Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 11, 2024

A Review Article on Phytochemical Constituent of Jamun Seeds for The Management of Type:2 Diabetes.

Vijay Solanki[1*], Ms. Purvi Ramanuj[2], Dr. Pragnesh Patani[3], VV Shrinidhi[4]

[1*]Student**,** Khyati College of Pharmacy, Palodiya, Ahmedabad

[2]Associate Professor, Department of Pharmaceutical Chemistry & QA, Khyati College of Pharmacy, Palodiya, Ahmedabad

[3]Principal, Khyati College of Pharmacy, Palodiya, Ahmedabad

[4]Student, Khyati College of Pharmacy, Palodiya, Ahmedabad

***Corresponding Author:** Vijay Solanki
*****Student**,** Khyati College of Pharmacy, Palodiya, Ahmedabad, Email: solankivijay3232@gmail.com

Abstract
Diabetes mellitus (DM) also known as diabetes, is a group of metabolic diseases in which there are high blood sugar levels over a longer period. This high blood sugar produces the symptoms of urination, increased thirst, and increased hunger. There are two types of diabetes. Type-1 diabetes is a chronic autoimmune disease characterized by insulin deficiency. Type-2 diabetes occurs when the body's cells don't respond properly to insulin or the pancreas doesn't produce enough insulin to control blood glucose levels. In the ayurvedic system of medicine, Jamun seeds are considered as an excellent remedy for diabetes. Jamun seeds are highly valuable and used for thousands of years by the people as the medicine to cure diabetes.

Keywords: Diabetes mellitus, Jamun (Syzygium Cumini), anti-diabetic properties, Jambosine, Ellagic Acid

1. Introduction:

Diabetes Mellitus (DM) is a common endocrine disorder that affects 6% of the population worldwide [1]. The number of people with type 2 DM is increasing in every country with 80% of people. The International Diabetes Federation (IDF) estimated an overall prevalence of diabetes mellitus to be 366 million in 2011, and predicted a rise to 552 million by 2030.[2]

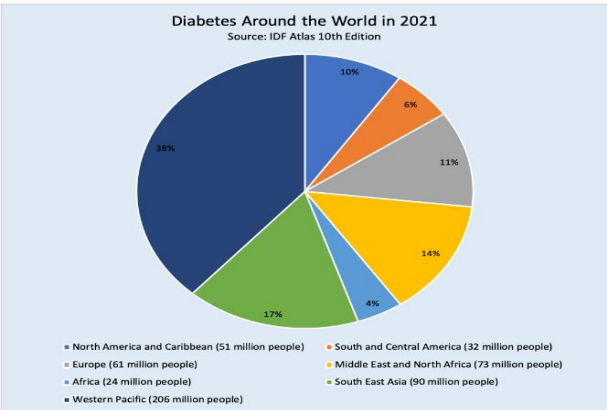


Fig: 1 Worldwide Diabetes

DIABETES: Diabetes mellitus (DM) also known as diabetes, is a group of metabolic diseases in which high blood sugar levels over a prolonged period [1]. The body does not produce enough insulin, or because cells do not respond to the insulin that is produced. They may damage many of body systems particularly blood vessels, eyes, kidney, heart and nerves.[3] Diabetes was first documented by the Egyptians and is characterized by weight loss and polyuria. However, it was the Greek physician Aertaeus who coined the term Diabetes Mellitus (DM). In Greek, diabetes means "to pass through" and mellitus is the Latin word for honey [4]

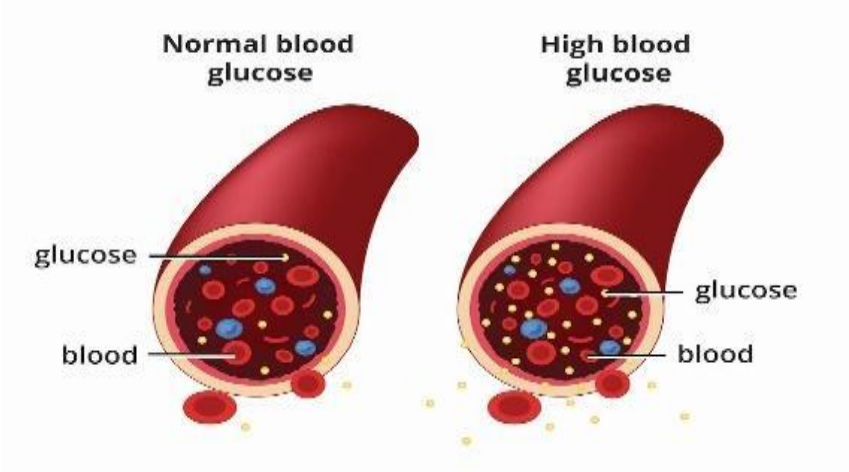


Fig: 2 Glucose level in two different blood-vessel

TYPES OF DIABETES:
There are two types**:**
I.Diabetes Type:1
II.Diabetes Type:2

Diabetes Type-1: Type I diabetes mellitus is also known as insulin- dependent diabetes mellitus (IDDM), this occurs mainly in children and young adults; the onset is usually sudden and can be life threatening [4]. Type 1 diabetes is a chronic autoimmune disease characterized by insulin deficiency. Type -1 diabetes has rapidly increased over the past 25 years, resulting in a broad understanding about many aspects of the disease, including its genetics, epidemiology, immune and β-cell phenotypes, and disease burden [5]. It is characterized by immune-mediated destruction of pancreatic β-cells resulting in insulin deficiency. This results in a common biochemical end-point of hyperglycemia and risk of ketoacidosis, but the clinical presentation varies widely depending on the rate and degree of β-cell failure[6] .Type 1 is usually characterized by the presence of anti–glutamic acid decarboxylase, islet cell or insulin antibodies which identify the autoimmune processes which leads to beta-cell destruction. Type 1 diabetes due to the destruction of b-cell which is usually leading to absolute insulin deficiency [7].

Diabetes Type-2: Type-2 diabetes is a chronic disease that affects the way your body metabolizes carbohydrates, fats and proteins. A defective insulin secretary response results in poor use of carbohydrates (glucose) and hyperglycemia. [7]
It begins as insulin resistance, a disorder in which normal to excessive amounts of insulin is made by the body, but the cells cannot use insulin properly. Type 2 diabetes is associated with obesity, family history of diabetes, impaired glucose tolerance & physical inactivity. It's caused by a combination of genetic, environmental, and behavioral factors. [8] Insulin is the hormone responsible for regulating blood glucose levels. When diabetes is not controlled, it can lead to hyperglycemia or high blood glucose levels. Over time, high blood glucose levels can cause severe damage to many parts of the body, including nerve cells and blood vessels [9].

No cure has yet been found for the disease; however, treatment modalities include lifestyle modifications, treatment of obesity. Other effective medications include non-sulfonylurea secretagogues, thiazolidinediones, alpha glucosidase inhibitors, and insulin. [10]

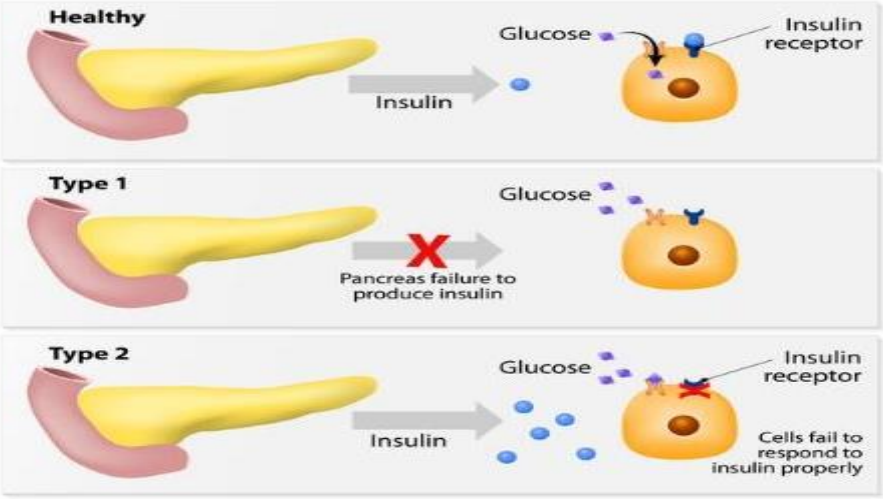


Fig: 3 Types of Diabetes Mellitus

Risk factors: [10-12]

Type 2 diabetes risk factors include the following:

i. **Weight:** Having too much belly fat increases your chance of getting type 2 diabetes. Extra weight in body - Higher risk of type 2 diabetes.
ii. **Family history**: Type 2 diabetes has a genetic component, and many people with the disease have a close relative with it too. The risk of developing type 2 diabetes increases with the number of affected family members7.
iii. **Blood lipid levels**: An increased risk is associated with low levels of high-density lipoprotein (HDL) cholesterol — the "good" cholesterol — and high levels of triglycerides.
iv. **Age**: The risk of type 2 diabetes increases with age, especially after age 35.
v. **Smoking and alcohol consumption:** Smoking and alcohol consumption are becoming more and more common and arouse increasing public concern. Meta-analysis found that active smoking is positively associated with an increased risk of type 2 diabetes.
vi. **Prediabetes**: Prediabetes is a condition in which the blood sugar level is higher than normal, but not high enough to be classified as diabetes. Left untreated, prediabetes often progresses to type 2 diabetes.
vii. **Pregnancy-related risks**: The risk of developing type 2 diabetes is higher in people who had gestational diabetes when they were pregnant and in those who gave birth to a baby weighing more than 9 pounds (4 kilograms).
viii. **Polycystic ovary syndrome**: Having polycystic ovary syndrome. A condition characterized by irregular menstrual periods, excess hair growth and obesity — increases the risk of diabetes.

PATHOPHYSIOLOGY: [13,14]

Type 2 diabetes mellitus is a metabolic disorder characterized by insulin resistance, impaired insulin secretion, and increased glucose production. This complex condition progresses through stages, beginning with insulin resistance, where peripheral tissues become less responsive to insulin, followed by impaired glucose tolerance, and ultimately, overt diabetes.

The disease is driven by multiple factors, including genetics, obesity, physical inactivity, aging, dietary factors, stress, and inflammation. Obesity plays a significant role, as excess adipose tissue leads to inflammation and lipotoxicity, worsening insulin resistance.

If left untreated, T2DM has severe consequences, including hyperglycemia, atherosclerosis, nephropathy, neuropathy, and retinopathy. Effective management requires a multi-faceted approach, incorporating lifestyle modifications, such as diet and exercise, pharmacological interventions, including oral hypoglycemic agents and insulin, and regular monitoring of blood glucose levels.
Early detection and management are crucial to prevent complications and improve patient outcomes. By understanding the pathophysiological mechanisms underlying T2DM, healthcare providers can develop targeted treatment strategies to mitigate the disease's impact.

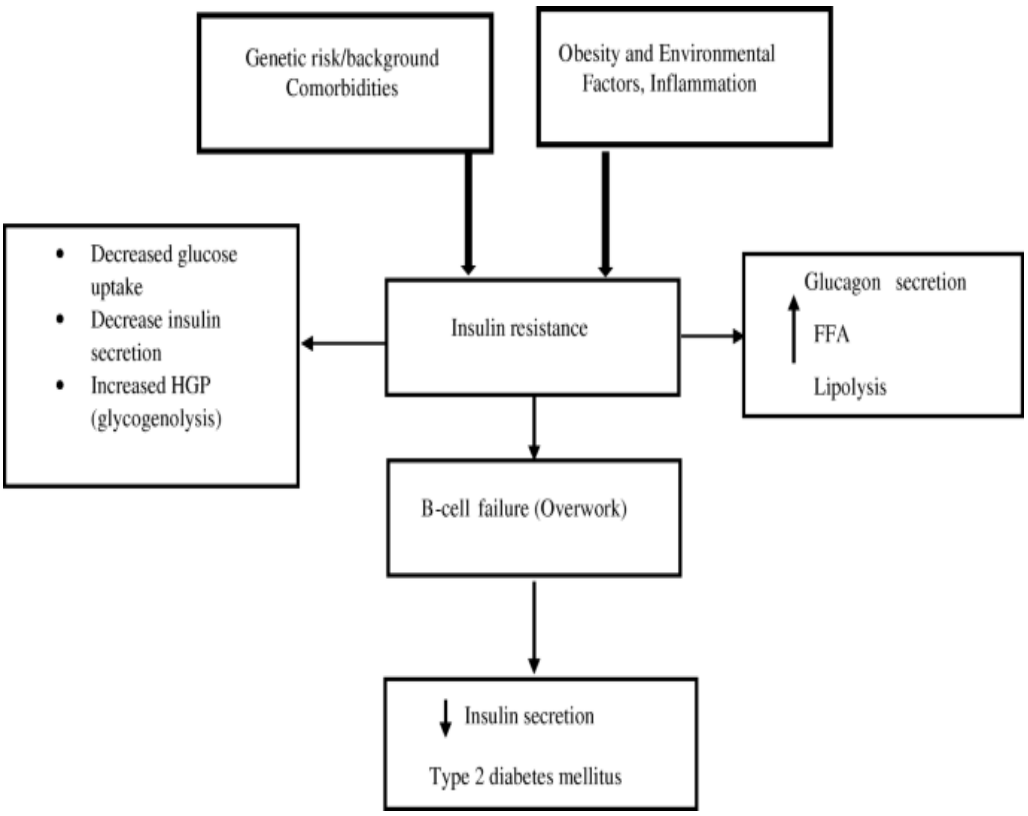


Fig:4 Pathophysiology of Type 2 DM

Causes:
i.Genetics
ii.Obesity
iii.Lack of physical activity
iv.Aging
v.Poor diet
vi.Stress

Consequences:
i.Heart disease
ii.Kidney damage
iii.Nerve damage
iv.Vision problems
v.Increased infection risk

Stages:
i.Normal blood sugar
ii.Insulin resistance (pre-diabetes)
iii.Impaired glucose tolerance (pre-diabetes)
iv.Type 2 Diabetes

Diagnosis:

i.Blood tests (fasting, glucose tolerance)
ii.Fasting Plasma Glucose (FPG)
iii.Oral Glucose Tolerance Test (OGTT)
iv.Hemoglobin A1c (HbA1c)
v.Random Plasma Glucose
vi.Urine Glucose

Treatment:

i.Lifestyle changes (diet, exercise)
ii.Medications (oral, injectable)
iii.Monitoring blood sugar levels

2. *Syzygium cumini* as Anti diabetic herb

In the ayurvedic system of medicine, *Syzygium cumini* seeds are considered as an excellent remedy for diabetes. Plants are highly valuable and used for thousands of years by the people as the medicine to cure many diseases. The original home of jamun is India. It is found growing wild throughout the country. Jamun is a large evergreen tree attaining a height of 2530 m and a stem girth 3-4 m. Jamun seeds are well known for their anti-diabetic properties. The study characterized promising accessions for anti-diabetic and anti-oxidant metabolites in seeds.[15]. The seeds are claimed to contain alkaloid, jambosine and glycoside jambolin or antimellin, which halts the diastatic conversion of starch into sugar. The α-amylase inhibitors propose an efficient antidiabetic strategy and the levels of postprandial hyperglycemia were lowered by restraining starch breakdown.[16]


Jamun plant **A branch of Jamun tree with flower**


Jamun Fruit ripen (black) **Jamun Fruit & Seeds**

Fig 5: *Syzygium Cumini* Plant, Flower, Fruit and Seeds

Pharmacognosy: [17-22]

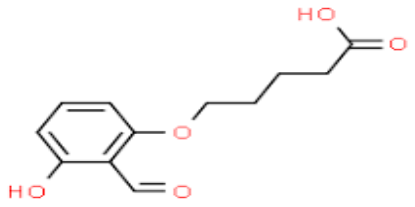
Botanical name: *Syzygium cumini* (L) Skeels.
Common name: Black berry, Black plum, Jambul or Java Plum
Family: Myrtaceae
Kingdom: Plantae
Order: Myrtales

Genus: Syzygium
Species: Cumini
Parts of plant are used: Leaves, Stem bark, Flowers, Fruit, Seeds

Geographical sources:
The original home of *Syzygium cumini* is India. It is also found in Thailand, Philippines, Madagascar and some other countries West Indies, East and West Africa and some sub-tropical regions including Florida, California, Algeria and Israel.

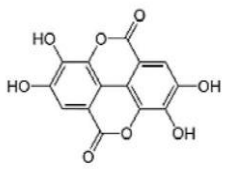
Morphological characteristics:
Jamun is a fast-growing tree that reaches heights up to 100 feet, and it bears fruits in clusters during the summer. Each fruit cluster may contain fruits numbering only a few to as many as 10 or even 40. The Jamun fruits are round to oblong in shape, with the size of each varying between 1/2 to 2 inches. They are green in color and turn from light to dark purple, or even black coloration, once they are fully ripe.1 The taste of the Jamun fruits is sweetish sour.

Phytochemical constituents present in Jamun seeds: [23]
Jamun seeds that contribute to their anti-diabetic properties include:
i.Alkaloids: Jamun seeds contain alkaloids that may help reduce diabetes symptoms. they may prevent the conversion of starch into sugar, which can regulate blood sugar level.
eg: Jambosine
Jambosine: Anti-diabetic reduces blood sugar levels, improves insulin activity.
Chemical Name: Jambosine
Molecular Formula: $C_{12}H_{14}O_5$
Molecular Weight: 238.24 g/mol

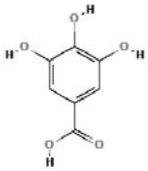


Jambosine

ii.Phenolic acid: Phenolic acids present in Jamun seeds that can help treat diabetes:
- Gallic Acid: Lowers blood sugar levels, improves insulin sensitivity, and has antioxidant or anti-diabetic effects
- Ellagic Acid: Enhances glucose uptake in cells, improves insulin sensitivity, and has antioxidant and anti-inflammatory or anti-diabetic effects.
- Ferulic Acid: Improves insulin sensitivity, increases glucose uptake in cells, and has antioxidant and anti-inflammatory or anti-diabetic effects.

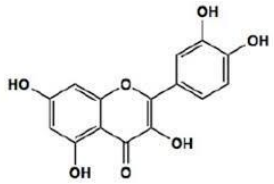


Ellagic acid



Gallic acid

iii.Flavonoids: They improve insulin sensitivity, improve glucose uptake in cells, they prevent diabetes. eg: Quercetin



Quercetin

iv.Triterpenoids:
- Ursolic Acid
- Qleanolic Acid

v.Glycoside:
- Syzgogenin

3. Anti-diabetic Activity shown by Jamun Seeds: [23-26]

Jamun seed extract dramatically lowers blood sugar levels as well as controls insulin levels in hyperglycemic rats. Jamun seeds extract reduced blood sugar levels by 12.29% and 5.35% in hyperglycemic normal and normal rats, respectively, while improving sugar levels by 6.19% and 2.82%. In normal and hyperglycemic rats, Jamun seed extract lowered sugar levels by 7.04% and 14.36%, respectively, or exhibited 7.24% and 3.56% raising insulin levels.

a. Animal Study Findings:

Ethanolic extracts of Jamun fruit and seeds demonstrated significant hypoglycemic effects in hyperglycemic rats. Jamun fruit extract reduced blood sugar levels by 12.29% in hyperglycemic rats and 5.35% in normal rats. Jamun seed extract lowered blood sugar levels by 7.04% in normal rats and 14.36% in hyperglycemic rats. Insulin levels were also improved in both normal and hyperglycemic rats.

b. Human Case Report:

A 38-year-old male patient with T2DM, initially requiring 32 insulin units daily, showed significant improvement after 12 weeks of ayurvedic therapy. The patient's HbA1c levels dropped from 11.1% to 5.6% after combining ayurvedic medication (Gudmar, Jamun, Nagarmotha, and Sudarshan) with insulin. After discontinuing insulin, the ayurvedic therapy alone maintained normal blood sugar levels.

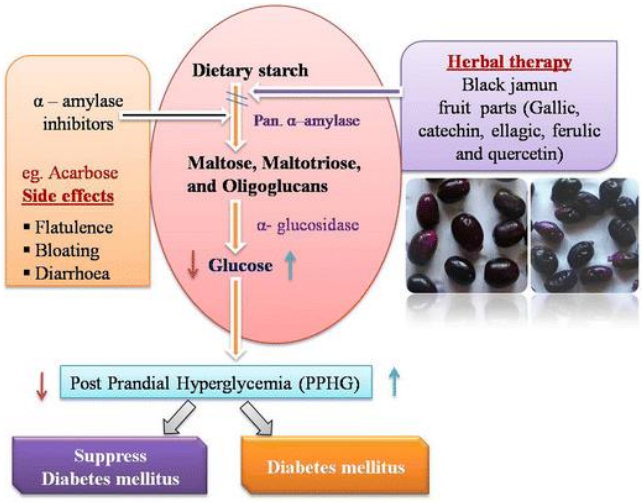


Fig 6: Anti-diabetic activity of jamun seeds

Conclusion:

The Jamun (*Syzygium cumini*) belonging to the family Myrtaceae has been used in traditional medicine for treatment, including diabetes. Jamun contains alkaloids, anthraquinone glycosides, flavonoids, tannins, saponins, phenols, cardiac glycosides and terpenoids. Syzygium cumini is an organic and natural product that may give a better response towards diabetes. Regular use of Jamun or jamun seeds may reduce the diabetic activity. (*Suzigium Cumini)* has many phytochemicals in its seeds like Jambolin, gallic acid, ellagic acid, ferulic acid, ursolic acid, oleanolic acid and some organic acids. The leaves and bark are also full of phytochemicals. The phytochemicals are useful in treatment of various health problems. Diabetes mellitus is a serious complication in today's life. The lifestyle and day today circumstances play a major role in causing this type of serious complications. In this review we get some ideas regarding diabetes mellitus.

REFERENCES

1. Kumar, Roshan, Purabi Saha, Yogendra Kumar, Soumitra Sahana, Anubhav Dubey, and Om Prakash. "A review on diabetes mellitus: Type1 & Type2." *World Journal of Pharmacy and Pharmaceutical Sciences* 9, no. 10 (**2020**).
2. Deshmukh, Chinmay D., Anurekha Jain, and B. Nahata. "*Diabetes mellitus: a review." Int. J. Pure App*l. Biosci 3, no. 3 (**2015**).
3. Alam, Uazman, Omar Asghar, Shazli Azmi, and Rayaz A. Malik. "General aspects of diabetes mellitus." *Handbook of clinical neurology* 126 (**2014**): 211-222.
4. Kaul K, Tarr JM, Ahmad SI, Kohner EM, Chibber R. "Introduction to diabetes mellitus." *Diabetes: an old disease, a new insight.* **2013**:1-1.
5. DiMeglio LA, Evans-Molina C, Oram RA. "Type 1 diabetes". *The Lancet*. **2018**,391(10138):2449-62.
6. Lambert P, Bingley PJ. "What is type 1 diabetes?". *Medicine*. **2002**,30(1):1-5.
7. Singh, Nishita, Roohi Kesherwani, Arun Kumar Tiwari, and Dilip Kumar Patel. "A review on diabetes mellitus." *The Pharma Innovation* 5, no. 7, Part A (**2016**): 36.
8. Diabetes mellitus history- from ancient to modern times. (accessed on 22nd July, **2011**)
9. A Ismail and S Ali. "A review of diabetes mellitus and its complications". *world journal of pharmaceutical and medical research*.**2022**,8(6):239-241.
10. Olokoba, Abdulfatai B., Olusegun A. Obateru, and Lateefat B. Olokoba. "Type 2 diabetes mellitus: a review of current trends." *Oman medical journal* 27, no. 4 (**2012**): 269.
11. Hu, Frank B. "Globalization of diabetes: the role of diet, lifestyle, and genes." *Diabetes care* 34, no. 6 (**2011**): 1249-1257.

12. Bi, Yufang, Tiange Wang, Min Xu, Yu Xu, Mian Li, Jieli Lu, Xiaolin Zhu, and Guang Ning. "Advanced research on risk factors of type 2 diabetes." *Diabetes/metabolism research and reviews* 28 (**2012**): 32-39.
13. Tripathi, K. D. **(2019).** Essentials of Medical Pharmacology. 8th ed. Jaypee Brothers Medical Publishers. Chapter 17: Hypoglycemic Drugs and Glycemic Control; 234-255
14. Himanshu, D., Wahid Ali, and Mohd Wamique. "Type 2 diabetes mellitus: pathogenesis and genetic diagnosis." *Journal of Diabetes & Metabolic Disorders* 19 (**2020**): 1959-1966.
15. Singh, A. K., Anju Bajpai, M. Muthukumar, and K. K. Mishra. "Antidiabetic assays' based fractionation and characterization of Jamun (Syzygium cumini Skeels) fruits." *Journal of Pharmacognosy and Phytochemistry* 7, no. 4 (**2018**): 3107-3111.
16. Helmstädter A, Syzygium cumini (L.) Skeels (Myrtaceae) against diabetes- 125 years of research, Die Pharmazie, (**2008)**; 63: 91-101.
17. Kumawat, Meenakshi, Jyoti Damor, Jaya Kachchhwaha, Ayush Kumar Garg, and Chandan Singh. "Pharmacological properties and therapeutic potential of Syzygium cumini (Jamun): A review." *World Journal of Pharmaceutical Sciences* 7 (**2018**): 312-322.
18. Dagadkhair, Amol Changdeo, Komal Nivrutti Pakhare, Ashok Dattatray Todmal, Rajkumar Ramrao Andhale, A. Dattatray Todmal, and R. Ramrao Andhale. "Jamun (Syzygium cumini) Skeels: a traditional therapeutic tree and its processed food products." *International Journal of Pure & Applied Bioscience* 5, no. 5 (2017): 1202-1209.
19. Proma, Nawreen Monir, Jannatul Naima, Mohammad Rashedul Islam, Jahirul Alam Papel, Mohammed Monzur Rahman, and Mohammed Kamrul Hossain. "Phytochemical constituents and antidiabetic properties of Syzygium cumini Linn. Seed." *International Journal of Pharmaceutical Sciences and Research* 9, no. 5 (**2018**): 1806.
20. Rizvi, Syed Ibrahim, and Neetu Mishra. "Traditional Indian medicines used for the management of diabetes mellitus." *Journal of diabetes research* 2013, no. 1 (**2013**): 712092.
21. Prabakaran, Kandan, and Govindan Shanmugavel. "Antidiabetic activity and phytochemical constituents of Syzygium cumini seeds in Puducherry region, South India." *International Journal of Pharmacognosy and Phytochemical Research* 9, no. 7 (**2017**): 985-989.
22. Jagetia, Ganesh Chandra. "Phytochemical Composition and pleotropic pharmacological properties of jamun, Syzygium cumini skeels." *Journal of exploratory research in pharmacology* 2, no. 2 (**2017**): 54-66.
23. Rizvi, Maryam Khalid, Roshina Rabail, Seemal Munir, Muhammad Inam-Ur-Raheem, Mir Muhammad Nasir Qayyum, Marek Kieliszek, Abdo Hassoun, and Rana Muhammad Aadil. "Astounding health benefits of jamun (Syzygium cumini) toward metabolic syndrome." *Molecules* 27, no. 21 (**2022**): 7184.
24. Mahmoud II, Marzouk MS, Moharram FA, El-Gindi MR, Hassan AM. Acylated flavonol glycosides from *Eugenia jambolana* leaves. Phytochemistry, (**2001**); 58: 1239–1244. [PubMed]
25. Bhargava, K. K., R. A. M. E. S. H. W. A. R. Dayal, and T. R. Seshardri. "Chemical components of Eugenia jambolana stem bark." (**1974**): 645-646.
26. Prabakaran, Kandan, and Govindan Shanmugavel. "Antidiabetic activity and phytochemical constituents of Syzygium cumini seeds in Puducherry region, South India." *International Journal of Pharmacognosy and Phytochemical Research* 9, no. 7 (**2017**): 985-989.
27. Banday, Mujeeb Z., Aga S. Sameer, and Saniya Nissar. "Pathophysiology of diabetes: An overview." *Avicenna journal of medicine* 10, no. 04 (**2020**): 174-188.
28. Galicia-Garcia, Unai, Asier Benito-Vicente, Shifa Jebari, Asier Larrea-Sebal, Haziq Siddiqi, Kepa B. Uribe, Helena Ostolaza, and César Martín. "Pathophysiology of type 2 diabetes mellitus." *International journal of molecular sciences* 21, no. 17 (**2020**): 6275.
29. Verge, Charles F., Roberto Gianani, Eiji Kawasaki, Liping Yu, Massimo Pietropaolo, H. Peter Chase, George S. Eisenbarth, and Richard A. Jackson. "Prediction of type I diabetes in first-degree relatives using a combination of insulin, GAD, and ICA512bdc/IA-2 autoantibodies." *Diabetes* 45, no. 7 (**1996**): 926-933.

30. American Diabetes Association. "Diagnosis and classification of diabetes mellitus." *Diabetes care* 37, no. Supplement_1 (**2014**): S81-S90.
31. Singh, Sanjay, A. K. Singh, P. L. Saroj, and S. Mishra. "Research status for technological development of jamun (Syzygium cumini) in India: A review." *The Indian Journal of Agricultural Sciences* 89, no. 12 (**2019**): 1991-8.