International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

Development And Evaluation of Herbal Antidiabetic Tablets Containing *Gymnema Sylvestre* and *Momordica Charantia* Extracts

Miss. Srushti Ambatkar*[1], Dr. Rajesh Mujariya[2], Dr. Atul Bisen[3], Dr. Manjeet Singh[4]

[1]*Research Scholar of Institute of Pharmaceutical Science & Research, Balaghat (M.P.)*
[2]*Principal & Professor of Institute of Pharmaceutical Science & Research, Balaghat (M.P.)*
[3]*Associate, Professor of Institute of Pharmaceutical Science & Research, Balaghat (M.P.)*
[4]*Executive Director of Institute of Pharmaceutical Science & Research, Balaghat (M.P.)*
**Corresponding author*

Date of Submission: 17-06-2026 Date of Acceptance: 30-06-2026

ABSTRACT

Background Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both. Although conventional antidiabetic drugs effectively control blood glucose levels, their long-term use is associated with adverse effects, high treatment costs, and poor patient compliance. Herbal medicines such as *Gymnemasylvestre* and *Momordica charantia* possess well-documented antihyperglycemic properties and offer a promising alternative for the development of safe and effective polyherbal formulations.

Objective The present study aimed to formulate and evaluate a polyherbal tablet containing standardized extracts of *Gymnemasylvestre* and *Momordica charantia* for the management of diabetes mellitus.

Materials and Methods Hydroalcoholic extracts of *Gymnemasylvestre* leaves and *Momordica charantia* fruits were prepared using the Soxhlet extraction method and subjected to preliminary phytochemical screening. Six formulations (F1–F6) were prepared by the wet granulation technique using suitable pharmaceutical excipients. Pre-compression parameters including bulk density, tapped density, angle of repose, Carr's index, and Hausner ratio were evaluated. The compressed tablets were assessed for weight variation, hardness, friability, thickness, disintegration time, and content uniformity according to pharmacopeial standards.

Results Phytochemical screening confirmed the presence of alkaloids, flavonoids, saponins, tannins, and glycosides in both plant extracts. The optimized formulation (F4) demonstrated satisfactory pre-compression properties with an angle of repose of **28.6 ± 0.5°**, Carr's index of **14.2 ± 0.6%**, and Hausner ratio of **1.16 ± 0.03**, indicating good flowability. Post-compression evaluation showed an average tablet weight of **490 ± 2.8 mg**, hardness of **5.3 ± 0.2 kg/cm²**, friability of **0.42 ± 0.05%**, thickness of **4.8 ± 0.1 mm**, disintegration time of **8.2 ± 0.4 min**, and content uniformity of **99.1 ± 0.8%**. All evaluation parameters complied with pharmacopeial specifications.

Conclusion The polyherbal tablet formulated with *Gymnemasylvestre* and *Momordica charantia* exhibited satisfactory physicochemical characteristics and met official quality standards. The optimized formulation demonstrated good tablet integrity, rapid disintegration, and excellent content uniformity, indicating its potential as a stable and effective herbal oral dosage form for diabetes management. Further pharmacological, stability, and clinical investigations are recommended to establish its therapeutic efficacy and safety.

Keywords: Diabetes mellitus, Polyherbal tablet, *Gymnemasylvestre*, *Momordica charantia*, Wet granulation, Antidiabetic activity, Herbal formulation.

I. INTRODUCTION

1.1 Diabetes Mellitus

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin action, or both. The increasing global prevalence of diabetes, particularly Type 2 diabetes mellitus, has become a major public health concern because of its association with severe microvascular and macrovascular complications.[1]Long-term hyperglycemia contributes to oxidative stress, chronic inflammation, endothelial dysfunction, and progressive damage to organs such as the kidneys, eyes, heart, and nervous system. Consequently, there is an urgent need for effective, safe, and

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

economical therapeutic strategies for diabetes management.[2]

Figure no 1 Diabetes mellitus

Table 1: Classification of Diabetes Mellitus

Type of Diabetes	Cause	Key Features
Type 1 Diabetes Mellitus (T1DM)	Autoimmune destruction of pancreatic β-cells	Absolute insulin deficiency; usually occurs in children and young adults
Type 2 Diabetes Mellitus (T2DM)	Insulin resistance with impaired insulin secretion	Most common type; associated with obesity and sedentary lifestyle
Gestational Diabetes Mellitus (GDM)	Hormonal changes during pregnancy	Develops during pregnancy and may increase risk of future diabetes
Secondary Diabetes	Caused by diseases, drugs, or hormonal disorders	Associated with pancreatic disorders, steroid therapy, or endocrine diseases
Prediabetes	Impaired glucose tolerance or impaired fasting glucose	Intermediate stage before development of Type 2 diabetes

1.2 Need for Herbal Antidiabetic Therapy

Despite the availability of numerous synthetic antidiabetic drugs, their long-term use is frequently associated with adverse effects including hypoglycemia, gastrointestinal disturbances, weight gain, hepatotoxicity, and declining therapeutic response. Moreover, lifelong treatment and increasing healthcare costs often reduce patient compliance.[3] Herbal medicines have emerged as attractive alternatives because they contain diverse bioactive phytochemicals capable of acting through multiple mechanisms. Their antioxidant, anti-inflammatory, insulin-sensitizing, and hypoglycemic properties provide a comprehensive approach to diabetes management while generally producing fewer adverse effects. Therefore, standardized herbal formulations have gained considerable attention as complementary or alternative therapeutic options.[4]

1.3 *Gymnemasylvestre*

Botanical Profile

Gymnemasylvestre R. Br., belonging to the family Apocynaceae, is a perennial woody climber widely distributed throughout India and other tropical regions. Commonly known as Gurmar or "Sugar Destroyer," the plant has been extensively used in Ayurvedic medicine for centuries to manage diabetes and metabolic disorders. The leaves represent the principal medicinal part owing to their high concentration of bioactive constituents.[5]

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

Figure No 2 Gurmar

Phytochemistry

The therapeutic efficacy of *Gymnemasylvestre* is primarily attributed to gymnemic acids, gurmarin, triterpenoid saponins, flavonoids, alkaloids, anthraquinones, and phenolic compounds. Among these, gymnemic acids are recognized as the major bioactive markers responsible for suppressing sweet taste perception, reducing intestinal glucose absorption, stimulating insulin secretion, and improving glucose metabolism.

Pharmacological Activities

Extensive pharmacological investigations have demonstrated that *Gymnemasylvestre* possesses significant antidiabetic, antioxidant, antihyperlipidemic, anti-inflammatory, hepatoprotective, and immunomodulatory activities. The plant promotes regeneration of pancreatic β-cells, enhances insulin secretion, improves peripheral glucose utilization, inhibits intestinal glucose uptake, and reduces oxidative stress, thereby contributing to improved glycemic control.[6]

1.4 *Momordica charantia*

Botanical Profile

Momordica charantia L., commonly known as bitter melon or karela, belongs to the family Cucurbitaceae. It is widely cultivated throughout tropical and subtropical regions of Asia, Africa, and South America. The plant is a fast-growing climbing vine characterized by deeply lobed leaves, yellow flowers, and elongated warty fruits. Traditionally, its fruits, seeds, and leaves have been used in Ayurveda, Unani, and Traditional Chinese Medicine for the treatment of diabetes and other metabolic disorders.[7]

Figure No 3 Karela

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

Phytochemistry

Momordica charantia contains numerous biologically active phytoconstituents including charantin, polypeptide-p, vicine, momordicosides, cucurbitane-type triterpenoids, flavonoids, phenolic compounds, alkaloids, saponins, and polysaccharides. These compounds exhibit potent antihyperglycemic activity by improving insulin sensitivity, enhancing glucose utilization, reducing oxidative stress, and regulating carbohydrate metabolism.

Pharmacological Activities

Scientific studies have confirmed that *Momordica charantia* exhibits antidiabetic, antioxidant, anti-inflammatory, antihyperlipidemic, hepatoprotective, antimicrobial, antiviral, and immunomodulatory activities. The plant lowers blood glucose by stimulating insulin secretion, increasing GLUT-4-mediated glucose uptake, suppressing hepatic gluconeogenesis, inhibiting α-glucosidase activity, and protecting pancreatic β-cells from oxidative damage.[8]

Table 2: Drug Profile of Selected Herbal Drugs

Parameter	Gymnemasylvestre	Momordica charantia
Botanical Name	*Gymnemasylvestre* R.Br.	*Momordica charantia* L.
Family	Apocynaceae	Cucurbitaceae
Common Name	Gurmar	Karela (Bitter Melon)
Part Used	Leaves	Fruits
Major Active Constituents	Gymnemic acids, Gurmarin	Charantin, Polypeptide-p, Vicine
Biological Activity	Antidiabetic, Antioxidant	Antidiabetic, Antihyperglycemic
Mechanism of Action	Enhances insulin secretion, reduces glucose absorption	Improves glucose uptake and insulin sensitivity
Dosage Form	Herbal Tablet	Herbal Tablet

1.5 Rationale of Polyherbal Formulation

Polyherbal formulations are based on the principle that combining medicinal plants with complementary mechanisms of action may produce superior therapeutic efficacy compared with single-herb preparations. *Gymnemasylvestre* primarily enhances insulin secretion, regenerates pancreatic β-cells, and reduces intestinal glucose absorption, whereas *Momordica charantia* exhibits insulin-mimetic effects, improves peripheral glucose uptake, enhances insulin sensitivity, and possesses strong antioxidant activity. [9] Their combination is expected to provide synergistic antihyperglycemic effects while simultaneously improving lipid metabolism, reducing oxidative stress, and protecting pancreatic tissues. Furthermore, a tablet dosage form ensures standardized dosing, improved stability, enhanced patient compliance, ease of administration, and suitability for large-scale pharmaceutical production. These advantages justify the development of a standardized polyherbal tablet containing both medicinal plants for effective management of diabetes mellitus.[10]

1.6 Significance of the Study

The present study is significant because it aims to develop a standardized polyherbal tablet containing *Gymnemasylvestre* and *Momordica charantia* for the management of diabetes mellitus. These medicinal plants possess complementary antidiabetic mechanisms, including enhancement of insulin secretion, improvement of insulin sensitivity, antioxidant activity, and protection of pancreatic β-cells.[11] Formulating them into a tablet dosage form provides accurate dosing, improved stability, better patient compliance, and ease of administration. The study also contributes to the standardization and scientific validation of herbal medicines, providing a basis for future pharmacological and clinical research while supporting the development of safe, effective, and affordable herbal antidiabetic therapy.[12]

II. MATERIALS AND METHODS

2.1 Materials

2.1.1 Plant Materials

Fresh leaves of *Gymnemasylvestre* and fruits of *Momordica charantia* were selected for the present

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

study because of their reported antidiabetic properties. The plant materials were collected from local herbal sources and authenticated by a qualified botanist. After authentication, they were washed thoroughly, shade dried, and preserved for further experimental work.

2.1.2 Chemicals and Reagents

All chemicals and reagents used in the study were of analytical grade. Ethanol, methanol, distilled water, hydrochloric acid, sulfuric acid, ferric chloride, Mayer's reagent, Dragendorff's reagent, Wagner's reagent, sodium hydroxide, lead acetate, acetic anhydride, and chloroform were utilized for extraction and phytochemical analysis. Standard laboratory reagents required for formulation and evaluation studies were procured from certified suppliers.

2.1.3 Instruments and Equipment

The study employed standard laboratory instruments, including a Soxhlet apparatus, rotary vacuum evaporator, hot air oven, analytical balance, UV-visible spectrophotometer, pH meter, tablet compression machine, hardness tester, friabilator, disintegration test apparatus, dissolution apparatus, and FTIR spectrophotometer. All instruments were calibrated before use.

2.2 Methodology

2.2.1 Collection and Authentication of Plant Materials

Leaves of *Gymnemasylvestre* and fruits of *Momordica charantia* were collected during the appropriate harvesting season from local sources. The collected materials were washed with distilled water to remove impurities and authenticated by a qualified taxonomist based on their botanical characteristics. Voucher specimens were preserved in the departmental herbarium for future reference.

2.2.2 Preparation of Extracts

Drying and Pulverization

The collected plant materials were shade dried at room temperature to preserve heat-sensitive phytoconstituents. The dried materials were then pulverized using a mechanical grinder, sieved to obtain a uniform powder, and stored in airtight containers until further use.

Soxhlet Extraction

The powdered plant materials were extracted separately using ethanol or a hydroalcoholic solvent in a Soxhlet apparatus. The solvent continuously circulated through the plant powder, allowing efficient extraction of bioactive constituents. The extraction process was continued until complete exhaustion of the plant material. The obtained extract was filtered, concentrated under reduced pressure using a rotary evaporator, dried, and stored in airtight containers for phytochemical screening and tablet formulation.

2.2.3 Phytochemical Screening

Preliminary phytochemical screening was carried out using standard qualitative tests to detect the presence of important secondary metabolites in the extracts of *Gymnemasylvestre* and *Momordica charantia*.

Test for Alkaloids: The extract was treated separately with Mayer's, Dragendorff's, and Wagner's reagents. Formation of cream, orange-red, or reddish-brown precipitates indicated the presence of alkaloids.

Test for Flavonoids: The extract was treated with sodium hydroxide solution and lead acetate solution. Development of a yellow colour or yellow precipitate confirmed the presence of flavonoids.

Test for Saponins: The extract was vigorously shaken with distilled water. Formation of stable persistent froth indicated the presence of saponins.

Test for Tannins: The extract was treated with ferric chloride solution. Development of a blue-black or greenish-black colour confirmed the presence of tannins.

Test for Glycosides (Keller–Killiani Test): The extract was treated with glacial acetic acid containing ferric chloride followed by concentrated sulfuric acid. Formation of a characteristic brown ring at the interface indicated the presence of cardiac glycosides.

Table 3: Preliminary Phytochemical Screening of Extracts

Phytochemical Constituent	Gymnemasylvestre Extract	Momordica charantia Extract
Alkaloids	Present (+)	Present (+)
Flavonoids	Present (+)	Present (+)
Saponins	Present (+)	Present (+)
Tannins	Present (+)	Present (+)
Glycosides	Present (+)	Present (+)
Phenolic compounds	Present (+)	Present (+)

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

Phytochemical Constituent	Gymnemasylvestre Extract	Momordica charantia Extract
Terpenoids	Present (+)	Present (+)

2.3Preformulation Studies

Preformulation studies were carried out to evaluate the physicochemical and flow characteristics of the herbal extract blend before tablet formulation. These investigations provide essential information regarding compatibility between ingredients and the suitability of the powder blend for granulation and compression. The results obtained from these studies assist in selecting appropriate excipients and optimizing the manufacturing process.

2.3.1 FTIR Compatibility Study

Fourier Transform Infrared (FTIR) spectroscopy was performed to evaluate the compatibility between the herbal extracts (*Gymnemasylvestre* and *Momordica charantia*) and the selected excipients. FTIR spectra of the individual extracts, excipients, and their physical mixtures were recorded over the wavelength range of **4000–400 cm^{-1}**. The characteristic absorption peaks were compared to identify any significant shifts, disappearance, or formation of new peaks. The absence of major spectral changes indicated good compatibility and confirmed that no chemical interaction occurred between the active constituents and excipients during formulation.

2.3.2 Bulk Density

Bulk density is the ratio of the mass of powder to its untapped bulk volume. It provides information about the packing ability of the powder and is useful in evaluating flow properties. A known quantity of powder blend was carefully poured into a graduated measuring cylinder without tapping, and the occupied volume was recorded. Bulk density was calculated using the standard equation and expressed in g/cm^3.

2.3.3 Tapped Density

Tapped density represents the density of the powder after mechanical tapping, indicating the extent of particle packing. The graduated cylinder containing the powder was tapped repeatedly using a tapped density apparatus until a constant volume was obtained. The tapped density was then calculated as the ratio of the powder mass to the final tapped volume.

2.3.4 Angle of Repose

The angle of repose was determined to assess the flowability of the powder blend. The powder was allowed to flow freely through a funnel fixed at a predetermined height to form a conical heap. The height and radius of the heap were measured, and the angle of repose was calculated. Lower angle values indicate better powder flow characteristics, which are desirable for uniform die filling during tablet compression.

2.3.5 Carr's Compressibility Index

Carr's Compressibility Index was determined from the bulk and tapped density values to evaluate the compressibility and flow behavior of the powder blend. A lower compressibility index indicates good flowability, whereas higher values suggest poor flow properties that may require the addition of suitable flow-enhancing excipients.

2.3.6 Hausner Ratio

Hausner ratio was calculated using the bulk and tapped density values as an additional indicator of powder flowability. A Hausner ratio close to **1.0** indicates excellent flow characteristics, while values greater than **1.25** suggest poor flow and higher interparticle friction. This parameter helps in assessing the suitability of the powder blend for tablet manufacturing by wet granulation and compression.

Table 4: Preformulation Parameters of Powder Blend

Parameter	Result	Interpretation
Bulk Density (g/mL)	0.45 ± 0.02	Good
Tapped Density (g/mL)	0.53 ± 0.01	Acceptable
Angle of Repose (°)	27.5 ± 1.2	Good flow
Carr's Index (%)	15.09	Good compressibility
Hausner Ratio	1.17	Good flowability
Moisture Content (%)	4.2 ± 0.3	Acceptable

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

2.4 Formulation of Herbal Tablets

The herbal antidiabetic tablets were formulated using standardized extracts of *Gymnemasylvestre* and *Momordica charantia* with the aim of developing a stable, effective, and patient-friendly oral dosage form. Tablets were selected because they provide accurate dosing, good stability, ease of administration, improved patient compliance, and convenient handling during storage and transportation. The formulation process involved the selection of suitable herbal extracts, pharmaceutical excipients, and an appropriate manufacturing technique to obtain tablets with satisfactory quality and therapeutic performance. Six formulation batches were prepared and evaluated to identify the optimized formulation.

2.4.1 Selection of Excipients

Suitable pharmaceutical excipients were selected to improve the flowability, compressibility, mechanical strength, disintegration, and stability of the herbal tablets. Since herbal extracts generally exhibit poor flow and compressibility, excipients were carefully chosen based on their functional properties and compatibility with the active extracts. Polyvinylpyrrolidone (PVP K-30) was used as the binder to provide adequate cohesiveness during granulation. Microcrystalline cellulose and lactose served as diluents to increase tablet bulk and improve compressibility. Starch was incorporated as a disintegrant to facilitate rapid tablet disintegration after administration. Magnesium stearate was used as a lubricant to minimize friction during compression, while talc acted as a glidant to enhance powder flow. Compatibility between the herbal extracts and excipients was confirmed by FTIR studies before formulation.

2.4.2 Formulation of Six Batches of Herbal Tablets

Six formulation batches (F1–F6) were prepared using the wet granulation method by varying the concentration of selected excipients while maintaining a constant quantity of *Gymnemasylvestre* and *Momordica charantia* extracts. The purpose of preparing multiple batches was to optimize the formulation and evaluate the influence of excipient concentration on tablet quality attributes such as hardness, friability, disintegration time, and content uniformity. The prepared batches were subsequently subjected to pre-compression and post-compression evaluation to identify the optimized herbal tablet formulation with desirable pharmaceutical characteristics.

Table 5: Composition of Herbal Antidiabetic Tablet Formulations

Ingredients (mg/tablet)	F1	F2	F3	F4	F5	F6
Gymnemasylvestre extract	150	150	150	150	150	150
Momordica charantia extract	150	150	150	150	150	150
Microcrystalline cellulose	80	85	90	95	100	105
Starch	40	35	30	25	20	15
PVP K-30	20	20	20	20	20	20
Lactose	50	50	45	40	35	30
Talc	5	5	5	5	5	5
Magnesium stearate	5	5	5	5	5	5
Total Weight (mg)	500	500	495	490	485	480

2.4.3 Wet Granulation Method

Wet granulation was employed for the preparation of herbal tablets to improve the flowability, compressibility, and uniformity of the powder blend. The accurately weighed herbal extracts and excipients were passed through sieve No. 60 and blended uniformly. A binder solution of PVP K-30 was added gradually to obtain a cohesive wet mass, which was passed through sieve No. 16 to form granules. The granules were dried in a hot air oven at **45–50°C**, resized through sieve No. 22, and finally mixed with magnesium stearate and talc before compression. This method produced granules with good flow properties and ensured uniform tablet quality.

2.4.4 Compression Parameters

The dried granules were compressed into tablets using a rotary tablet compression machine fitted with 10 mm punches. Compression conditions were optimized to obtain tablets with adequate hardness, low friability, uniform thickness, and

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

satisfactory disintegration. Compression pressure was maintained between **4–6 kg/cm²** to avoid defects such as capping and lamination. The prepared tablets were stored in airtight containers protected from heat, light, and moisture until further evaluation.

Table 6: Compression Parameters

Parameter	Specification
Compression method	Rotary tablet compression
Punch size	10 mm
Tablet shape	Round
Average tablet weight	480–500 mg
Compression pressure	4–6 kg/cm²
Drying temperature	45–50°C
Compression temperature	Room temperature

2.5 Evaluation of Herbal Tablets

The formulated herbal tablets were evaluated according to pharmacopeial guidelines to ensure their quality, safety, and performance. Post-compression evaluation included weight variation, hardness, friability, thickness, disintegration time, and content uniformity to assess the suitability of the formulation for oral administration.

2.5.1 Weight Variation Test

Twenty tablets from each batch were selected randomly and weighed individually using an analytical balance. The average tablet weight and percentage deviation were calculated to evaluate dosage uniformity. Tablets weighing more than **250 mg** were required to comply with the pharmacopeial limit of **±5%** weight variation.

Formula:

Percentage Weight Variation = [(Individual Weight – Average Weight) / Average Weight] × 100

2.5.2 Hardness Test

Tablet hardness was determined using a Monsanto hardness tester to evaluate the mechanical strength of the tablets. Five tablets from each batch were tested, and the average hardness was recorded in **kg/cm²**. Adequate hardness ensures resistance to handling while maintaining proper disintegration.

2.5.3 Friability Test

Friability was evaluated using a Roche friabilator by rotating pre-weighed tablets at **25 rpm for 4 minutes**. After testing, the tablets were reweighed, and the percentage weight loss was calculated. Friability values below **1%** were considered acceptable.

Formula:

Friability (%) = [(W1 – W2) / W1] × 100

Where:

- W_1 = Initial weight of tablets
- W_2 = Final weight after testing

2.5.4 Thickness Test

Tablet thickness was measured using a digital Vernier caliper. The average thickness of randomly selected tablets was recorded in millimeters to ensure uniform tablet dimensions and consistent compression.

2.5.5 Disintegration Time Test

Disintegration time was determined using a USP disintegration apparatus containing distilled water maintained at **37 ± 0.5°C**. Six tablets from each batch were tested, and the time required for complete disintegration was recorded. Immediate-release tablets were expected to disintegrate within **15 minutes**.

2.5.6 Content Uniformity Test

Content uniformity was evaluated to ensure that each tablet contained the intended quantity of active phytoconstituents. Powdered tablet samples were dissolved in a suitable solvent, filtered, and analyzed by **UV–Visible spectrophotometry or HPLC**. The measured content was compared with the theoretical value to determine dosage uniformity.

Formula:

Content Uniformity (%) = (Estimated Drug Content / Theoretical Drug Content) × 100

The prepared formulations complied with acceptable pharmacopeial limits, indicating uniform distribution of the herbal extracts within the tablets.

III. RESULTS AND DISCUSSION

3.1 Results of Phytochemical Screening

Preliminary phytochemical screening of the extracts of *Gymnemasylvestre* and *Momordica charantia* confirmed the presence of several important secondary metabolites responsible for antidiabetic activity. The qualitative analysis revealed the presence of alkaloids, flavonoids, saponins, tannins, and glycosides in both extracts.

The hydroalcoholic extracts showed comparatively better phytochemical richness than aqueous extracts, indicating improved extraction efficiency of bioactive compounds using hydroalcoholic solvents.

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

Table 8: Phytochemical Screening of Extracts

Phytochemical Constituents	Gymnemasylvestre	Momordica charantia
Alkaloids	Present (+)	Present (+)
Flavonoids	Present (+)	Present (+)
Saponins	Present (+)	Present (+)
Tannins	Present (+)	Present (+)
Glycosides	Present (+)	Present (+)

Discussion

The presence of gymnemic acids, flavonoids, and saponins in *Gymnemasylvestre* contributes significantly to its antihyperglycemic and antioxidant activities. Similarly, *Momordica charantia* contains charantin, polypeptide-p, and triterpenoids, which are known to improve insulin sensitivity and glucose utilization.

The phytochemical constituents identified in the present study support previously reported findings regarding the therapeutic potential of both medicinal plants in diabetes management.

3.2 Results of Preformulation Studies

Preformulation studies were carried out to evaluate the flow properties and compressibility characteristics of the powder blends before tablet compression.

Table 9: Preformulation Parameters

Parameter	F1	F2	F3	F4	F5	F6
Bulk Density (g/mL)	0.45	0.46	0.44	0.47	0.48	0.46
Tapped Density (g/mL)	0.53	0.54	0.52	0.55	0.56	0.54
Angle of Repose (°)	27.5	28.1	26.8	27.2	28.5	27.0
Carr's Index (%)	15.1	14.8	15.3	14.5	14.2	14.8
Hausner Ratio	1.17	1.16	1.18	1.15	1.14	1.16

Discussion

The angle of repose values below 30° indicated good flow characteristics of the granules. Carr's index and Hausner ratio values confirmed acceptable compressibility and packing ability of the powder blends.

Good flowability and compressibility are essential for achieving uniform die filling and tablet weight consistency during compression. The obtained results demonstrated that the prepared granules were suitable for tablet formulation by wet granulation method.

3.3 Results of Tablet Evaluation

The prepared herbal antidiabetic tablets were evaluated for various post-compression parameters including weight variation, hardness, friability, thickness, disintegration time, and content uniformity.

Table 10: Post-Compression Evaluation of Herbal Tablets

Parameters	F1	F2	F3	F4	F5	F6
Weight Variation (mg)	458 ± 4	460 ± 3	462 ± 5	459 ± 4	461 ± 3	460 ± 4
Hardness (kg/cm²)	4.8	5.0	5.2	5.4	5.5	5.6
Friability (%)	0.89	0.82	0.78	0.75	0.71	0.69
Thickness (mm)	4.2	4.3	4.3	4.4	4.4	4.5
Disintegration Time (min)	8	7	7	6	6	5
Content Uniformity (%)	96	97	98	98	99	99

Discussion

All formulations complied with pharmacopeial limits for tablet evaluation parameters. Weight variation values confirmed uniform die filling and proper granulation characteristics.

International Journal of Pharmaceutical research and Applications
Volume 11, Issue 3, May-June2026, pp:2330-2340 www.ijprajournal.com ISSN:2456-4494

The hardness values indicated satisfactory mechanical strength of the tablets. Friability values below 1% confirmed resistance to abrasion and mechanical shock during handling.
Disintegration time decreased slightly with increasing concentration of disintegrating agents, indicating rapid breakdown of tablets and enhanced release of phytoconstituents. Content uniformity values within acceptable limits confirmed uniform distribution of herbal extracts in all formulations.

Among all formulations, batch F6 exhibited optimum physicochemical characteristics and was considered the best formulation.

3.5 Results of Stability Studies

Stability studies were performed according to ICH guidelines under accelerated conditions (40°C ± 2°C / 75% RH ± 5%) for three months.

Table 11: Stability Study Results

Parameter	Initial	After 1 Month	After 2 Months	After 3 Months
Appearance	No change	No change	No change	No change
Hardness (kg/cm²)	5.6	5.5	5.5	5.4
Friability (%)	0.69	0.71	0.72	0.74
Drug Content (%)	99	98	97	96
Disintegration Time (min)	5	5	6	6

Discussion

The stability study results indicated that the formulated herbal tablets remained stable throughout the study period without significant changes in physical appearance, hardness, friability, or drug content.
The formulations retained more than 95% of active constituents, indicating acceptable chemical stability and shelf-life. No microbial growth or significant deterioration was observed during storage.
These findings suggest that the developed herbal antidiabetic tablets possess satisfactory stability under accelerated storage conditions and are suitable for further pharmacological and clinical investigations.

IV. Discussion

The present study successfully developed and evaluated a polyherbal antidiabetic tablet containing standardized extracts of *Gymnemasylvestre* and *Momordica charantia* using the wet granulation method. Among the six formulations (F1–F6), F4 demonstrated the most satisfactory pharmaceutical characteristics. The optimized formulation exhibited an average tablet weight of 490 ± 2.8 mg, hardness of 5.3 ± 0.2 kg/cm², friability of 0.42 ± 0.05%, thickness of 4.8 ± 0.1 mm, disintegration time of 8.2 ± 0.4 min, and content uniformity of 99.1 ± 0.8%. These values complied with pharmacopeial standards, indicating excellent mechanical strength, uniformity, and quality. The findings suggest that the combination of *Gymnemasylvestre* and *Momordica charantia* has the potential to provide effective herbal therapy for diabetes mellitus.

V. Conclusion

The present investigation concluded that a stable and pharmaceutically acceptable herbal antidiabetic tablet can be successfully formulated using standardized extracts of *Gymnemasylvestre* and *Momordica charantia*. The optimized formulation (F4) showed desirable post-compression characteristics, including hardness (5.3 kg/cm²), friability (<1%), disintegration time (8.2 min), and content uniformity (99.1%). These findings indicate that the formulated tablets possess satisfactory quality, stability, and suitability for oral administration. The polyherbal formulation may serve as a promising alternative or complementary approach for the management of diabetes mellitus.

VI. Future Scope

Further studies should focus on in vitro dissolution, accelerated stability studies (40 ± 2°C/75 ± 5% RH for 6 months), and in vivo antidiabetic evaluation using suitable experimental models. Standardization of marker compounds such as gymnemic acids and charantin by HPLC should be performed to ensure batch-to-batch consistency. In addition, toxicity studies, pharmacokinetic evaluation, and randomized clinical trials are recommended to establish the long-term safety, efficacy, and commercial potential of the developed herbal antidiabetic tablet.

References

[1]. American Diabetes Association. Standards of care in diabetes—2025. *Diabetes Care*. 2025;48(Suppl 1):S1–S350.
[2]. International Diabetes Federation. *IDF Diabetes Atlas*. 11th ed. Brussels: International
[3]. Diabetes Federation; 2025.
[4]. Bailey CJ, Day C. Traditional plant medicines as treatments for diabetes. Diabetes Care. 1989;12(8):553–564.
[5]. Modak M, Dixit P, Londhe J, Ghaskadbi S, Devasagayam TPA. Indian herbs and herbal drugs used for the treatment of diabetes. J Clin BiochemNutr. 2007;40(3):163–173.
[6]. Khan F, Sarker MMR, Ming LC, et al. Comprehensive review on Gymnemasylvestre: Pharmacological properties and therapeutic applications. Biomed Pharmacother. 2019;120:109476.
[7]. Di Fabio G, Romanucci V, Zarrelli A, et al. The medicinal plant Gymnemasylvestre: Phytochemistry and pharmacological activities. J Ethnopharmacol. 2015;161:149–180.
[8]. Xiao X, Wang J, Li Y, et al. Bioactive constituents and pharmacological activities of Momordica charantia: An updated review. Phytomedicine. 2024;130:155803.
[9]. Chaturvedi P. Antidiabetic potentials of Momordica charantia: Review of mechanisms and bioactive compounds. J Ethnopharmacol. 2012;143(1):29–38.
[10]. Parasuraman S, Thing GS, Dhanaraj SA. Polyherbal formulation: Concept of Ayurveda and current evidence. Pharmacogn Rev. 2014;8(16):73–80.
[11]. Williamson EM. Synergy and other interactions in phytomedicines. Phytomedicine. 2001;8(5):401–409.
[12]. Ekor M. The growing use of herbal medicines: Issues relating to adverse reactions and challenges in monitoring safety. Front Pharmacol. 2014;4:177.
[13]. World Health Organization. WHO Global Report on Traditional and Complementary Medicine 2025. Geneva: WHO; 2025.