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The Use of Herbal Preparation in the Management of Type-II Diabetes Mellitus: A Review Article



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ABSTRACT

Diabetes is a serious chronic disease that occur either when the pancreas does not produce enough insulin or a hormone that regulate blood glucose level. Diabetes mellitus one of the major disorders which is growing at faster rate second after the cancer. India faces several challenges in diabetes management, including a rising prevalence in urban and rural areas, lack of disease awareness among the public, limited health care facilities, high cost of treatment, suboptimal glycemic control and rising prevalence of diabetic complications. There is an increase in the prevalence of type-1 diabetes also, but main cause of diabetes outbreak is type 2 diabetes mellitus, which are present more than 90% of all diabetes cases. Type 2 diabetes is a serious and common chronic disease resulting from a complex inheritance- environment interaction along with other risk factors such as obesity and sedentary life style. There are various types of synthetic drugs that helps in diagnose type 2 diabetes mellitus but it shows various adverse effect like cardiovascular problem, kidney damage, nerve damage, hypersensitivity, vision loss. Due to this, there is no permanent remedy available which can help to get recovered completely from this disorder. That's why herbal preparation are used because they shows lesser side effect, low cost, permanent cure, safe and eco-friendly than synthetic drugs. This review focused on Indian herbal preparation which helps to reader to understand the importance of various types of herbal preparation present traditionally which can be used type 2 DM.



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INTRODUCTION- (1,2,3)

As per ayurveda diabetes or madhumeha is a disease in which improper functioning of insulin and as a result sugar level in the blood increases. (1) Diabetes may cause cardiovascular problem, kidney failure and blurred vision if not treated timely. (2) From the ancient Indian herbalist such as Charak and Sushruta many herbal medicines in different oral formulation have been suggested in madhumeha and confident claim of cure are on record. (1)

Types of Diabetes-

The older classification diving diabetes mellitus based on etiology into following four groups.

- 1) Type 1 diabetes mellitus
- 2) Type 2 diabetes mellitus
- 3) Gestational diabetes
- 4) Impaired glucose tolerance.(3)

Table No. 1. Classification of diabetes mellitus: (2,3)

Types	Condition	Age	Severity	Risk factor	Treatment
Type -1	Body fails to production of insulin. Also destruction of B-cells.	In childhood and early adulthood.	10 %	Environmental factor, nutritional factor and destruction of immune system.	Insulin injection.
Type-2	Delayed insulin secretion and excessive glucagon secretion.	Age of 40 years.	80%	Obesity, family history, defect in insulin receptor and history of gestational DM.	By using synthetic drug. . By using natural drug.
Gestational diabetes	Hormonal changes in during pregnancy.	Any phase of pregnancy.	4 %	Metabolic change.	Regular exercise and proper diet.
Impaired glucose tolerance	Transition state between normality and diabetes mellitus.	Older than 50 years.	6 %	Hypertension, smoking, family history and increasing age.	Proper diet, daily exercise, antidiabetic medication.

Global Burden- ⁽⁴⁾

According to IDF diabetes atlas 2022 report there are 537 million adults (20-79 years) are living with diabetes – 1 in 10. This number is predicted to rise to 643 million by 2030 and 783 million by 2045. Over 3 in 4 adults with diabetes live in low- and middle-income countries. Diabetes is responsible for 6.7 million deaths in 2021 1 every 5 seconds. Diabetes caused at least USD 966 billion dollars in health expenditure a 316% increase over the last 15 years. 541 million adults have Impaired Glucose Tolerance (IGT), which places them at high risk of type 2 diabetes.

Type 2 DM : ^(2,3,5)

Type 2 diabetes mellitus is a chronic disease in which high levels of sugar in the blood occurred. Type 2 diabetes is also known as adult-onset diabetes. However, developing time of period in more and more children and teens are seen this condition. ⁽³⁾ Type 2 diabetes is much more common than type 1 diabetes and is really a different disease. But it compares with type 1 diabetes high blood sugar levels, and the complications of high blood sugar. During digestion, food is broken down into basic components like, carbohydrates are broken down into simple sugars called glucose. Glucose are important source of energy for the body's cells. To provide energy to the cells, glucose needs to leave the blood and get inside the cells. ⁽⁵⁾ Insulin is a hormone produced by the pancreas which are organ in gastrointestinal tract. When levels of glucose in the blood rise the pancreas produces more insulin. Type 2 diabetes occurs when your body's cells resist the normal effect of insulin, which is to drive glucose in the blood into the inside of the cells. This condition is called insulin resistance. As a result, glucose starts to build up in the blood. ⁽²⁾

History- ^(6,7)

In many researchers have observed the effect of diabetes for hundreds of years. For many years, little data was known about this fatal illness that caused squandering without end of the body, excessive thirst, and frequent urine excretion. It wasn't until 1922 that the first patient was effectively treated with insulin. One of the major complications of diabetes is the increase level of glucose excrete in the urine. The Indian physicians Sushruta in about 400 B.C. proposed the sweet taste of urine from diabetic effective people and for a many hundreds of years, the sweet taste of urine was a key point to diagnose the disease of diabetes. Around 250 B.C. the name "diabetes" was first utilized which are a Greek word that

meaning “to siphon” reflecting how diabetes appeared to quickly drain fluid out of the affected person. The Greek doctor Aretaeus noticed that as effected people wasted away, they passed expanding measures of urine as if there seemed to be “liquefaction of flesh and bones into urine”. In 1674 by Thomas Willis was discovered the term “Diabetes mellitus” which are personal doctor of King Charles II. Mellitus is Latin word for sweet honey which is the means by which Willis represented the urine of diabetics.

In 1936, Sir Harold W. Percival published research in that he differentiated between type 1 & type 2 diabetes. In that research he said that the many people had insulin resistance rather than insulin deficiency. Insulin resistance is one of the major factors that leads to type 2 diabetes mellitus.

From that research we known the two new concepts like, “Insulin sensitive” & “Insulin insensitive” means type 1 & type 2 respectively. As recently 20 years ago type 2 diabetes mellitus was not observed in children. In fact, it was once referred to as “adult-onset diabetes”. But in past two decades more cases began appearing in children & teenagers due to their poor eating habits, lack of exercise & excessive weight. In 1988, Type 2 diabetes mellitus was firstly described as a component metabolic syndrome.

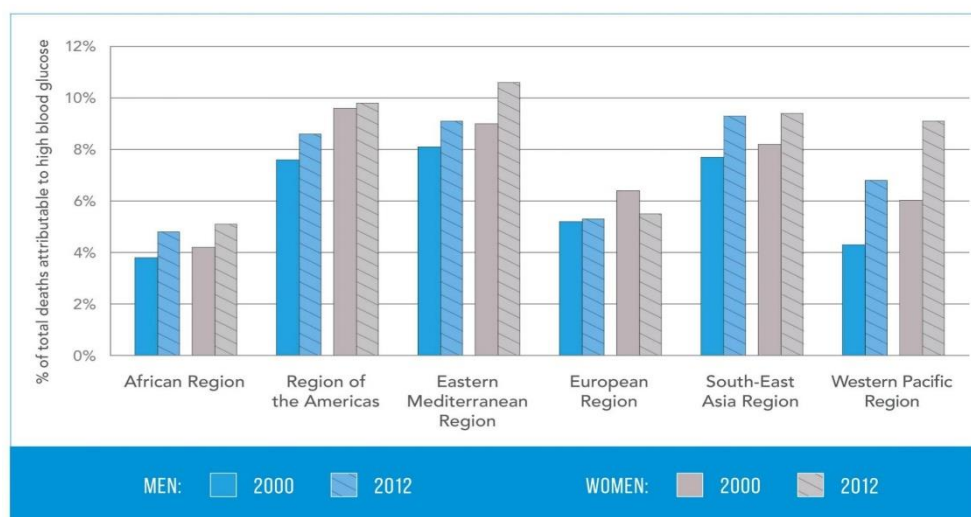
Pathophysiology-^(3,8)

- 1) Pancreas continues produce some endogenous insulin production from β -cells or also poorly utilized it by the tissue (insulin resistance).
- 2) Insulin resistance are the them in which inability of cell to response adequately to normal circulating insulin, which process occurs firstly in muscle, liver & fat tissue.
- 3) In insulin resistance condition liver inappropriately release glucose into the blood (leads to hyperglycemia). Not only insulin resistance develops DM but also a dysfunction of pancreatic β -cell is responsible for production of DM.
- 4) Dysfunction of pancreatic β -cells are represented by the inability to produce sufficient amount of insulin genetic factor. A person with one parent having T2DM is at an increased risk of getting diabetes, but if both parents have T2DM the risk in offspring rises of 40%.

Epidemiology – (4)

The IDE estimate nearly 537 million people lived with diabetes mellitus worldwide in 2021 out of them 80% of people whom have T2DM & other 20% of people whom have T1DM & gestational DM.

Percentage of all deaths attributable to high blood glucose for adults aged 20–69 years, by who region and sex, for years 2000 and 2012 :⁽³⁸⁾



Sign & symptoms-^(3,9)

The following sign & symptoms are arising during the diabetes mellitus like increase thirst, polydipsia, polyuria (frequent urination), weight loss, blurred vision, extremely paresthesia (numbness or tingling feet's in hands & feet).

Causes-^(2,3,9)

Cells in muscle, liver & fat (peripheral tissue) become insulin resistance which means they no longer respond to insulin & they are unable to absorb use of glucose. The β -cell of pancreas are unable to produce sufficient amount of insulin to manage blood sugar level.

Diagnosis -^(3,10,11)

The diabetes can be measured by analyzing the blood sugar levels. The blood sugar level in healthy man on fasting are 80 mg/dl and in postprandial state is up to 160 mg/dl.^(3,10) Different test for diagnosed of diabetes in laboratory are finger prick blood sugar test, fasting blood sugar, glucose tolerance diagnostic test, glycohemoglobin.⁽¹⁰⁾

Table No. 2. Test results for diagnosis of prediabetes & diabetes ⁽¹¹⁾

Diagnosis	A1C	Fasting Plasma Glucose	Oral Glucose Tolerance Test
Normal	below 5.7%	99 mg/dL or below.	139 mg/dL or below.
Prediabetic	5.7% to 6.4%	100 to 125 mg/dL.	140 to 199 mg/dL.
Diabetes	6.5% or above	126 mg/dL or above.	200 mg/dL or above.

Treatment –

Treatment of DM without any side effects are a biggest question in the medical practitioners.

SYNTHETIC PREPRATION - ^(2,12,13)

Different categories of antidiabetic medications are present in the market which are used in daily life. In which includes insulin analogues, sulphonylureas, biguanides, dipeptidyl peptidase-4 inhibitors, thiazolidinediones, a-glucosidase inhibitors, etc. Where the mechanism of this are increased glucose level is different for different categories. Which are shown in the following tabel no. 4 with their side effects.

Table No. 3. Examples of synthetic drug of type 2 diabetes mellites with their side effects ^{;(14)}

Sr.No.	Drug	Action	Side effects
1)	Metformin	Lowering glucose production in the liver improve body sensitivity to insulin.	Nausea, bloating and abdominal pain.
2)	Sulfonylureas	Help to body secrete more insulin.	Low blood sugar level and weight gain.
3)	Glinides (Biguanide)	Stimulate pancreas to secrete more insulin.	Low blood sugar level and weight gain.
4)	Thiazolidinediones (Glitanide)	Make body tissues more sensitive to insulin.	Risk of CHF, bladder cancer, bone fracture, cholesterol.
5)	DPP 4 inhibitors	Help to reduce sugar level.	Risk of pancreatitis and joint pain.
6)	SGLT 2 inhibitors	Inhibit the retrun of glucose is excreted in the urine.	Risk of amputation, bone fracture, vaginal yeast function, high cholesterol and urinary tract infection.

However, synthetic drugs which are used for treatment of type 2 diabetes mellitus are associated with various adverse effect such as sickness, vomiting, dysentery, alcohol flush, migraine, swelling, malignant anemia and faintness. Synthetic drugs not permanently cure the disease that's why herbal preparation are used.^(12,13)

HERBAL PREPRATION- ^(12,13)

Herbal preparation contain natural herbs, fruits and vegetables extract which are beneficial in treatment of various diseases without any adverse effect. Herbal formulations are easily available without prescription. Herbal preparation are ecofriendly and cheap. These Drugs are also used when chemical drugs are ineffective in treatment of disease. These are natural and safe drugs.

Advantages of herbal preparation: ⁽¹⁰⁾

Synthetic drugs are not permanently cured the disease while herbal drugs permanently cure the person and their disease. Herbal drugs are proved to be better choice over synthetic drugs because of less side effects.

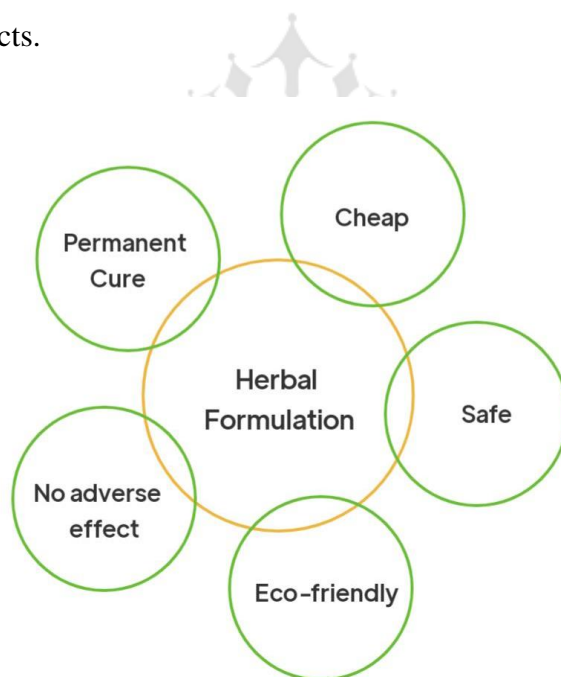


Fig-1. Advantages of herbal preparation

❖ *Catharanthus roseus* :^(15,16)



Fig-2. Flowers of periwinkle

Catharanthus roseus is a flowering plant belongs to the family Apocynaceae. It is also known as Madagascar periwinkle, *Vinca rosea* worldwide.⁽¹⁵⁾ It's flowers, leaves and roots have long been used as a natural medicine for diabetes as well as other ailment in the ayurvedic system of medicine. It is composed of several compounds with confirmed anti-diabetic properties like Vincristine, Vinblastine.⁽¹⁶⁾

• **Mechanism of action :**⁽¹⁷⁾

C. roseus is probably mediated through enhance secretion of insulin from the β -cells of Langerhans or through extra- pancreatic mechanism.

• **Preparation:**⁽¹⁷⁾

Fresh leaves of *C. roseus* (pink variety) were collected and were crushed in a stainless steel mortar and Squeezed by means of a fine cloth to separate the juice.

• **Dose :**⁽¹⁸⁾

Traditional doses have included 10 leaves & 10 flower boiled in water as a tea, or 9 pink flowers in 0.5 L of water for 3 hours (“solar tea”) sipped throughout the day.

• **Precaution:**⁽¹⁹⁾

There is no reliable safety data regarding the use of catharanthus during pregnancy and breast feeding. Therefore it is strictly advised to consult a doctor and take essential precautions if you plan on adding this herb to your dietary routine.

❖ **Bitter melon :** ⁽²⁰⁾



Fig-3. Bitter melon

Bitter melon are scientifically known as *Momordica charantia* belong to family Cucurbitaceae. It is also known as Balsam pear, is a tropical vegetable widely cultivated in Asia, Africa and South America, and has been used extensively in folk medicine as a remedy for diabetes. It is very popular for its anti-diabetic properties. It's also rich in micronutrients, which are required for prevention of complications of diabetes. The blood sugar lowering action of the fresh juice or extract of the unripe fruit has been clearly established in both experimental and clinical studies. *Bitter melon* is composed of several compounds with confirmed anti-diabetic properties, like charantin, momordica, insulin-like polypeptide called polypeptide-P.

• **Mechanism of action:** ⁽²¹⁾

M. charantia can stimulate insulin secretion from the endocrine pancreas and elicit glucose uptake in the liver.

• **Preparation:** ⁽²²⁾

- 1) Take 2 large bitter gourds then washed it with water and cut into halves. Scoop out the rind and seeds.
- 2) Then take a slices of 2 bitter gourds and soak the pieces in salt water for 10 minutes.
- 3) After that extract the juice of the vegetable using a juicer.
- 4) Squeeze half a lemon juice, a teaspoon of turmeric powder and a pinch of salt to the bitter gourd juice.

• **Dose:** ^(22,23)

Drink 50-60 ml of the juice orally once a daily on an empty stomach to keep your diabetes under control and shown good result.

• **Precaution:** ⁽²²⁾

Excessively high doses of bitter melon juice can cause abdominal pain and diarrhea. Pregnant women should not consume bitter melon juice in any form because it may increase the risk of bleeding, contraction and pregnancy loss. Small anyone with hypoglycemia should not take bitter melon, since this herb could theoretically trigger or worsen low blood sugar, or hypoglycemia.

❖ ***Syzygium cumini*** : ^(24,25)



Fig-4. Jamun

Syzygium cumini belongs to family: Myrtaceae. Jamuns are one of India's favorite summer fruits, known to have numerous health benefits. Commonly known as the Indian blackberry, java plum, or black plum. They are rich in protein, fiber, antioxidants, flavonoids, calcium, iron, phosphorus, potassium, manganese, vitamin C and B6, and several other nutrients. The goodness of jamuns isn't just limited to just the fruit, the seeds, which are often removed before consumption, are in fact rich in nutrients as well. The seeds are also known for their anti-diabetic properties, which can help patients with severe blood sugar levels. A jamun seed extracts reduced blood glucose levels significantly, and regulated insulin levels in hyperglycemic rats. It added that the seeds have a potent prophylactic role against hyperglycaemia. The best way to consume jamun seeds is in the form of powder, which can be mixed with water or milk on a daily basis.

• **Mechanism of action :** ⁽²⁵⁾

Jamun may have reduced free radicals and improved the functioning of β -cells of pancreas reducing the sugar level. Jamun also stimulates the activation of different enzymes like catalase glutathione peroxidase, glutathione-s-transferase and increased synthesis of

glutathione and reduced lipid peroxidation that may have also helped to reduce the sugar cholesterol levels in the blood.

• **Preparation:** ⁽²⁴⁾

- 1) Separate the seeds from the fruit and wash them thoroughly by using water to make sure that no fleshy part of the fruit remains on the seed of fruit.
- 2) Keep the seeds to sun-dry on a clean cloth for at least three to four days. Once dried, peel off the outer shell and keep just the green inner core of the seeds.
- 3) This core can be broken into two half pieces by pressing the seeds. Then again sun-dry them for a few more days.
- 4) Once they are dried thoroughly, powder them in a grinder.
- 5) Sieve the coarse powder and store seed powder in a air tight container and consume it by mixing it with water or milk.

Apart from helping with managing diabetes, it is believed that the powder also helps in a good detox, eliminating toxins from the body. It is also recommended for boosting metabolism and also for good digestion.

• **Dose:** ⁽²⁶⁾

Take a glass of a water and add one tablespoon of jamun powder to it. Stir well and drink this early morning. You may also consume it with low fat dairy milk or almond milk twice a day before meals to maintain healthy blood sugar level.

• **Precautions:** ⁽²⁶⁾

Jamun seed powder must be avoided before one week and a minimum of two weeks after surgery as it may have adverse effect on healing. Eating of Jamun empty stomach and also after drinking of milk may produce adverse effect. Breast feeding mothers and pregnant women should not eat jamun seed powder. Eating of powder in excess amount may lead to cough, sputum accumulation in lungs, body ache and fever. Always consult your doctor about your diabetes medication before consuming jamun seed powder.

❖ **Fenugreek :** ⁽²⁷⁾



Fig-5. Seeds of fenugreek

Fenugreek are scientifically known as *Trigonella foenum-graecum* belongs to family Fabaceae. It is one of the oldest cultivated medicinal plants. In fact, several beneficial effects on health, attributed to the consumption of fenugreek, have been demonstrated during tests in both animals and humans.

• **Mechanism of action:** ⁽²⁸⁾

The fiber content of fenugreek has been attributed to its ability to inhibit lipid and carbohydrate-hydrolyzing enzymes in the digestive system, which is a well-established mechanism by which fiber has been shown to inhibit lipid and glucose absorption and thereby decrease postprandial hyperglycemia and hyperlipidemia.

• **Preparation:** ⁽²⁹⁾

1) Fenugreek water is also very beneficial in controlling blood sugar levels. Put one teaspoon of fenugreek seeds in a glass of warm water and leave it overnight.

2) Filter it the next day and drink it on an empty stomach.

• **Dose :** ^(30,31)

Daily dose of 10 gram of soaked fenugreek seeds an empty stomach.

• **Precaution :** ⁽³²⁾

Pregnant women should not use fenugreek seeds because it may induce uterine contraction. Also women with hormone sensitive cancers should not use it can cause allergic reaction.

❖ **Carica papaya :**⁽³³⁾



Fig-6. Carica papaya

Carica papaya belongs to family Caricaceae. It is a medicinal plant that is generally distributed in the tropical regions of Africa. Seeds of *C. papaya* are usually regarded as waste materials after processing and consumption of the edible fruits. These waste materials incorporate unlimited opportunities for new medicine. Diverse secondary metabolites embedded in the *C. papaya* seeds with no elicit signs of toxicity.

• **Mechanism of action :**⁽³³⁾

The competitive mechanism of action of *Carica papaya* seed subfraction K could be due to its inhibitory effects on both amylase and glucosidase. This may be due to the presence of bioactive compounds detected in the subfraction.

• **Preparation:**

A) Preparation of papaya leaves juice:⁽³⁴⁾

- 1) Take a some fresh papaya leaves and washed with water. Start a cutting off the stem.
- 2) Now chop the leaf, just like you would chop cabbage and add it to the blender with some water.
- 3) Just churn it and the juice is ready. You can add a bit of salt to make the juice taste better.

B) Preparation of papaya seed powder:⁽³⁵⁾

- 1) Take 8 to 10 dried seeds were crushed and grinded in a mixer grinder and coarse powder was prepared.
- 2) Extract of the dried seed powder was prepared in boiling water. The extract was filtered and dried at sunlight.

3) The obtained powder was in chocolate color with aromatic odor.

• **Dose :**^(34,36,37)

One can have up to 100 ml of papaya leaf juice in three parts during a day.

Also, you can consume one cup of papaya daily (3 or 4 thin slices).

You can consume about 30 ml of papaya leaf juice before breakfast. But make sure to consult your doctor before consumption if you are under medication.

• **Precaution:**⁽³⁴⁾

Papaya contains an enzyme papain. If you consume papaya in more than normal quantities, it may lead to respiratory disorders like asthma and wheezing. Woman avoid papaya juice during pregnancy because may result in miscarriage.

CONCLUSION-

Diabetes mellitus is a serious complication in today's life. The lifestyle and day to day situations are play major role in occurring this type of serious complications. According to the data there are many peoples are suffering from type 2 diabetes mellitus & still undiagnosed. The synthetic formulation against the diabetes mellitus is available in market. They are showing excellent clinical and pharmacological activity in diabetic patients but they have significant adverse effect. So, it is necessary to aware the people who are suffered from type 2 diabetes mellitus to treat this disorder by using herbal preparation which is showing antidiabetic action. In this review paper we have provided the information of herbal preparation which are easily available or easy to prepare. The herbal drugs and their preparation discussed in review have shown potent antidiabetic activity with minimum side effect. Hence herbal drugs are preferred over synthetic drug to avoid serious side effects and adverse effects.

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REFERENCES-

- 1) Soniya Verma, Madhu Gupta, Harvinder Popli, Geeta Aggarwal. Diabetes mellitus treatment using herbal drugs . April 2018 International Journal of Phytomedicine 10(1):01.
- 2) K. D. Tripathi. Essentials of Medical Pharmacology. JAYPEE health science publisher. 8th edition 2019 .
- 3) Harsh Mohan. Pathophysiology . JAYPEE health science publisher.8th edition. 2019.
- 4) IDF diabetes Atlas 2022 reports .
- 5) Harvard Health Publishing harvard medical school, Type II diabetes mellitus Feruary 23, 2022.
- 6) Firoz Khan, Prem Prakash Khosla. To study the effect of sprouted fenugreek seeds as nutraceutical as an add-on therapy in patients of diabetes mellitus, obesity and metabolic syndrome.Pharmacy and Pharmacology International Journal. Volume 6 .
- 7) Dwiti Modak. A review : Antidiabetic activity of herbal drugs. Pharma Eutor ; 3(9) 36-42 .
- 8) Santwana Padhi a, Amit Kumar Nayak b, Anindita Behera. Type II diabetes mellitus: a review on recent drug based therapeutics. Biomedicine and Pharmacotherapy. Pharmacotherapy 2020 . Volume : 131.
- 9) Yanling Wu, Yanping Ding, Yoshima Tanaka , and Wen Zhang. Risk Factors Contributing to Type 2 Diabetes and Recent Advances in the Treatment and Prevention. International Journal of Medical Science. 2014; 11(11): 1185–1200. Published : 2014 Sep 6.
- 10) Soniya Verma, Madhu Gupta, Harvinder Popli, Geeta Aggarwal. Diabetes mellitus treatment using herbal drugs . April 2018 International Journal of Phytomedicine 10(1):01
- 11) American Diabetes Association Professional Practice Committee. Standard of medical care in diabetes – 2022. Diabetes Care. 2022;(suppl 1): 1-16.
- 12) Kumar K, Fateh V, Verma B, Pandey S. Some herbal drug use for treatment of diabetes. Review article: International volume 2014.
- 13) Galor SW, Benzie IF. Herbal medicine: an introduction to its history, usage, regulation, current trendsand; Research needs. 2011.
- 14) Adedapo AA and Ogunmiluyi IO . The use of Natural products in the Management of Diabetes : The current Trends .Journal of Drug Delivery and Therapeutics. 2020;10(1):153-162.
- 15) Tummala D. Therapeutic Efficacy and Antihyperglycemic Properties of Catharanthus roseus for Diabetes Mellitus: A Systematic Review. International Journal of Diabetes Clinical research. Volume :8 (Issue :4) 2021.
- 16) Kurana Rasineni, Ramesh Bellamkonda and Saralakumari Desireddy. Antihyperglycemic activity on Catharanthus roseus leaf powder in streptozotocin – induced diabetic rats. Pharmacognosy research 2 (3): 2010 .195 – 201.
- 17) Srinivas Nammi, Murthy K Boini and Ravindra Babu S Behara. The juice of fresh leaves of Catharanthus roseus Linn. reduces blood glucose in normal and alloxan diabetic rabbits. BMC complementary and alternative medicine : 3 , Article number : 4 (2003)
- 18) Duke J, Bogenschutz GM, Duke P. Handbook of Medicinal Hearbs. 2nd Boca Raton, FL: CRC Press ; 2022.
- 19) Periwinkle uses , benefites and dosage . Drug.com Hearbal Database. Aug 22, 2022.
- 20) Adedapo AA and Ogunmiluyi IO. The use of natural product in management of diabetes : The current trend . Journal of drug delivery and therapeutics 2020 ; 10(1) :153-162 .
- 21) Jeong J, Lee S , Hue J, Lee K, Nam SY, Yun YW. Effects of bittermelon (Momordica Carantia) on antidiabetic activity in C57BL/6J db / db mice. Korean J Vet Res. 2008; 48(3): 327-336.
- 22) Natalie Butler, R.D , L. D. , Lana Barhum. How does bittermelon affect blood sugar levels ? Medical News Today . May 7, 2019.
- 23) Longjam Dineshwor. If you have diabetes, drink bitter gourd or karela juice daily in the morning. The Health Site. December 14 , 2020.
- 24) Anjali krishnan. Jamun seed powder to manage diabetes. Tha better India 2022 .
- 25) Jagetia GC. Review on the role of jamun, Syzygium cumini skeels in the treatment of diabetes. International Journal Compliment Alt Med. 2018;(2):94 .
- 26) Dr. Pakhi Sharma. Known How to Use Jamun Seed Powder. Diabetes Phable Care. June 9, 2022.
- 27) Myriam Sfar, Aya Jaouani, Kamel Ben-Mahrez, Hajer Aounallah Skhiri, Chihab Ben Rayana, Rachid Chemli, Faika Ben Mami , Fethi Ben Slama. The Effect of Fenugreek on Blood Glucose, Lipid Parameters,

Insulin and Resistin in Obese Women with Type 2 Diabetes. Human Journals Research Article February 2018 Vol.:11, Issue:3 .

28) Scott Fuller and Jacqueline M Stephens. Diosgenin , 4-Hydroxyisoleucic acid and fiber from Fenugreek : Mechanism of action and potential effect on metabolic syndrome. *Advanced in nutrition* 2015.

29) Genet Alem Geberemeskel , Yared Godefa Debebe, and Nigisty Abraha Nguse. Antidiabetic Effect of Fenugreek Seed Powder Solution (*Trigonella foenum-graecum L.*) on Hyperlipidemia in Diabetic Patients. *Journal of diabetes research* 2019.6(2) : 189:197.

30) Nazil Kassaian , Leila Azadbakht, Badrolmoolok Forghani, Masud Amini. Effect of fenugreek seeds on blood glucose and lipid profiles in type 2 DM patients. *International Journal Vitamin Nutrition Research*. 2009.

31) Jack N Losso, Darryl L Holliday, John W Finley, Roy J Martin, Jenifer C Rood. Fenugreek bread: a treatment for DM. *Journal Medicinal Food*. Oct 2009 .

32) Kathy W. Warwick, R.D. , CDE, Rena Goldman and Tim Jewell. Diabetes : can fenugreek lower my blood sugar ? Feb 5, 2020 .

33) Reuben Agada and Dluya Samuel Thagriki. In vitro antioxidant and antidiabetic activities of *Carica papaya* Seed extract. *Journal of Medicinal Plants Review*.

34) Papaya leaf juice: Health benefits, how to make and the right way to consume. *TIMES OF INDIA*. Jan 20, 2021.






35) Venkateshwarlu E , Dileep P, Rakesh Kumar Reddy P, Sandhya P. Evaluation of anti diabetic activity of carica papaya seeds on streptozotocin- induced type-ii diabetic rats. *Journal of Advanced Scientific Research*, 2013, 4(2):38-41 .

36) Shifa Fatima, Dr. Apoorva T, MHM. Is Papaya Good For Diabetes ? *Sugar.fit*. April 6, 2022.

37) Anchal Mathur. How to make papaya leaf juice to increase Blood Platelets, Improve Digestion and Manage Diabetes. October 21, 2021 .

38) Global report on diabetes, World Health Organization
<https://www.who.int/publications/i/item/9789241565257>



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