Inter. J. PharmaO$_2$
ISSN: 2582-4708
Vol.7/Issue 3/2025; Patil P., 28-34.

International Journal of PharmaO$_2$
Journal Home Page: http://www.ijpo.in/
(IJPO: A Peer-reviewed Bi-monthly online journal)

Research Article

Development and Evaluation of *Syzygium cumini–Momordica Charantia* Tablet a Novel herbal formulation for Diabetes management

Ms. Prajakta c Patil[1]*, Mr. Krushna c Shinde[2] *
[1]Assistant Professor, SMBT Institute of Diploma pharmacy, Affiliated to MSBTE, Maharashtra India.
[2]Student of SMBT Institute of Diploma pharmacy, Affiliated to MSBTE, Maharashtra, India

ARTICLE INFO

Article history:
Received; 01/11/2025
Revised; 01/11/2025
Accepted: 02/12/2025

Key Words:
*Diabetes mellitus, Syzygium cumini, Momordi*ca charantia, Herbal medicine

Please cite this article as: *Patil P.*, Development and Evaluation of Syzygium cumini–Momordica Charantia Tablet a Novel herbal formulation for Diabetes management

7(3), 28-34.

ABSTRACT

Diabetes mellitus is a major global health concern, with an increasing prevalence worldwide. Traditional herbal medicines have gained attention due to their potential therapeutic effects, minimal side effects, and affordability. Among various medicinal plants with anti-diabetic properties, Syzygium cumini (Jamun) and Momordica charantia (Bitter Melon) are well known for their glucose-lowering effects. This study aimed to develop and evaluate a novel tablet formulation combining standardized extracts of these two plants to provide a natural and effective option for diabetes management. The formulation process involved selecting suitable excipients and incorporating the herbal extracts into a tablet matrix using a wet granulation technique, followed by compression into uniform tablets. Various pharmaceutical parameters, including weight uniformity, hardness, friability, disintegration time, and dissolution profile, were evaluated to ensure tablet integrity and consistent drug release. The in-vitro anti-diabetic efficacy of the tablet was assessed using glucose-lowering tests, which demonstrated the formulation's ability to reduce blood glucose levels. A comparative analysis was performed against commercially available anti-diabetic drugs. Additionally, pharmacokinetic evaluations examined the bioavailability and absorption rate of the active compounds. Stability studies were conducted under different environmental conditions to assess the formulation's shelf life, ensuring the maintenance of its physical, chemical, and therapeutic properties over time. The results indicated that the combination of Syzygium cumini and Momordica charantia in tablet form exhibited significant glucose-lowering activity, comparable to synthetic anti-diabetic drugs. The formulation demonstrated stability, efficacy, and safety, reinforcing its potential as an alternative therapeutic approach for diabetes management. This research highlights the advantages of integrating traditional herbal medicines into modern drug delivery systems. It supports the potential of well-formulated herbal tablets as a viable and cost-effective alternative to conventional diabetes medications. Further clinical studies are needed to confirm the long-term efficacy and safety of this formulation in diabetic patients.

* **Corresponding Author-** Patil P.,Assistant Professor, SMBT Institute of Diploma Pharmacy, Nandi-Hills Dist Nashik.

Introduction:

Diabetes mellitus is a major global health issue, affecting millions of people worldwide. It is characterized by high blood glucose levels resulting from either insufficient insulin production or poor cellular response to insulin. If not properly managed, diabetes can lead to severe complications, including cardiovascular disease, kidney failure, blindness, and neuropathy. With the increasing prevalence of this disorder, the need for effective and affordable treatment options has never been more critical. While conventional therapies such as

oral hypoglycemic agents and insulin are commonly used, these treatments often come with side effects and high costs, limiting their accessibility and long-term effectiveness. As a result, there has been growing interest in alternative therapies, particularly those derived from medicinal plants, which have been traditionally used for their therapeutic properties.

Herbal medicines offer a promising solution due to their natural origins, relatively low cost, and minimal side effects. Two plants, Syzygium cumini (Jamun) and Momordica charantia (Bitter Melon), have long been used in traditional medicine for the treatment of diabetes and related conditions. Syzygium cumini, commonly known as Indian blackberry, has been extensively studied for its anti-diabetic properties. It is rich in bioactive compounds such as anthocyanins, flavonoids, and alkaloids, which have been shown to help regulate blood glucose levels, improve insulin sensitivity, and reduce oxidative stress. Similarly, Momordica charantia, or Bitter Melon, has been recognized for its ability to mimic insulin-like activity, promoting glucose uptake by cells and lowering blood sugar levels. Both of these plants have demonstrated significant potential in managing diabetes, making them ideal candidates for formulating an effective and natural anti-diabetic tablet.

The combination of Syzygium cumini and Momordica charantia has not been widely explored in tablet form, despite the synergistic effects these plants may offer when used together. This study aims to fill this gap by developing a tablet formulation that combines the medicinal properties of both plants. The goal is to create a safe, effective, and easily accessible oral dosage form for managing blood glucose levels in diabetic patients. To achieve this, the study involves several stages, including the selection of suitable excipients, formulation of the tablet, and rigorous evaluation of its physical and chemical properties. The final product will undergo tests such as hardness, friability, disintegration time, dissolution, and stability testing to ensure its quality and effectiveness.

An important aspect of the research is to evaluate the in-vitro anti-diabetic activity of the formulated tablet. By conducting glucose-lowering assays, the study will assess the tablet's ability to reduce blood glucose levels in a controlled environment, mimicking the body's response to glucose intake. The findings of this research could provide valuable insights into the therapeutic potential of Syzygium cumini and Momordica charantia as a combination therapy for diabetes, offering a natural alternative to conventional anti-diabetic drugs.

In addition to exploring the therapeutic benefits, this study also aims to contribute to the growing body of research on the formulation of herbal-based drugs. By incorporating modern pharmaceutical techniques into the development of herbal formulations, the study seeks to enhance the bioavailability and stability of these plants' active compounds, making them more effective and accessible for long-term use.

The growing interest in natural and herbal medicine for chronic conditions such as diabetes is driven by the increasing demand for safer and more sustainable treatment options. This research aligns with the global trend towards integrating traditional knowledge with modern pharmaceutical practices. It underscores the importance of interdisciplinary research in addressing the challenges posed by chronic diseases like diabetes, particularly in regions where access to conventional medicine may be limited.

This introduction sets the foundation for the rest of the study, highlighting the significance of the research, the rationale behind the choice of plants, and the objectives of developing a new herbal tablet formulation. It provides context for understanding how these medicinal plants could offer a viable alternative for managing diabetes and its complications.

Types of Diabetic mellitus

There is main two type of Diabetic mellitus disorder they were classified depending upon the insulin dependency.

Type 1. Insulin dependent diabetic mellitus.

This type of diabetic mellitus is occurred due to autoimmune disease of beta cell. Due to the destruction of beta cells of pancreases the circulation of insulin in blood is not regulated they are occurring in beta cells fails to respond to age of 30 years. In that the beta cells fail to respond to normal stimuli.

Type 2. Non-insulin dependent diabetic mellitus

This type of diabetic mellitus is not depended on the insulin. Obesity is the major cause of this type of diabetic mellitus. That the beta cell count is

decrease. This type of diabetic is occurring in onward 40 year.

- **Why Choose Karela Leaves Powder and Jamun Powder for Antidiabetic Tablets?**

1. Scientifically Proven Antidiabetic Properties
Both Karel leaves (Momordica charantia, Bitter Melon) and Jamun (Syzygium cumini, Indian Blackberry) have been extensively studied for their hypoglycemic and antidiabetic effects.
Bitter Melon (Karel Leaves)
Contains charantin, vicine, and polypeptide-p, which have insulin-mimetic properties.
Stimulates GLUT4 translocation, enhancing glucose uptake.
Reduces postprandial hyperglycemia by inhibiting carbohydrate digestion.
Jamun (Syzygium cumini)
Contains jamboline and ellagic acid, which slow down the conversion of starch into sugar.
Improves pancreatic β-cell regeneration, enhancing insulin secretion.
Rich in polyphenols and flavonoids, which possess antioxidant and anti-inflammatory effects, preventing diabetes-related complications.
2. Synergistic Effect for Better Diabetes Management
Karel leaves lower blood glucose levels by increasing insulin sensitivity.
Jamun regulates postprandial glucose spikes and enhances pancreatic function.
Combined, they offer a dual mechanism:
Improving insulin secretion (Jamun)
Enhancing glucose uptake & utilization (Karel leaves)
3. Natural, Safe, and Cost-Effective Alternative to Synthetic Drugs
Unlike synthetic oral hypoglycemic agents (OHA) like metformin, these herbs have fewer side effects (e.g., no lactic acidosis risk).
Being natural, they are non-toxic and rich in antioxidants, preventing diabetic complications.
Easily available and cost-effective compared to conventional antidiabetic drugs.
4. Backed by Traditional & Clinical Evidence
Ayurveda & Traditional Medicine: Used for centuries in Ayurveda and Unani medicine for diabetes.
Clinical Studies:
A study published in Journal of Ethno pharmacology reported that Momordica charantia significantly lowers fasting blood glucose levels.
Research in the Asian Pacific Journal of Tropical Biomedicine demonstrated Syzygium cumini improves pancreatic function and insulin secretion.
5. Multi-targeted Approach for Diabetes Control
Unlike synthetic drugs that target a single mechanism, these herbal extracts act via:
1. Insulin Mimicry – Bitter melon acts like insulin, reducing glucose levels.
2. Pancreatic Protection – Jamun helps in β-cell regeneration.
3. Carbohydrate Metabolism Regulation – Both inhibit α-amylase and α-glycosidase, slowing glucose absorption.
4. Oxidative Stress Reduction – Rich in antioxidants, reducing diabetes-induced complications.
Karela (Bitter Melon) Leaves
1. Scientific Name: Momordica Charania
2. Antidiabetic Properties: Chirantan, vicine, and polypeptide-p reduce blood sugar levels
3. Benefits:
- Lowers blood glucose
- Improves insulin sensitivity
- Antioxidant and anti-inflammatory effects

Jamun Powder
1. Scientific Name: Syzygium cumini
2. Antidiabetic Properties: Anthocyanin's, flavonoids, and terpenoids regulate blood sugar
3. Benefits:
- Reduces blood sugar and HbA1c levels
- Enhances insulin production
- Antioxidant and anti-inflammatory effects

Combination and Benefits of Antidiabetic Tablet-
1. Synergistic effect: Enhanced antidiabetic activity
2. Improved insulin sensitivity
3. Reduced risk of complications (e.g., nephropathy, retinopathy)
Symptoms: - polyuria, polydipsia, polyphagia, fatigue and long-term diabetes may causes gangrene and myocardial infraction.

MATERIALS AND METHODOLOGY-

Step 1: - Syygium cumini fruit processing
1] Collect fresh Syygium cumini fruits and wash them thoroughly.
2] Remove seeds and crush the fruits into small pieces.

3] Dry the fruit pieces in a dehydrator or under the sum until completely dry.
4] Grind the dried fruit into a fine powder using a grinder.
5] Sieve the powder to remove any lumps or large particles.

Step 2: - Momordica charantia leaves processing
1] Collect fresh Momordica charantia leaves and wash them thoroughly.
2] Dry the leaves in a dehydrator or under the sun until completely dry.
3] Grind the dried leaves into a fine powder using a grinder.
4] Sieve the powder to remove any lumps or large particles.
Step 3. Tablet formulation
The herbal antidiabetic tablet was prepared by using wet granulation method. In this method the solvent were used for the reparation of damp mass. The entire ingredient was weighed and triturated by using mortar and pestle and this mass was passed through sieve no 8 individually. In the net stop the herbal drug. Starch mixed with sufficient quantity of water along with small amount of gelatin to form dump mass i.e. coherent mass. The granules were passed through sieve no 16 to form granules and the granules remaining amount of quantity of starch. Talc, magnesium stearate was added mixed with spatula. At the last prepared granules were passed for compression by single punching machine.

Fig. 1: Formulated herbal Antidiabetic tablet.

Table: - 1 EVALUATIONS OF TABLET

Sr. no	Name of ingredient	Role	Quantity for 50 Tablets (g)	Description
1	Syzygium cumini Powder	Active ingredient	3.75 g	Regulates blood sugar levels with hypoglycemic properties.
2	Momordica charantia Powder	Active ingredient	3.75 g	Contains charantin and polypeptide-p, effective in managing diabetes.
3	Microcrystal line cellulose	Binder and filler	3.75 g	Ensures tablet integrity and provides bulk
4	Corn starch	Disintegran t	1.125 g	Helps the tablet break down in the gastrointestinal tract for better absorption
5	Magnesium stearate	Lubricant	0.125 g	Prevents tablet sticking during manufacturing and enhances production flow.

Hardness Tester

The hardness of tablet is also called as tablet crushing strength hardness of the prepared tablet in this test, we can measure the force which is required for the breaking of the tablet. Pfizer tablet hardness tester is a plier fitted with a pressure dial. The tablet is placed between the jaw of the plier and pressure is applied by pressing the handles with hand unit until the tablet breaks. The reading of the dial indicates the pressure needed to break the tablet.

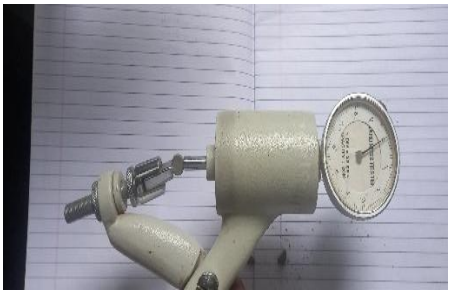

Fig. 2: Hardness test

Friability test

During the tablet compression process, adequate pressure is applied to the granules to ensure the tablets can endure wear and tear during transportation and handling. However, despite

taking all necessary precautions, tablets may still experience significant powdering after normal handling, leading to an undesirable appearance. The friability test is conducted to assess the tablet's ability to withstand the stresses of packing, handling, and transportation. This test is carried out using a specialized device called a **Friabilator**.

The apparatus consists of a plastic chamber, which is divided into two parts and it revolves at speed of 25.p.m. four tablets are weighed and placed in the plastic chamber. The chamber is rotated for 4 minutes or 100 revolutions. During each revolution the tablet falls from a distance and weighed. Loss in weight indicates the friability. The tablets are considered to be of good quality if the loss in weight is less than 0.8%

Roche friabilator is used it is used it is laboratory friability test. In that the preweighed antidiabetic tablet sample is placed in the friabilator which consist of plastic chamber that operate 100 revolutions for 4 min means 25 rpm. The tablet is then dusted and reweighed. Conventional compressed tablet that loses less than that 0.5-1.0 % of their weight a few generally acceptable.

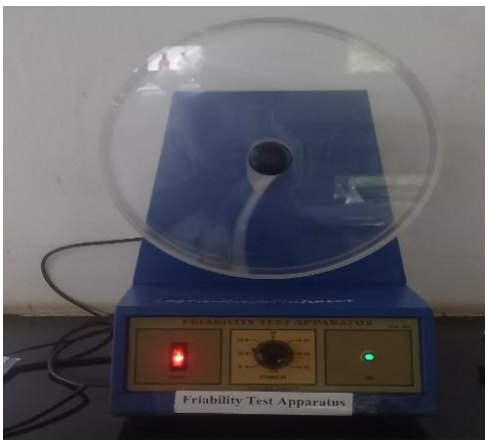

Fig. 3- Friability test

Dissolution test: -

Dissolution is the process by which a sold solute enters in the solution. It may be defined as the amount of drug substance that goes into solution per unit time. The disintegration test simply identified the time required for the tablet to break up under the condition of test and all the particles are passed through mesh no. 10 screen. The rate of drug absorption of acidic drug is high in GIT. So, for that purpose the rate of dissolution is determined. For determination of dissolution rate of tablet, we were taking 900 ml of 0.1n HCL. In basket of dissolution apparatus and which were rotated at 50 rpm and time limit of accepted amount dissolution limit for 20 min is not less than 80%.

Fig. 4- Dissolution test

Disintegration Time: -

This take a look at is executed to degree the time taken through the drug to crumble with inside the body. This is executed to decide whether the pill disintegrates with inside the prescribed time while located in a liquid medium below the prescribed experimental conditions. One every pill become brought to every of six tubes of the basket and a disc become brought to every of the. Tubes had been dipped in zero .1N HCL answer maintained at 37

Fig.5- Disintegration test

Sr.no	Evaluation parameter	Value
1	Color	Greenish brown
2	Odor	Characteristic

		bitter
3	Texture	Smooth
4	Dissolution (min)	20
5	Friability (%)	0.01
6	Thickness (mm)	5
7	Hardness (kg/cm2)	3.41
8	Disintegration (min)	13.9

Conclusion: -The herbal antidiabetic tablet containing Karela leaves powder and Jamun powder meets the disintegration test requirements, with an average disintegration time of 20.5 minutes. All tablets disintegrated within 30 minutes, ensuring the release of active ingredient. The jamun-karela tablet offers a novel, effective and safe herbal formulation for diabetes management. Its development and evaluation demonstrate the potential of traditional herbal remedies in modern healthcare.

Precautions: -

1. Not recommended for type 1 diabetes.
2. Consult a healthcare professional before using with other medications.
3. Not recommended for pregnant or breastfeeding women. Precautions:
4. Consult a healthcare professional before using
5. Monitor blood sugar levels regularly
6. Adjust dosage and medication as needed
7. May interact with other medications (e.g., sulfonylureas)

Storage: -Store in well cool dry place protect from light and moisture.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Dr. Yogesh V. Ushir Sir, Principal of SMBT Institute of Diploma Pharmacy, for their invaluable support and encouragement throughout this research. I also extend my heartfelt appreciation to my mentor for their insightful advice and assistance during the research project.

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