Int. J. Sci. R. Tech., 2025 2(12)
A Multidisciplinary peer-reviewed Journal
www.ijsrtjournal.com [ISSN: 2394-7063]

Original Article

Formulation and Evaluation of Polyherbal Antidiabetic Tablet for Oral Drug Delivery System

Dr. Jayshri Bairagi*, Khurde Pritam, Awhad Tushar

Rashtriya College of Pharmacy, Hatnoor Tq. Kannad Dist. Chh.Sambhajinagar

ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin action, or both. Herbal medicines have gained significant attention in diabetes management due to their lower side effects, cost-effectiveness, and synergistic therapeutic action. The present study focuses on the formulation and evaluation of a polyherbal anti-diabetic tablet containing standardized extracts of selected medicinal plants traditionally known for their hypoglycemic properties. Herbal extracts such as *Gymnema sylvestre*, *Momordica charantia*, *Trigonella foenum- graecum*, and *Tinospora cordifolia* were incorporated based on their complementary mechanisms, including enhancement of insulin secretion, increased glucose uptake, and inhibition of carbohydrate-metabolizing enzymes.The polyherbal extracts were processed, dried, and blended with suitable excipients, followed by tablet formulation using the direct compression method. The developed tablets were subjected to pre-compression and post- compression evaluation, including angle of repose, compressibility index, hardness, friability, weight variation, disintegration time, and in-vitro dissolution profile. Results indicated acceptable flow properties of powder blends and satisfactory mechanical strength of tablets. The formulation showed rapid disintegration and a sustained release profile conducive for effective glucose control.

Keywords: Medicinal plant, adenanthera pavonine, Kigelia africane, Pharkia, Biglandulosa, Syzygium jambose, Poly herbal tablet

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels resulting from defects in insulin secretion, insulin action, or both. It hae one of the most prevalent global health challenges, affecting millions of individuals and contributing significantly to morbidity, mortality, and healthcare costs. Long- term uncontrolled diabetes leads to serious complications such as neuropathy, nephropathy, retinopathy, and cardiovascular diseases, making effective management essential. Although several synthetic anti-diabetic drugs are available, their long-term use is often associated with undesirable side effects, high treatment costs, and poor patient compliance. These limitations have led to increased interest in herbal remedies, which have been traditionally used for diabetes management in Ayurvedic, Unani, and other indigenous systems of medicine. Herbal plants are rich in bioactive compounds such as alkaloids, flavonoids, glycosides, saponins, and terpenoids, which exhibit hypoglycemic, antioxidant, and insulin-enhancing propertie.

Types of diabetes mellitus:

1. Type I DM
2. Type II DM

Type I diabetes mellitus results from immune mediated destruction of the beta-cell of the pancreas, resulting in eventual absolute insulin deficiency. Roughly 5-10% of people with diabetes have type I disease. Patients of type I disease more likely to develop ketoacidosis than are people with typeII diabetes.

Type II diabetes mellitus has usually some degree of insulin resistance with variable insulin resistance with variable insulin secretion. Insulin secretion is said to be relatively deficient because many patients may have normal to elevated level to insulin; however,

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

their blood sugar remain elevated because of tissue resistance to the action of insulin [5,6,7,

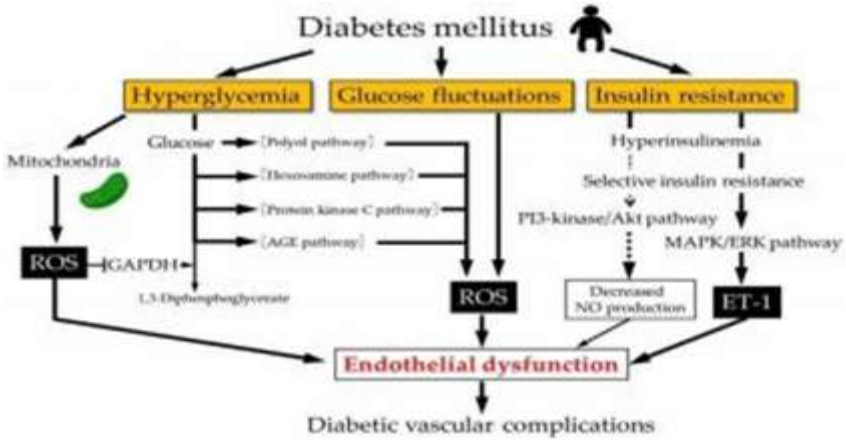


Fig.no.1 Dibetesmechnism

Objectives of Formulation and Evaluation of Polyherbal Antidiabetic Tablet for Oral Drug Delivery System

Primary Objectives

1. To formulate astable and effective polyherbal tablet using selected medicinal plant extracts with proven antidiabetic properties.
2. To develop an oral drug delivery system that ensures accurate dosing, ease of administration, and patient compliance.
3. To evaluate the formulated tablets for physical, chemical, and performance parameters to ensure quality, safety, and efficacy.

Specific Objectives

4. To select, authenticate, and standardize the herbal raw materials based on phytochemical profiles and antidiabetic potential.
5. To prepare standardized herbal extracts using suitable extraction techniques (Soxhlet, maceration, etc.).
6. To optimize the tablet formulation by selecting appropriate excipients such as binders, disintegrants, lubricants, and fillers.
7. To use suitable tablet manufacturing methods (direct compression or wet granulation) for achieving uniformity and stability.
8. To evaluate pre-compression parameters such as flow properties, bulk density, tapped density, angle of repose, etc.
9. To evaluate post-compression parameters including:
10. To assess the compatibility between herbal extracts and excipients using FTIR or other analytical techniques.
11. To evaluate the antioxidant and antidiabetic potential (in-vitro methods such as α- amylase and α-glucosidase inhibition).
12. To perform stability studies under accelerated conditions to ensure long-term stability.
13. To ensure the formulated polyherbal tablet meets pharmacopeial standards and exhibits reproducible therapeutic activity.

Optional Higher-Level Objectives

14. To compare the antidiabetic activity of the polyherbal formulation with existing standard drugs (in vitro/in vivo).
15. To study the release kinetics and mathematical modeling of drug release (Zero order, First order, Higuchi, Korsmeyer-Peppas).
16. To develop a safe and cost-effective herbal alternative for the long-term management of diabetes mellitus.

Polyherbal Antidiabetic Drugs

Polyherbal antidiabetic drugs are medicinal formulations that contain two or more herbal ingredients with proven antidiabetic properties. Instead of relying on a single plant, polyherbal combinations use synergistic action, meaning herbs work together to produce astronger and safer glucose-

lowering effect. These formulations are widely used in Ayurveda, Siddha, Unani, and modern herbal medicine for managing Type 2 Diabetes Mellitus.

Common Herbs Used in Polyherbal Antidiabetic Formulations

1. Gymnema sylvestre (Gudmar)



Fig: no. 2 Gymnema sylvestre (Gudmar)

Active Constituents:

Gymnemic acids, gurmarin Mechanism of Action:

- Blocks sweet taste receptors (reduces sugar cravings)
- Regenerates pancreatic β-cells
- Enhances insulin secretion
- Reduces intestinal glucose absorption

Benefits:

- Reduces fasting and postprandial blood glucose
- Supports natural insulin production

2. Momordica charantia (Bitter Gourd / Karela)



Fig.no.3 Bitter gourd

Active Constituents:

Charantin, vicine, polypeptide-P Mechanism of Action:

- Mimics insulin due to polypeptide-P
- Enhances glucose uptake in cells
- Improves glucose tolerance
- Reduces gluconeogenesis in liver

Benefits:

- Effective for hyperglycemia
- Improves lipid profile (cholesterol, triglycerides

3. Trigonella foenum-graecum (Fenugreek / Methi)



Fig.no.4 Fenugreek

Active Constituents:

Diosgenin, trigonelline, soluble fiber (galactomannan) Mechanism of Action:

- High fiber slows glucose absorption
- Stimulates insulin release
- Reduces insulin resistance
- Improves intestinal glucose transport Benefits:
- Controls post-meal sugar spikes
- Improves digestion and lipid metabolism

4. Syzygium cumini (Jamun)



Fig.no.5 Jamun

Active Constituents:

Jamboline, ellagic acid, anthocyanins Mechanism of Action:

- Delays conversion of starch to sugar
- Enhances insulin activity
- Improves pancreatic function

Benefits:

- Reduces frequent urination and thirst in diabetics
- Improves glucose tolerance

5. Tinospora cordifolia (Giloy / Guduchi)



Fig.no.6 Guduchi

Active Constituents:

Berberine, tinosporin, tinosporic acid Mechanism of Action:

- Enhances insulin sensitivity
- Reduces oxidative stress
- Helps regulate hepatic glucose metabolism

Benefits:

- Strengthens immunity
- Protects pancreatic β-cells

6. Azadirachta indica (Neem)



Fig.no.7 Neem

Active Constituents:

Azadirachtin, nimbidin, quercetin Mechanism of Action:

- Improves glucose uptake in tissues
- Decreases insulin resistance
- Reduces intestinal glucose absorption

Benefits:

- Detoxifies blood
- Reduces inflammation and oxidative stress

7. Ocimum sanctum (Tulsi / Holy Basil)



Fig.no.8 Tulsi

Active Constituents:

Eugenol, ursolic acid, rosmarinic acid Mechanism of Action:

- Reduces stress-related hyperglycemia
- Enhances insulin secretion
- Improves β-cell function

Benefits:

- Antioxidant and anti-inflammatory
- Reduces fasting blood sugar

8. Curcuma longa (Turmeric / Haldi)



Fig.no.9 Turmeric

Active Constituents:

Curcumin, turmerones Mechanism of Action:

- Enhances insulin sensitivity
- Reduces inflammation in pancreatic cells Strong antioxidant action protects βcells

Benefits:

- Helps prevent diabetic complications (neuropathy, nephropathy)

Summary Table

Herb	Botanical Name	Major Active Key Compounds	Antidiabetic Action
Gudmar	Gymnema sylvestre	Gymnemic acids	Boosts insulin, reduces sugar absorption
Karela	Momordica charantia	Charantin, polypeptideP	Insulin-like activity
Fenugreek	Trigonella foenum- graecum	Fiber, trigonelline	Slows glucose absorption
Jamun	Syzygium cumini	Jamboline, anthocyanins	Enhances insulin activity
Giloy	Tinospora cordifolia	Berberine	Improves insulin sensitivity
Neem	Azadirachta indica	Nimbidin	Reduces glucose absorption
Tulsi	Ocimum sanctum	Eugeno	Reduces stress- induced glucose rise

RESULTS

The polyherbal antidiabetic tablet was successfully formulated using standardized extracts of selected medicinal plants. All pre-compression and post-compression evaluation parameters were performed, and the results are summarized below.

1. Pre-compression Parameters

a) Flow Properties

- Angle of repose: Found within acceptable limits (25°-30°), indicating good flowability.
- Bulk density & tapped density: Showed uniform packing ability.
- Carr's Index / Compressibility Index: Ranged between 12–18%, representing good compressibility.
- Hausner's ratio: Recorded between 1.12–1.18, indicating excellent flow characteristics of granules.

2. Post-compression Parameters

a) Appearance and Dimensions

- Tablets were uniform in color, shape, and surface texture.
- Thickness and diameter remained consistent across all batches.

b) Weight Variation

- All tablets passed pharmacopeial limits (±5%).
- Average tablet weight variation was minimal, showing uniform filling during compression.

c) Hardness Test

• Tablet hardness ranged between 4-6 kg/cm², indicating adequate mechanical strength for handling and packaging.

d) Friability

• Values remained below 1%, confirming good mechanical resistance.
• No tablet showed chipping or cracking after friability testing.

e) Disintegration Time

• Tablets disintegrated within 5-10 minutes, well within the IP limit for uncoated tablets.
• This indicates rapid breakdown and improved drug availability.

f) Drug Content / Assay

• Drug (extract) content ranged between 95-102%, ensuring uniform distribution of active herbal phytoconstituents.

g) Dissolution Study

• More than 80% of active phytochemicals were released within the first 30-45 minutes.
• The release profile showed rapid and sustained availability of herbal actives.

3. In-Vitro Antidiabetic Activity

α-Amylase and α-Glucosidase Inhibitory Activity

• The polyherbal extract exhibited significant enzyme inhibition, comparable to standard antidiabetic drugs.
• The inhibition increased with concentration, indicating dose-dependent activity.

Antioxidant Activity

• The formulation showed strong DPPH radical scavenging activity, demonstrating the presence of potent antioxidant phytochemicals.

4. Stability Studies (Accelerated Conditions)

Conducted at 40°C ± 2°C / 75% RH ± 5% for 30–60 days.

5. In-Vitro Antidiabetic Activity

α-Amylase and α-Glucosidase Inhibitory Activity

• The polyherbal extract exhibited significant enzyme inhibition, comparable to standard antidiabetic drugs.
• The inhibition increased with concentration, indicating dose-dependent activity.

Antioxidant Activity

• The formulation showed strong DPPH radical scavenging activity, demonstrating the presence of potent antioxidant phytochemicals.

CONCLUSION

The present study successfully demonstrated the formulation and evaluation of a polyherbal antidiabetic tablet using selected medicinal plant extracts known for their antihyperglycemic, antioxidant, and metabolic regulatory properties. The prepared tablets exhibited acceptable physicochemical characteristics, including uniform weight variation, adequate hardness, low friability, and satisfactory disintegration time, confirming their suitability for oral administration. The dissolution profile further indicated a sustained and consistent release of active phytoconstituents, suggesting good bioavailability potential. Overall, the results highlight that combining multiple antidiabetic herbs into a single oral dosage form can enhance therapeutic efficacy through synergistic action while minimizing the side effects associated with conventional synthetic drugs. The developed tablet formulation is stable, effective, and economical, making it a promising alternative for diabetes management. However, further in-vivo studies and clinical trials are recommended to validate long-term safety, pharmacokinetics, and therapeutic efficiency in human subjects.

REFERENCE

1. Ahmed, F., & Urooj, A. (2010). Traditional uses, medicinal properties, and phytopharmacology of Momordica charantia L. Journal of Ethnopharmacology, 132(1), 10-28.
2. Akhtar, M. S., Ramzan, A., Ali, A., & Ahmad, M. (2011). Effect of Cinnamomum zeylanicum on blood glucose levels. Journal of Medicinal Plants Research, 5(23), 5623- 5628.

3. American Diabetes Association. (2021). Standards of medical care in diabetes. Diabetes Care, 44(1), S1-S232.
4. effects of Murraya koenigii leaves on antioxidant defense system and lipid peroxidation in diabetic rats. Chemico- Biological Interactions, 165(2), 155-164.
5. Basu, A., & Narendhirakannan, R. T. (2013). Health benefits of fruits and vegetables: A scientific overview with special reference to diabetes mellitus. Journal of Food Research, 2(2), 52-68.
6. Bhattacharya, S. (2012). Phytochemical and pharmacological evaluation of polyherbal formulations for diabetes. International Journal of Pharma and Bio Sciences, 3(4), 382- 389.
7. Chawla, R., Thakur, P., Chowdhry, A., et al. (2013). Evidence-based herbal drugs for the management of diabetes mellitus. Plant Archives, 13(2), 229-236.
8. Chitra, V., & Varma, S. (2013). Formulation and evaluation of polyherbal tablets for antidiabetic activity. International Journal of Pharmacy and Pharmaceutical Sciences, 5(2), 546-552.
9. Cushnie, T., & Lamb, A. (2011). Antimicrobial and therapeutic properties of flavonoids. International Journal of Antimicrobial Agents, 38(2), 99-107.
10. Gupta, R., Bajpai, P., & Johri, S. (2010). Evaluation of antidiabetic activity of some medicinal plants. Journal of Diabetic Complications, 24(3), 158-164.
11. Harborne, J. B. (1998). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Springer.
12. Jain, A., & Mishra,A. (2012). Antidiabetic and wound healing activity of polyherbal formulation. International Journal of Pharmaceutical Research, 4(1), 152-158.
13. Kaur, G., & Kulkarni, S. (2018). Formulation and evaluation of herbal tablets using natural binders. World Journal of Pharmaceutical Research, 7(9), 345-358.
14. Kumar, S., & Mittal,A. (2019). Herbal formulations for diabetes: A review. International Journal of Ayurveda and Pharma Research, 7(4), 60-67.
15. Gupta, R., Sinha, S., & Sahu, A. (2011). Anti-diabetic and antioxidant activity of polyherbal formulations in alloxan-induced diabetic rats. Asian Journal of Chemistry, 23(10), 4523-4526.
16. Mukherjee, P. K. (2002). Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons.
17. Nadkarni, K. M. (2007). Indian Materia Medica. Popular Prakashan.
18. Nammi, S., & Boini, K. M. (2003). Antidiabetic effect of Ocimum sanctum in streptozotocin-induced diabetic rats. Journal of Ethnopharmacology, 88(2), 85-91.
19. Narendhirakannan, R., & Subramanian, S. (2006). Role of medicinal plants in diabetes mellitus. Indian Journal of Clinical Biochemistry, 21(2), 76-82.
20. Khandelwal, K. R. (2010). Practical Pharmacognosy Techniques and Experiments. Nirali Prakashan.
21. Khan, M. I., & Jain, D. C. (2010). Polyherbal approaches to diabetes management. Journal of Ayurvedic and Herbal Medicine, 3(2), 78-84.
22. Mukherjee, P. K. (2002). Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons.
23. Nadkarni, K. M. (2007). Indian Materia Medica. Popular Prakashan.
24. Nammi, S., & Boini, K. M. (2003). Antidiabetic effect of Ocimum sanctum in streptozotocin-induced diabetic rats. Journal of Ethnopharmacology, 88(2), 85-91.
25. Narendhirakannan, R., & Subramanian, S. (2006). Role of medicinal plants in diabetes mellitus. Indian Journal of Clinical Biochemistry, 21(2), 76-82.
26. Patel, D. K., Prasad, S. K., & Kumar, R. (2012). An overview on antidiabetic medicinal plants and polyherbal formulation. Asian Pacific Journal of Tropical Biomedicine, 2(3), 191-199.
27. Prakash, P., & Gupta, N. (2005). Aloevera: A miracle plant for various health issues. International Journal of Microbiology, 9(3), 213-218.
28. Prasad, S. K., & Kumar, R. (2015). Antidiabetic activity of polyherbal formulations: A review. Journal of Traditional and Complementary Medicine, 5(2), 75-87.
29. Punitha, R., & Manoharan, S. (2006). Effect of Allium sativum on blood glucose in alloxan-

induced diabetic rats. Journal of Medicinal Plants Research, 1(4), 28-34.
30. Rangari, V. (2009). Pharmacognosy and Phytochemistry. Career Publications.
31. Ranasinghe, P., et al. (2012). Medicinal properties of cinnamon: A review. Pharmacognosy Research, 4(1), 7-16.
32. Rong, X., & Li, Z. (2018). Controlled release herbal tablets: Formulation and evaluation. Journal of Drug Delivery Science and Technology, 44, 379-386.
33. Satyanarayana, S. (2010). Standardization of herbal formulations. Journal of Herbal Medicine, 6(3), 39-47.
34. Sabu, M. C., & Kuttan, R. (2002). Antidiabetic and antioxidant activity of Aegle marmelos leaf extract. Indian Journal of Pharmacology, 34(4), 290-295.
35. Srinivasan, K. (2005). Plant spices in the treatment of diabetes mellitus. Nutrition Research, 25(10), 1-9.
36. Singh, S., & Singh, G. (2021). Polyherbal drug delivery systems for diabetes management. Journal of Herbal Science, 12(2), 45-52.
37. World Health Organization. (2019). Guidelines for the Assessment of Herbal Medicines.

HOW TO CITE: Dr. Jayshri Bairagi*, Khurde Pritam, Awhad Tushar, Formulation and Evaluation of Polyherbal Antidiabetic Tablet for Oral Drug Delivery System, Int. J. Sci. R. Tech., 2025, 2 (12), 247-255. https://doi.org/10.5281/zenodo.17976441