia diffusa* reveals a therapeutic capacity for type 2 diabetes by inhibiting small intestinal glucose absorption and stimulating muscle glucose uptake [28].

Ethnobotanical studies have identified over 1200 medicinal plants used for managing diabetes mellitus [29]. Herbal medicines have been widely utilized by diabetic patients (80-85%) for treating diabetes mellitus [30]. Plant-derived drugs can also correct metabolic abnormalities and delay the progression of diabetic complications [31]. Previous research has shown that bioactive compounds isolated from plants with hypoglycemic effects exhibit greater efficacy than conventional medications used for diabetes management [32].

The World Health Organization recommends further research on plant-based medicines due to their perceived lower toxicity and side effects [33]. Globally, various extracts of medicinal plants have been used for managing diabetes mellitus, as they are considered to be relatively safer, with fewer side effects and lower costs [34]. Numerous bioactive compounds have been isolated from plant extracts for direct use or as lead compounds [35]. Different parts of medicinal plants have been experimentally studied for their anti-diabetic effects, with leaves being the most commonly investigated component. Plant-based products rich in phytoconstituents like flavonoids have shown promising potential in managing diabetes [36].

3. EXTRACTION OF MEDICINAL PLANTS

The anti-diabetic properties of the raw extracts and solvent fractions from various parts of medicinal plants, as well as the use of specific chemical compounds, have been studied. The research was conducted using hydro-methanolic extracts to achieve a higher yield. Notably, 80% methanol has shown to be more effective in breaking down cell walls and seeds, while also exhibiting low or no enzyme activity compared to water. Additionally, the methanolic extract of the medicinal plant contains a wide range of polar (and somewhat nonpolar) substances [37]. Hydro-methanol was the most commonly used solvent for extracting medicinal plants, followed by aqueous and ethanol solvents. In terms of solvent fractionation, chloroform was the most frequently used solvent. Various parts of medicinal plants have been experimentally tested for their antidiabetic effects in India [38].

4. CONCLUSION

These herbal remedies are becoming increasingly important due to their effectiveness and superior therapeutic outcomes with fewer side effects. Medicinal plants that are abundant in phytochemicals such as flavonoids, coumarins, terpenoids, phenolic compounds, and other bioactive compounds have shown significant potential in lowering blood glucose levels. Ultimately, we recommend ensuring future success in the clinical research and development of new diabetes treatments using these medicinal plants.

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