WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.63
Volume 15, Issue 15, 1411-1428. Research Article ISSN 2277–7105

A RESEARCH ON FORMULATION AND EVALUATION OF ANTIDIABETIC TABLET FROM *COSTUS IGNEUS* AND *FENUGREEK*

Santoshkumar Anandrao Shewale*[1], Pratiksha Ganesh Sate[2], Rutuja Namdev Awale[3], Pallavi Sandip Tate[4]

[1,2,3]Student, Shree Santkrupa College of Pharmacy, Ghogaon.

[4]Assistant Professor, Shree Santkrupa College of Pharmacy, Ghogaon.

Article Received on 03 July 2026,
Article Revised on 24 July 2026,
Article Published on 01 Aug. 2026,

https://doi.org/10.5281/zenodo.21698275

***Corresponding Author**

Santoshkumar Anandrao Shewale

Student, Shree Santkrupa College of Pharmacy, Ghogaon.

How to cite this Article: Santoshkumar Anandrao Shewale*[1], Pratiksha Ganesh Sate[2], Rutuja Namdev Awale[3], Pallavi Sandip Tate. (2026). A Research on Formulation and Evaluation of Antidiabetic Tablet From Costus Igneus and Fenugreek. World Journal of Pharmaceutical Research, 15(11), 1411–1428.

ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. The increasing global prevalence of diabetes, particularly in developing countries such as India, highlights the need for effective and affordable therapeutic approaches. Herbal medicines have gained considerable attention due to their multi-targeted mechanisms, safety profile, and cost-effectiveness. The formulated tablets exhibited satisfactory physicochemical properties, including uniform weight distribution, adequate hardness, low friability (<1%), and acceptable disintegration time (within 15 minutes). Dissolution studies demonstrated effective release of active constituents within the specified time frame. The combination of *Costus igneus* and *Trigonella foenum-graecum* is expected to provide synergistic antidiabetic effects through mechanisms such as improved insulin sensitivity, enhanced glucose uptake, and antioxidant activity. In conclusion, the developed polyherbal tablet showed promising pharmaceutical characteristics and may serve as a potential alternative or adjunct therapy for the management of diabetes mellitus. However, further pharmacological and clinical studies are required to substantiate its therapeutic efficacy and safety.

KEYWORDS: *Diabetes mellitus, Costus igneus, Trigonella foenum-graecum, Antidiabetic activity, Polyherbal tablet.*

1. INTRODUCTION

The number of people living with diabetes in urban areas is expected to increase to 472.6 million in 2045 mainly due to global urbanization, according to the latest 2017 data from the International Diabetes Federation (IDF). Diabetes mellitus is a constant ailment which causes a great many deaths worldwide every year because of the related difficulties.

The term diabetes is the shortened version of the full name diabetes mellitus. Diabetes mellitus is derived from the Greek word *diabetes* meaning "siphon – to pass through" and the Latin word *mellitus* meaning "honeyed" or "sweet". This is because in diabetes excess sugar is found in blood as well as the urine. It was known in the 17th century as the "pissing evil". The term diabetes was probably coined by Apollonius of Memphis around 250 B.C. In 1910, Sir Edward Albert Sharpey-Schafer suggested that people with diabetes were deficient in a single chemical that was normally produced by the pancreas. He proposed calling this substance "insulin", from the Latin *Insula*, meaning "Island", in reference to the insulin-producing Islets of Langerhans in the pancreas.

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. It is one of the most significant non-communicable diseases worldwide, posing a major public health challenge due to its rapidly increasing prevalence and long-term complications. According to global health reports, the incidence of diabetes has risen dramatically over the past few decades, particularly in developing countries such as India, where urbanization, sedentary lifestyles, dietary transitions, and genetic predisposition contribute significantly to disease burden.[1]

DM is broadly classified into several types, with Type 1 diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM) being the most prevalent. T1DM is an autoimmune disorder characterized by the destruction of pancreatic β-cells, leading to absolute insulin deficiency. In contrast, T2DM is characterized by insulin resistance combined with a relative insulin deficiency and accounts for nearly 90–95% of all diabetes cases. Other forms include gestational diabetes mellitus and secondary diabetes resulting from endocrine disorders or drug-induced causes.[2] Chronic hyperglycaemia associated with diabetes can lead to severe microvascular complications such as neuropathy, nephropathy, and retinopathy, as well as macrovascular complications including cardiovascular diseases, stroke, and peripheral vascular disorders.

The pathophysiology of diabetes involves complex interactions between genetic, environmental, and lifestyle factors. Insulin resistance, impaired glucose uptake, increased hepatic glucose production, and oxidative stress play critical roles in disease progression. Additionally, chronic inflammation and the generation of reactive oxygen species (ROS) contribute to pancreatic β-cell dysfunction and the development of diabetic complications. Effective management of diabetes therefore requires a multi-targeted therapeutic approach that addresses not only blood glucose levels but also associated metabolic disturbances.[3,4]

Conventional management strategies for diabetes include lifestyle modifications such as diet control and physical activity, along with pharmacological interventions like oral hypoglycaemic agents and insulin therapy. Although these treatments are effective in controlling blood glucose levels, they are often associated with limitations such as adverse effects, high cost, risk of hypoglycaemia, and reduced patient compliance during long-term use. These challenges have prompted increasing interest in alternative and complementary therapeutic approaches, particularly those derived from medicinal plants. Herbal medicines have been used for centuries in traditional systems of medicine such as Ayurveda, Siddha, and Unani for the management of diabetes. These natural remedies are gaining renewed scientific attention due to their multi-targeted mechanisms of action, relatively favourable safety profiles, and cost-effectiveness. Many medicinal plants exhibit antidiabetic properties through mechanisms such as enhancing insulin secretion, improving insulin sensitivity, inhibiting carbohydrate-digesting enzymes, reducing intestinal glucose absorption, and providing antioxidant and anti-inflammatory effects. Moreover, phytochemicals such as flavonoids, alkaloids, saponins, and terpenoids play a crucial role in mediating these therapeutic effects.[5,6]

The concept of polyherbal formulation is based on the principle of synergism, where the combined effect of multiple herbal ingredients produces enhanced therapeutic efficacy compared to individual components. Polyherbal formulations can target multiple pathways involved in diabetes pathogenesis, thereby offering a more comprehensive approach to disease management.

1.2 PLANT INTRODUCTION

Costus igneus (also known as blazing costus, step ladder, spiral flag, or insulin plant) is a medicinal plant belonging to the family Costaceae. It is native to South and Central America and was later introduced to India, where it gained popularity as a traditional herbal remedy

for diabetes because of its remarkable antihyperglycemic activity. Due to its ability to help regulate blood glucose levels, it is commonly known as the insulin plant.

The plant is widely cultivated as an ornamental species in South India owing to its attractive spiral arrangement of leaves and bright orange flowers. It also grows naturally in several tropical and subtropical regions. In India, particularly in Tamil Nadu, the leaves are traditionally consumed by diabetic patients, with one fresh leaf taken daily to assist in maintaining normal blood glucose levels. Indigenous tribes inhabiting the Kolli Hills of Namakkal district have long utilized the leaves of *Costus igneus* in the management of diabetes.[2–4]

Costus igneus is a perennial, evergreen herb that grows up to 2 feet (60 cm) in height. It possesses broad, dark green leaves arranged spirally around the stem and produces attractive orange-colored flowers. Native to eastern Brazil, the plant has adapted well to the climatic conditions of southern India and is now cultivated extensively in home gardens and herbal plantations. Besides its antidiabetic potential, the plant exhibits significant antioxidant activity, which enhances immune function and provides protection against bacterial infections.[5]

Fig. 1: *Costus igneus.*

1.2.1 SCIENTIFIC CLASSIFICATION

Table 1: Scientific Classification of *Costus igneus.*

Parameter	**Classification**
Botanical Name	*Costus igneus*
Synonyms	Spiral Flag, Fiery Costus, Insulin Plant
Kingdom	Plantae
Subkingdom	Viridiplantae
Class	Liliopsida

Subclass	Commelinidae
Order	Zingiberales
Family	Costaceae
Genus	*Costus*

1.2.2 CHEMICAL CONSTITUENTS

Phytochemical investigations have revealed that *Costus igneus* leaves are rich in several bioactive constituents responsible for their medicinal properties. The leaves contain antioxidant compounds such as ascorbic acid, α-tocopherol, β-carotene, flavonoids, terpenoids, and steroids, along with appreciable amounts of proteins and iron. Phytochemical screening has shown that the methanolic extract contains the highest concentration of bioactive constituents, including proteins, carbohydrates, triterpenoids, alkaloids, tannins, saponins, flavonoids, glycosides, and steroids.[7,8]

Preliminary phytochemical analysis demonstrated that the leaves contain approximately 21.2% crude fiber. Successive solvent extraction yielded 5.2% extractives in petroleum ether, 1.06% in cyclohexane, 1.33% in acetone, and 2.95% in ethanol. The ethanol extract was found to contain alkaloids, while the ether fraction predominantly consisted of bis(2-ethylhexyl)-1,2-benzenedicarboxylate (59.04%), along with α-tocopherol and ergastanol. Studies on the stem have also identified the steroid stigmasterol and the triterpenoid lupeol, both of which contribute to the pharmacological activities of the plant.[9,10,15]

Overall phytochemical screening confirmed the presence of steroids, triterpenoids, alkaloids, tannins, flavonoids, glycosides, saponins, carbohydrates, and proteins, with methanol being the most effective extraction solvent.[19,20]

1.2.3 MEDICINAL USES

The medicinal properties of *Costus igneus* have been extensively studied, particularly for its antidiabetic activity. The major therapeutic uses include:

1. **Reduces Fasting Blood Glucose:** Helps lower fasting blood glucose levels by improving glucose metabolism.
2. **Reduces Postprandial Blood Glucose:** Decreases blood glucose levels after meals, thereby improving glycemic control.
3. **Renal Protection:** Restores kidney function parameters toward normal levels and protects against diabetic nephropathy.

4. **Hepatoprotective Activity:** Improves liver function by normalizing hepatic biochemical parameters.
5. **Reduction of Glycated Hemoglobin (HbA1c):** Lowers glycated hemoglobin levels, indicating improved long-term blood glucose control.
6. **Improves Lipid Profile:** Reduces total cholesterol, triglycerides, and low-density lipoproteins while improving high-density lipoprotein levels.
7. **Weight Management:** Helps restore body weight in diabetic individuals experiencing weight loss due to uncontrolled diabetes.
8. **Enhances Insulin Activity:** Improves insulin secretion and sensitivity, contributing to better regulation of blood glucose.
9. **Antioxidant Activity:** Neutralizes free radicals and protects cells against oxidative stress.
10. **Tissue Repair:** Improves histopathological changes in pancreatic, hepatic, and renal tissues, thereby supporting tissue regeneration and recovery.

1.3 FENUGREEK (*Trigonella foenum-graecum*)

Fenugreek (*Trigonella foenum-graecum* L.) is one of the oldest medicinal plants known to mankind and has been used for more than 6,000 years in traditional systems of medicine. It belongs to the Fabaceae family and is native to the Mediterranean region, Western Asia, and Southern Europe. Traditionally, fenugreek has been used as a tonic, laxative, and remedy for menstrual disorders, menopausal symptoms, kidney stones, and several other ailments. It is also widely recognized for its galactagogue property, which helps stimulate milk production in breastfeeding mothers.[16]

Fenugreek is valued for its ability to purify the blood and eliminate harmful toxins from the body. It aids digestion by helping dissolve excess mucus, thereby promoting a healthy and clean digestive system. Additionally, fenugreek seeds have been reported to improve memory and cognitive function. Due to these diverse therapeutic properties, fenugreek has become an important medicinal and dietary plant in many cultures.

Fenugreek seeds and leaves are rich sources of macronutrients, vitamins, minerals, and several biologically active phytochemicals. The major bioactive constituents include alkaloids (trigonelline), flavonoids (quercetin and luteolin), saponins, steroidal sapogenins, dietary fiber, proteins, carbohydrates, lipids, and volatile oils. These compounds contribute to its antioxidant, antidiabetic, hypolipidemic, anti-inflammatory, and digestive health-promoting activities.[16]

Fenugreek is a clover-like annual herb with aromatic seeds that possess a characteristic maple syrup-like aroma and flavor. Because of this distinctive flavor, fenugreek is widely used as a spice and flavoring agent in foods, beverages, and tobacco products. Besides its culinary importance, its seeds are highly nutritious and are extensively used as a functional food and herbal medicine for the prevention and management of several chronic diseases, particularly diabetes mellitus.[13]

Fig. 2: Fenugreek seeds.

1.3.1 SCIENTIFIC CLASSIFICATION

Table No. 2. Scientific Classification.

Botanical name	***Trigonella foenum-graecum***
Synonyms	Methi
Kingdom	Plantae
Subkingdom	Tracheobionta
Class	Magnoliopsida
Subclass	Rosidae
Order	Fabales
Family	Fabaceae
Genus	*Trigonella*
Species	*T. foenum-graecum*
Specific epithet	*foenum-graecum*

1.3.2 MEDICINAL USES

1. Fenugreek (*Trigonella foenum-graecum*), commonly known as Methi, is a well-established traditional medicinal plant used as a complementary treatment for Type 2 diabetes mellitus and prediabetes.
2. Research indicates that the daily consumption of fenugreek can significantly reduce fasting blood glucose (FBG) levels and glycated hemoglobin (HbA1c), thereby improving long-term blood sugar control.

2. EXPERIMENTAL WORK

2.1 Collection of Plant Material

Fresh leaves of *Costus igneus* and fenugreek seeds were collected during the months of December–January from Dhebewadi, Maharashtra.

2.2 Authentication of Plant Material

The selected plant was identified and authenticated by Dr. G. G. Potdar (Assistant Professor), Department of Botany, Yashwantrao Chavan College of Science, Karad.

2.3 Drying of Plant Material

The freshly collected leaves of *Costus igneus* were naturally dried in the open air for about two weeks and powdered using an electronic mixer. The prepared fine powder of *Costus igneus* leaves was passed through sieve No. 120.

2.4 Storage Condition

The prepared coarse powder of *Costus igneus* leaves was stored in an airtight container in a cool and dry place.

2.5 Method of Extraction of *Costus igneus* Powder

Maceration Procedure for *Costus igneus*

1. **Drying and Powdering:** Shade-dry the *Costus igneus* leaves for 5–7 days and grind them into a coarse powder using a mechanical grinder.
2. **Soaking:** Place the powder in a clean glass container and add 90% ethanol (solvent) in a **1:10** ratio (e.g., 50 g powder in 500 mL ethanol).
3. **Extraction:** Close the container tightly and allow it to stand at room temperature for 3–7 days.
4. **Agitation:** Shake the container vigorously twice daily to ensure the solvent penetrates all the plant material.
5. **Filtration:** Filter the mixture through Whatman No. 1 filter paper or a fine muslin cloth to separate the liquid extract (micelle) from the solid residue (marc).
6. **Concentration:** Evaporate the solvent using a water bath at 40°C or a rotary evaporator until a thick, dry extract remains.

Figure: 4 Maceration of Costus igneus leaves & Concentration of Extract.

2.6 Extraction of Fenugreek

Use finely powdered fenugreek seeds or a dried aqueous extract (decoction) of the seeds.

2.7 Granule Formation

1. **Sifting:** Pass the dried extracts and excipients separately through a 60-mesh sieve to remove clumps and ensure uniform particle size.
2. **Dry Blending:** Mix the *Costus igneus* extract, fenugreek powder/extract, and lactose in a mortar and pestle for 15–20 minutes until the color is uniform.
3. **Damp Massing (Granulation):** Gradually add a binder solution (e.g., 10% starch paste or PVP K30 in water/alcohol) to the powder mixture. Mix until it reaches a snowball consistency (it should hold its shape when squeezed but break easily).

Figure 5: Granule Formation.

4. **Wet Screening:** Pass the damp mass through a 12-mesh sieve to obtain wet granules.
5. **Drying:** Dry the granules in an oven at 40–50°C for 2–4 hours until the moisture content is below **2%**.
6. **Dry Screening:** Pass the dried granules through a 20-mesh sieve to obtain granules of uniform size suitable for tablet compression.
7. **Lubrication:** Add a small quantity of talc and magnesium stearate (generally 1–2% of the total weight) to the dried granules and mix gently.
8. **Compression:** Feed the lubricated granules into a single-punch tablet machine and adjust the compression pressure to obtain tablets of the desired hardness.

2.8 Formulation Steps

1. **Powder Preparation:** Dry and finely powder *Costus igneus* leaves and fenugreek seeds, or use standardized extracts.
2. **Mixing:** Blend the active ingredients uniformly with microcrystalline cellulose.
3. **Granulation:** Add starch paste as a binder to form a damp mass.
4. **Screening:** Pass the damp mass through a suitable sieve to obtain granules.
5. **Drying:** Dry the granules at approximately 50–60°C.
6. **Lubrication:** Add magnesium stearate and talc, and mix gently.
7. **Compression:** Compress the lubricated granules into tablets using a **tablet press.**

2.9 MATERIALS

Table No. 3. Formulation Table.

Ingredients	Properties	B1	B2	B3
Costus igneus leaf powder/extract	Active Pharmaceutical Ingredient	50 mg	125 mg	100 mg
Fenugreek seed powder/extract	Secondary API	50 mg	125 mg	100 mg
Lactose	Diluent	350 mg	200 mg	250 mg
Methyl Cellulose	Binder	30 mg	30 mg	30 mg
Sodium Benzoate	Preservative	5 mg	5 mg	5 mg
Talc	Glidant	7.5 mg	7.5 mg	7.5 mg
Magnesium Stearate (Lubricant)	Lubricant	7.5 mg	7.5 mg	7.5 mg

2.10 ANTIDIABETIC ACTIVITY

Procedure

1. In vitro α-amylase inhibition was studied by the method of Bernfeld.

2. Briefly, 100 µL of different concentrations (20, 40, 60, 80, and 100 µg/mL) of the test compound was allowed to react with 500 µL of 0.1 M phosphate buffer (pH 6.9) containing α-amylase enzyme (fungal diastase, 0.5%).
3. After incubation for 10 minutes at 25°C, 500 µL of 1% starch solution prepared in 0.1 M phosphate buffer (pH 6.8) was added. The reaction mixture was further incubated at 25°C for 10 minutes.
4. The same procedure was performed for the control, in which 500 µL of the enzyme solution was replaced with phosphate buffer. After incubation, 1000 µL of dinitrosalicylic acid (DNS) reagent was added to both the control and test samples.
5. The reaction mixtures were heated in a boiling water bath for 10 minutes, cooled to room temperature, and the absorbance was measured at 540 nm using a UV-Visible spectrophotometer. The percentage inhibition of α-amylase was calculated using the following formula:

Inhibition (%) = Abs 540 (control) – Abs 540 (extract) * 100 Abs 540(control)

Table No. 4: α-Amylase Enzyme Inhibition Assay.

Sr. No.	Sample Code	Concentration (µg/mL)	Test 1	Test 2	Test 3	Mean Absorbance (540 nm)	% Inhibition	IC_{50} (µg/mL)
1	Control	—	1.74	1.74	1.74	1.74	—	—
2	Standard (Acarbose)	20	1.42	1.45	1.40	1.42	18.39	rowspan = **50.80**
		40	1.07	1.09	1.05	1.07	38.51	
		60	0.71	0.74	0.69	0.71	59.20	
		80	0.50	0.53	0.48	0.50	71.26	
		100	0.29	0.28	0.25	0.27	84.48	
3	*Costus igneus* Leaf Extract Tablet	20	1.53	1.57	1.51	1.54	11.69	rowspan = **94.44**
		40	1.32	1.36	1.29	1.32	23.95	
		60	1.16	1.14	1.19	1.16	33.14	
		80	0.91	0.88	0.92	0.90	48.08	
		100	0.78	0.76	0.78	0.77	55.56	

2.11 ANTIOXIDANT ACTIVITY

Procedure

1. The antioxidant activity of the test compounds was evaluated for their free radical scavenging activity using the DPPH (1,1-Diphenyl-2-picrylhydrazyl) assay.
2. One millilitre (1 mL) of different concentrations (20, 40, 60, 80, and 100 µg/mL) of the test sample was transferred into separate test tubes. 1.5 mL of 0.1% methanolic DPPH solution was added to each tube, and the mixtures were incubated for 30 minutes in the dark.

3. After incubation, the samples were observed for discoloration from purple to yellow, indicating free radical scavenging activity. The absorbance was measured at 510 nm using a colorimeter.
4. The DPPH radical scavenging activity (%) was calculated using the following equation:

DPPH radical scavenging activity (%) = [(Absorbance of control - Absorbance of test sample) / (Absorbance of control)] x 100

Table No. 5: Antioxidant (DPPH Radical Scavenging) Assay.

Sr. No.	Sample Code	Concentration (µg/mL)	Test 1	Test 2	Test 3	Mean Absorbance (510 nm)	% Inhibition	IC_{50} (µg/mL)
1	Control	–	1.93	1.93	1.93	1.93	–	–
2	Standard (Ascorbic Acid)	20	1.45	1.42	1.40	1.42	26.42	rowspan = **59.23**
		40	1.31	1.29	1.33	1.31	32.12	
		60	0.95	0.97	0.93	0.95	50.77	
		80	0.82	0.85	0.79	0.82	57.51	
		100	0.35	0.32	0.32	0.33	82.90	
3	*Costus igneus* Leaf Extract Tablet	20	1.59	1.60	1.57	1.59	17.79	rowspan = **NE**
		40	1.46	1.49	1.43	1.46	24.35	
		60	1.39	1.40	1.37	1.39	28.15	
		80	1.25	1.22	1.28	1.25	35.23	
		100	1.04	1.06	1.02	1.04	46.11	

3. RESULTS AND DISCUSSION

Figure 7: Tablets of *Costus igneus* and Fenugreek.

3.1 Evaluation

1. Physical Appearance

The formulated herbal tablets containing *Costus igneus* and fenugreek were evaluated for their physical characteristics. The tablets were found to be circular in shape, green in colour, smooth in texture, and possessed a characteristic pungent odour. The tablets were free from visible defects such as cracks, chipping, or capping, indicating satisfactory appearance and acceptable manufacturing quality.

Table No. 6: Evaluation Parameters.

Parameter	Observation
Colour	Green
Shape	Circular
Odour	Pungent
Texture	Smooth

2. Thickness

The thickness of the formulated *Costus igneus* and fenugreek tablets was found to be **1.2 ± 0.1 cm**. Tablet thickness depends upon the size of the die and punches, the amount of granules filled into the die cavity, and the applied compression force. The obtained thickness indicated uniform die filling and consistent tablet dimensions.

3. Hardness Test

The hardness of the formulated tablets was found to be within the acceptable range of 4.31 ± 0.21 to 5.21 ± 0.03 kg/cm². Adequate hardness is essential to withstand mechanical stress during packaging, transportation, and handling. The obtained hardness values indicated that the tablets possessed sufficient mechanical strength without affecting their disintegration properties.

4. Friability Test

The friability of all formulations ranged from 0.14 ± 0.045% to 0.31 ± 0.12%, which is well below the acceptable pharmacopoeial limit of 1%. The tablets exhibited no evidence of capping or lamination and demonstrated good resistance to abrasion, indicating suitability for handling and commercial storage.

5. Disintegration Test

The disintegration test was carried out using the USP Disintegration Test Apparatus with a basket-rack assembly maintained at 37 ± 0.5°C. The formulated tablets disintegrated within 15 minutes, complying with the acceptable limit for conventional herbal tablets and indicating satisfactory release characteristics.

6. Dissolution Test

The dissolution study was performed to evaluate the rate and extent of release of the active phytoconstituents from the 500 mg herbal tablets using the USP Dissolution Apparatus Type II (Paddle Method). The test was conducted at a paddle speed of 50–75 rpm for a duration of 30–60 minutes. The dissolution profiles of formulations B1, B2, and B3 are presented below.

Table No. 7. Dissolution Test Results.

Time (Min)	B1 (%)	B2 (%)	B3 (%)
0	0	0	0
30	24	22	25
60	41	39	43
90	48	45	51
120	55	52	59
150	63	58	64
180	72	65	78
210	85	79	89
240	94	90	97

Table No. 8. Standard Calibration Data for Dissolution Study.

Concentration	Absorbance
0	0.000
5	0.052
10	0.101
15	0.152
20	0.201
25	0.205

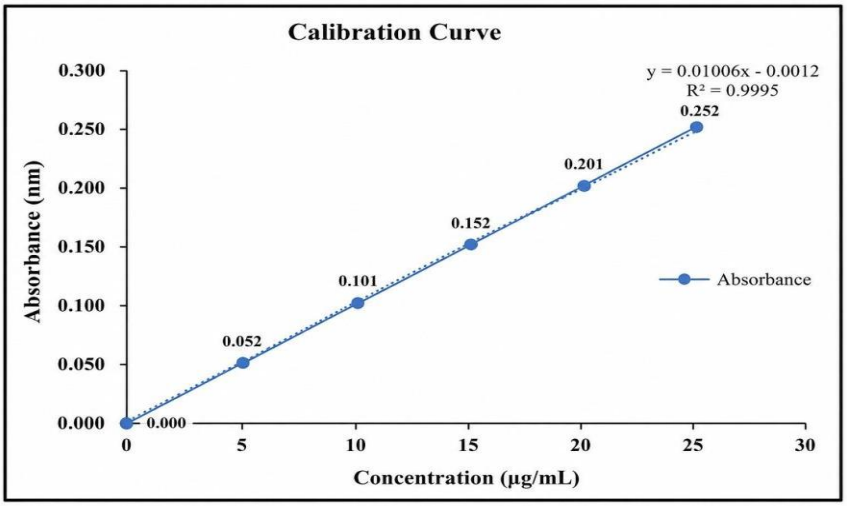


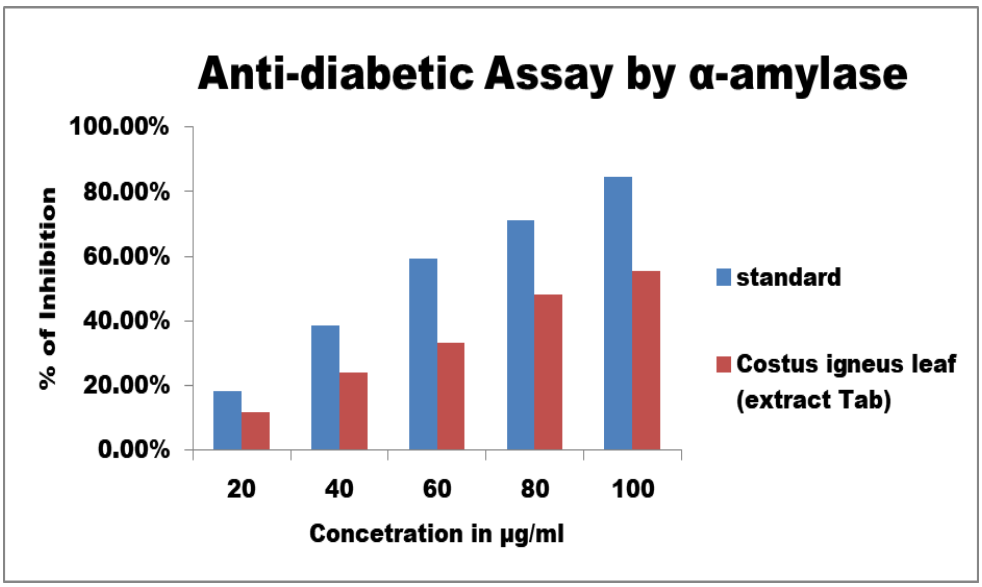
Table No. 9: In Vitro Dissolution Study.

Time (Min)	B1 (% Drug Release)	B2 (% Drug Release)	B3 (% Drug Release)
0	0.0	0.0	0.0
30	18.4	16.8	22.6
60	32.7	29.4	40.3
90	46.9	43.5	55.7
120	58.3	54.8	68.9
150	71.5	67.2	82.4
180	81.8	78.5	91.6
210	91.2	88.7	98.4
240	96.5	94.3	99.2

POST- COMPRESSION PARAMETERS

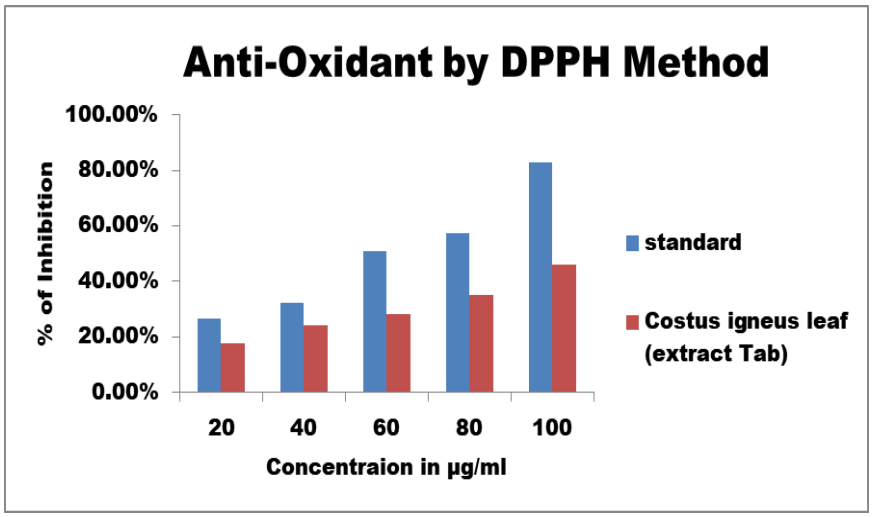
Post-Compression Parameters	B1	B2	B3
Thickness (mm)	1.2 ± 0.10	1.2 ± 0.21	1.2 ± 0.21
Hardness (kg/cm²)	5.5 ± 0.20	5.5 ± 0.20	4.8 ± 0.11
Weight Variation (%)	0.399 ± 0.021	0.399 ± 0.021	0.398 ± 0.019
Friability (%)	0.23 ± 0.023	0.14 ± 0.045	0.22 ± 0.011
Disintegration Time	12–13 min	12.5–13 min	14–14.5 min
Dissolution Test	30–45 min	30–55 min	30–60 min

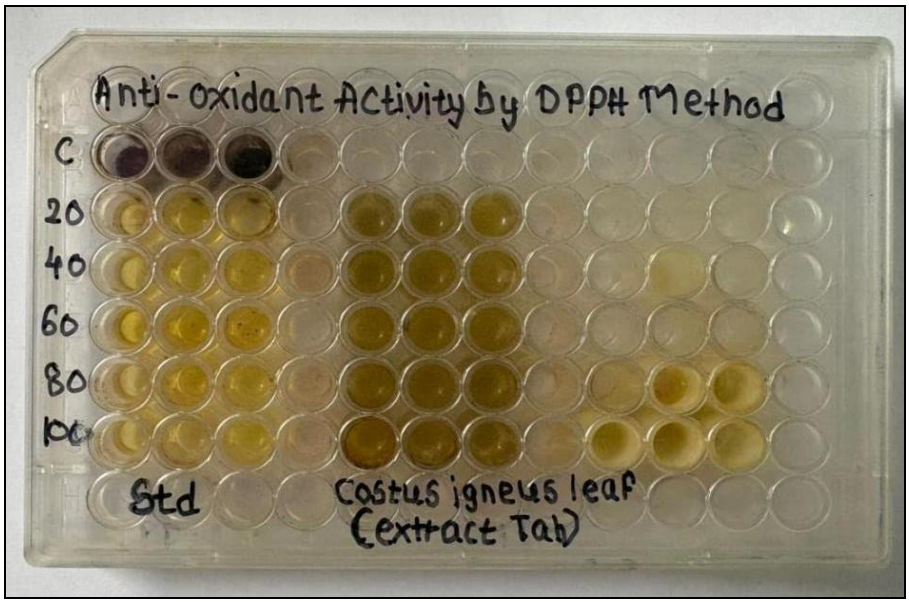
3.2 ANTIDIABETIC ASSAY



In Vitro α-Amylase Inhibitory Activity

3.3 ANTIOXIDANT ASSAY





4. CONCLUSION

The study successfully formulated a polyherbal tablet containing Costus igneus and Trigonella foenum-graecum using the wet granulation method. The tablets showed acceptable physicochemical properties, including good hardness, low friability, uniform weight, and appropriate disintegration and dissolution behavior. As the concentration increases from 20 to 100 µg/ml, the percentage inhibition of α-amylase gradually rises, indicating improved efficacy of the extract at higher doses. Although the standard drug shows stronger inhibition across all concentrations (reaching up to ~85%), the plant extract also exhibits appreciable activity, achieving around ~55–57% inhibition at the highest concentration. This suggests that the extract is capable of reducing carbohydrate breakdown by inhibiting α-amylase, thereby potentially controlling postprandial blood glucose levels. Overall, the findings

highlight that *Costus igneus* leaf extract has moderate yet promising antidiabetic potential. The antioxidant profile of compound Costus igneus leaf (extract Tab) was evaluated by measuring the percent of inhibition against DPPH reagent via test tube method. The compound Costus igneus leaf (extract Tab) exhibited Moderate antioxidant activity against *DPPH scavenging reagent* and however the concentration increases also the antioxidant activity of the compound increases as compared to the standard ascorbic acid. The formulation exhibited moderate, concentration-dependent antidiabetic activity through α-amylase inhibition, along with moderate antioxidant activity. Overall, the developed formulation shows promising potential for diabetes management, but further in vivo and clinical studies are required to confirm its efficacy and safety.

5. REFERENCES

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care.*, 2023; 46(1): S19–S40.
2. International Diabetes Federation. *IDF Diabetes Atlas.* 10th ed. Brussels: International Diabetes Federation, 2021.
3. Joseph B, Reddy LJ. Essential oils from the stems, leaves, and rhizomes of *Costus pictus*, a medicinal plant from southern India. *Int J Pharm Pharm Sci.*, 2010; 2(2): 100–101.
4. Benny M. Insulin plant in the garden. *Nat Prod Radiance*, 2004; 3(5): 349–350.
5. Devi VD, Urooj A. Hypoglycemic potential of *Morus indica* L. and *Costus igneus*: A preliminary study. *Indian J Exp Biol.*, 2008; 46(9): 614–616.
6. Elavarasi S, Saravanan K. Ethnobotanical study of plants used to treat diabetes among tribal people in Kolli Hills, Tamil Nadu. *Int J Pharm Tech Res.*, 2012; 4(1): 404–411.
7. Meléndez-Camargo ME, Castillo-Nájera R, Silva-Torres R, Campos-Aldrete ME. Diuretic action of an aqueous extract of *Costus pictus* in rats. *Proc West Pharmacol Soc.*, 2006; 49: 72–74.
8. Eevera T, Pazhanichamy K, Pavithra S, et al. Morphological and phytochemical analysis of *Costus igneus*. *J Int Pharm Res.*, 2010; 3: 747–752.
9. Shankarappa L, Gopalakrishna B, Jagadish NR, Siddalingappa GS. Pharmacognostic and phytochemical analysis of *Costus igneus*. *Int J Pharm Sci.*, 2011; 1(1): 36–41.
10. Mathew F, Varghese B. A review on medicinal exploration of *Costus igneus* (insulin plant). *Int J Pharm Sci Rev Res.*, 2019; 54(2): 51–57.
11. Urooj A, Devi VD. Nutrient profile and antioxidant components of *Costus igneus*. *Indian J Nat Prod Resour*, 2010; 1(1): 116–118.

12. Basch E, Ulbricht C, Kuo G, Szapary P, Smith M. Therapeutic applications of fenugreek (*Trigonella foenum-graecum*). *Altern Med Rev.*, 2003; 8(1): 20–27.
13. Srinivasan K. Fenugreek (*Trigonella foenum-graecum*): A review of health beneficial physiological effects. *Food Rev Int.*, 2006; 22(2): 203–224.
14. Evans WC. *Trease and Evans Pharmacognosy.* 16th ed. London: Elsevier, 2009.
15. Aulton ME, Taylor K. *Aulton's Pharmaceutics: The Design and Manufacture of Medicines.* 5th ed. London: Elsevier, 2018.
16. Lachman L, Lieberman HA, Kanig JL. *The Theory and Practice of Industrial Pharmacy.* 3rd ed. Philadelphia: Lea & Febiger, 1986.
17. Patel VR, Patel PR, Kajal SS. Antioxidant activity of some selected medicinal plants in western region of India. *Adv Biol Res.*, 2010; 4(1): 23–26.
18. Rao NB, Gajula RG, Sujatha E, et al. Phytochemical analysis and antimicrobial activity of *Costus igneus* leaf extract. *Int J Biol Pharm Allied Sci.*, 2016; 5(6): 1207–1214.
19. Rasool N, Rizwan K, Zubair M, et al. Antioxidant potential of different extracts and fractions of *Catharanthus roseus* shoots. *Int J Phytomedicine,* 2011; 3(1): 108–114.
20. Gray A, Flatt P. Insulin-releasing and insulin-like activity of the traditional anti-diabetic plant *Coriandrum sativum*. *Br J Nutr.*, 1999; 81: 203–208.
21. Baliyan S. Determination of antioxidants by DPPH radical scavenging activity and quantitative phytochemical analysis of *Ficus religiosa*. *Molecules*, 2022.
22. Jadhav G, Pagire D, Jadhav V. Formulation and evaluation of anti-diabetic tablet from insulin plant (*Costus igneus*). *International Journal for Multidisciplinary Research (IJFMR),* 2023; 5(3).
23. Khalkar KB, Chaudhari KK, Gaikwad GN. Formulation and evaluation of anti-diabetic tablet from insulin plant (*Costus igneus*). *Res J Sci Tech.*, 2025; 17(1): 21.
24. Radhika PR, Niranjan R, Navya Durga R. Fabrication and evaluation of anti-diabetic sustained release herbal tablets. *World Journal of Pharmaceutical Research*, 2015; 4(10): 920–945.