

## “FORMULATION AND EVALUATION OF ANTIDIABETIC TEA”

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### ABSTRACT

This study aimed to formulate and evaluate a polyherbal tea containing *Syzygium cumini* (jamun seed) along with turmeric, Krishna Tulsi, cinnamon, ginger, star anise, stevia, and menthol for antidiabetic activity. Diabetes mellitus, a chronic metabolic disorder, requires safer and cost-effective therapeutic alternatives, making herbal formulations a promising option. Jamun seeds were extracted and subjected to phytochemical screening, confirming the presence of alkaloids, tannins, glycosides, terpenoids, and saponins. The polyherbal tea was prepared using standard procedures and evaluated for parameters such as moisture content, mass uniformity, flow properties, and physicochemical characteristics. Results indicated acceptable quality parameters and the presence of bioactive compounds, suggesting potential antidiabetic efficacy. The study concludes that the formulated polyherbal tea may serve as a promising natural alternative for diabetes management.

**Keywords:** Antidiabetic, Polyherbal tea, *Syzygium cumini*, Phytochemicals, Diabetes

## INTRODUCTION

Diabetes mellitus is a complex metabolic disorder characterized by hyperglycaemia and clinical manifestations like polyuria, polydipsia, polyphagia, fatigue, and irritability. It results in insulin insufficiency or dysfunction with disruption of carbohydrate, fat, and protein metabolism. Ninety percent of people have either Type I or Type II diabetes. In 2000, global prevalence was 2.8%; by 2030, it is predicted to reach 4.4%. In India, cases are expected to rise from 31.7 million in 2000 to 79.4 million by 2030. Experimental data indicates the role of free radicals and lipoprotein metabolism anomalies in complications <sup>[1]</sup>. Diabetes is characterized by elevated blood glucose due to inadequate insulin synthesis or poor use, increasing the risk of heart disease, kidney damage, and neurological dysfunction. Despite pharmaceutical advances, challenges remain due to adverse drug reactions and rising costs. This has increased interest in natural remedies such as Jamun (*Syzygium cumini*), which has recognized antidiabetic effects in traditional medicine <sup>[2]</sup>. Jamun seed powder can reduce blood sugar levels and has been used for over 130 years <sup>[3]</sup>. Only a small percentage of patients achieve optimal glycaemic control with current drugs. There is a need for effective antihyperglycemic agents that improve insulin sensitivity and pancreatic function. Herbal treatments are considered safer with fewer side effects and are a promising source of hypoglycemic agents. Combinations of medicinal ingredients are used in the Indian traditional system to enhance efficacy and reduce adverse effects <sup>[4]</sup>. In light of the aforementioned data, the current study aims to develop and evaluate the antidiabetic potential of a polyherbal formulation that combines various herbs. viz. *Syzygium cumini*, *Curcuma longa*, *Illicium verum*, *Cinnamon verum*, *Stevia rebaudiana*, *Zingiber officinale*.

## WHAT IS POLYHERBAL TEA

Tisane, another name for herbal tea, is a beverage containing dried leaves, seeds, flowers, or other botanical ingredients derived from plant species other than *Camellia sinensis*. Ancient systems like Ayurveda and Traditional Chinese Medicine developed herbal medicines to treat various ailments. Polyherbal formulations are preferred as they are thought to have greater pharmacological effects than single herbs. A large proportion of the population uses plant-based medicines. Tea or infusions of medicinal plants can help prevent or treat conditions and are widely consumed as a common beverage after water. This preparation aids immune system development, energy levels, stress reduction, and overall health benefits <sup>[5]</sup>.

### Plant Profile of Selected Polyherbal Ingredients

Sr. no.	Plant name	Synonyms	Biological sources	Chemical constituents	Biological activities	Application
1	Syzygium cumini (Jamun seed)	Myrtus cumini, Eugenia jambolana	Fruit of <i>Syzygium cumini</i> (Myrtaceae)	Gallic acid, corilagin, ellagic acid, quercetin, $\beta$ -sitosterol [6]	Antidiabetic, antioxidant, antimicrobial, cardioprotective [7]	Blood sugar control, detoxifying agent, digestive aid [8-10]
2	Curcuma longa (Turmeric)	Indian saffron, Haldi	Dried rhizome (Zingiberaceae) [11].	Curcuminoids, curcumin [12].	Anti-inflammatory, antioxidant, antidiabetic, antimicrobial [13].	Immunity booster, wound healing, skin health [14]
3	Ocimum tenuiflorum (Krishna Tulsi)	Holy Basil, Shyama Tulsi	Leaves (Lamiaceae)	Alkaloids, flavonoids, tannins, terpenoids	Antioxidant, antimicrobial, anti-inflammatory [15].	Respiratory relief, stress reduction, immunity booster [16].
4	Cinnamomum verum (cinnamon plant") (Cinnamon)	Dalchini, Ceylon cinnamon	Inner bark (Lauraceae)	Cinnamic aldehyde, eugenol, tannins	Antioxidant, antimicrobial, antidiabetic	Flavouring agent, blood sugar regulation [17].
5	Illicium verum (Star Anise)	Chinese star anise	Fruit (Magnoliaceae)	Terpenoids, flavonoids, lignans	Antiviral, antimicrobial, antioxidant	Flavouring, digestive aid, medicinal uses [18].
6	Zingiber officinale (Ginger)	Adrak	Rhizome (Zingiberaceae)	Gingerols, shogaols, zingerone	Anti-inflammatory, antioxidant, antidiabetic	Digestive aid, anti-nausea, culinary uses

						[19–20].
7	<i>Stevia rebaudiana</i> (Stevia)	Sweet leaf, Honey leaf	Leaves (Asteraceae)	Steviol glycosides, flavonoids	Antidiabetic, antioxidant, antihypertensive	Natural sweetener, diabetic-friendly products [21].
8	<i>Mentha arvensis</i> (Menthol crystal)	Mint crystals	Essential oil (Lamiaceae)	Menthol, menthone, limonene	Analgesic, antimicrobial, anti-inflammatory	Cooling agent, decongestant, flavoring [22–23].

**Table 1 : Plant Profile of Selected Polyherbal Ingredients**



Figure 1: jamun seeds and jamun seeds powder



Figure 2: Turmeric (*Curcuma longa*)

Figure 3: Krishna Tulsi (*Ocimum tenuiflorum*)



Figure 4: Cinnamon (*Cinnamomum verum*)

Figure 5: Star Anise (*Illicium verum*)

Figure 6: Ginger (*Zingiber officinale*)Figure 7: Stevia (*rebaudiana Bertoni*)Figure 8: Menthol crystal (*Mentha arvensis*)

## FORMULATION METHOD

### Selection and collection of crude drugs:

Dried powder of crude drug such as jamun seed, turmeric, Krishna tulsi, cinnamon, ginger, star anise, and stevia were selected and collected from natural sources of it.

### Method of preparation:

1. **Preparation of herbal tea powder:** All the herb ingredients are in dry form and grinded in mixer to make uniform and moderately fine powder.
2. **Weighing:** All the required herbs powder for herbal tea preparation were accurately weighed individually by using digital balance.
3. **Mixing:** All these fine ingredients were mixed thoroughly in mortar and pestle to get uniform mixing.
4. **Sieving:** Fine tea powders were passed through sieve no. 40 to get sufficient quantity of fine powder.
5. **Collection and storage:** Tea powder mixture then transferred in tea bags. Then evaluations of herbal tea were done <sup>[24]</sup>.



Figure 9: Preparation of tea bag and herbal tea

**Formulation table:**

Sr no.	Ingredients	Quantity	Role
1	Jamun seed	1.0gm	Reducing blood glucose levels
2	Turmeric	0.10gm	Improving insulin sensitivity
3	Krishna Tulsi	0.20gm	Lowering blood glucose levels
4	Cinnamon	0.20gm	Enhancing insulin sensitivity
5	Star anise	0.10gm	Supports glucose metabolism
6	Ginger	0.20gm	helps regulate blood sugar
7	Stevia	0.15gm	Acts as a natural sweetener
8	Menthol crystals	0.5gm	Improves flavor

**Table 2: Formulation table****MATERIALS AND METHODS:**

➤ **Extraction of jamun seed (*Syzygium cumini*)** <sup>[25]</sup>.

Collect fresh Jamun seeds from the market.



Transport the collected seeds to the laboratory.



Wash the seeds thoroughly with water to remove dirt.



Place washed seeds in a clean area to air-dry for 7 days at room temperature.



Oven- dry the seeds at 50°C to remove residual moisture.



Use a mixer grinder to powder the dried seeds into fine powder.



Store the powdered seeds in an air-tight container for future use.



Measure 50g of powdered Jamun seeds Add the powder to 500mL distilled water.



Heat the mixture at 80-90°C for 80-100 minutes.



Allow the heated extract to cool to room temperature.



Filter the cooled extract using filter paper to remove solid particles.



Store the filtered extract in suitable containers for further use or analysis.



**Figure 10:** Extraction of jamun seed.

## **PRELIMINARY PHYTOCHEMICAL SCREENING OF JAMUN SEED (SYZYGIUM CUMINI)**

The preliminary phytochemical investigation was carried out with aqueous extract of *Syzygium cumini* fruit seed for identification of phytochemical constituents. Phytochemical tests were carried out by standard methods [25-26].

➤ **Alkaloids:**

Mayer's, Wagner's, and Hager's tests were performed. Formation of yellow (Mayer's, Hager's) and brown/reddish (Wagner's) precipitates indicated the presence of alkaloids.

➤ **Carbohydrates:**

Fehling's and Benedict's tests were conducted. Formation of red or orange-red precipitate confirmed the presence of reducing sugars.

➤ **Saponins:**

Froth and foam tests were carried out. Persistent foam formation indicated the presence of saponins.

➤ **Tannins:**

Ferric chloride and lead acetate tests were used. Bluish-black coloration or yellow/reddish-brown precipitate confirmed tannins.

➤ **Terpenoids:**

Extracts treated with chloroform and concentrated H<sub>2</sub>SO<sub>4</sub> showed reddish-brown coloration, indicating terpenoids.

➤ **Glycosides:**

Modified Borntrager's test showed pink to red color (anthraquinone glycosides). Keller–Killiani test produced a blue color, confirming cardiac glycosides.

## **PRELIMINARY PHYTOCHEMICAL SCREENING OF SYZYIUMCUMINI TEA BAG**

The preliminary phytochemical investigation was carried out with aqueous extract of *Syzygium cumini* fruit seed for identification of phytochemical constituents. Phytochemical tests were carried out by standard methods [27].

➤ **Alkaloids:**

Detected by Mayer's, Wagner's, and Hager's tests; formation of yellow or brown/reddish precipitates indicated presence.

➤ **Carbohydrates:**

Identified by Fehling's and Benedict's tests; red or orange-red precipitate confirmed reducing sugars.

➤ **Saponins:**

Confirmed by froth and foam tests; persistent foam formation indicated presence.

➤ **Tannins:**

Detected using ferric chloride and lead acetate tests; bluish-black coloration or yellow/reddish-brown precipitate indicated presence.

➤ **Terpenoids:**

Identified by chloroform and concentrated H<sub>2</sub>SO<sub>4</sub> test; reddish-brown coloration confirmed presence.

➤ **Glycosides:**

Detected by Modified Borntrager's test (pink to red color) and Keller–Killiani test (reddish-brown ring with greenish-blue layer).

## **EVALUATION PARAMETERS FOR POLYHERBAL TEA POWDER:**

### **1. Sensory Assessment**

- Colour – Visual characteristics of the dry powder and the prepared tea.
- Aroma – Distinctive herbal fragrance.
- Flavour – Presence of bitterness, astringency, or other pertinent flavours.
- Mouthfeel – Granularity or smoothness of the powder [30].

### **2. Brew Performance / Infusion Analysis**

- Clarity: Assess the infusion for any presence of sediment or cloudiness.
- Colour: Analyse the intensity of the tea's colour.
- Duration for Full Infusion: Typically achieved within 3 to 7 minutes in hot water.
- Final Volume Post-Brewing: Measure the final volume after 5 minutes of steeping in 100 ml of boiling water [30].

### **3. Determination of moisture content of Syzgiumcumini tea bag:**

A quantity of 2 g of Syzgiumcumini tea was weighed into a crucible. The total weight of the tea in the crucible was determined (W<sub>1</sub>). It was then dried at 105 °C in an oven until a constant weight was obtained. It was then removed, cooled in a desiccator and weighed (W<sub>2</sub>). The loss in weight on drying is determined by;

$$\text{Moisture content} = \frac{w_1 - w_2}{w} \times 100$$

Where, W = weight of sample,

W1= weight of sample before drying,

W2= weight of sample after drying [28].

#### 4. Uniformity of mass of formulated *Syzygiumcumini* tea bags:

Twenty (20) randomly selected tea bags were weighed. A single filled tea bag was weighed and recorded. It was then opened and completely emptied, ensuring that no fragments were lost. The quantity of the content in the tea bag was calculated by subtraction of the mass of the empty bag from the filled bag. This procedure was repeated on nineteen more tea bags. The average mass of the twenty tea bags was then determined. The uniformity of mass was deduced from these readings [29].

$$m = W1 - W2 = x.$$

$$M = \frac{x_1 + x_2 + x_3 + \dots + x_{20}}{20}.$$

Where, M= Average mass of total tea bags.

m= mass of a tea bag.

W1= Mass of a filled tea bag.

W2= Mass of an empty tea bag.

#### 5. Flowability of formulated *Syzygiumcumini* tea powder:

The flowability of tea bag formulation is crucial in manufacturing, ensuring consistent quality, precise dosing, and even filling during automated or semi-automated production. The following standard characteristics are frequently evaluated to find out how well the powdered or granulated herbal blend used in tea bags flows:

**a. Angle of Repose:** The angle of repose was measured using the stationary funnel technique. A funnel was positioned above graph paper that was laid out horizontally and fastened with its point at a specific height (h). The mixture was meticulously poured through the funnel until the conical pile's peak touched the funnel's tip. The cylindrical pile's base's radius was calculated. The following method was used to determine the angle of repose:

$$\tan \theta = h/r$$

Where,  $\theta$  = Angle of repose, h = Height of the cone, r = Radius of the cone base.

Angles of repose values between 25 and 30 show outstanding flow properties, 31 to 35 show good flow properties, 36 to 40 show acceptable flow properties, and 41 to 45 show passable flow properties. Angles of repose values between 40 and 60 imply a poorly flowing substance [32].

**b. Bulk Density and Tapped Density:** These are established in order to compute the Hausner ratio and compressibility index: The mass of the powder divided by the bulk volume is the bulk density ( $\rho_b$ ). Mass of powder divided by tapped volume (after mechanical tapping) is the Tapped Density ( $\rho_t$ ) [30].

Formula:

$$\rho_b = \text{mass of powder} / \text{bulk volume}$$

$$\rho_t = \text{mass of powder} / \text{tapped volume.}$$

**c. Carr's Compressibility Index (%):** (Carr's index) is a metric for a powder's tendency to be compacted. It can be calculated using the mass and pierced densities. Theoretically, a substance is more flowable the less deformable it is. It serves as a gauge for the relative significance of particle interactions. Such interactions are typically less important in a free-flowing powder, and the values of the bulk and tapped densities will be closer. There are commonly more particle contacts in poorly moving materials, which results in a larger discrepancy between the bulk and tapped densities. The Carr's Index, which is computed using the following methods, reflects these variations [33].

Formula:

$$\text{Compressibility Index} = \rho_t - \rho_b / \rho_t \times 100$$

Where,  $\rho_t$  = tapped density,

$\rho_b$ =bulk density.

**d. Hausner Ratio:** The Hausner's ratio is a proximate indicator of particle movement simplicity. The method used to determine it is as follows. Tapped density ( $\rho_t$ ) / Bulk density ( $\rho_b$ ) is known as Hausner's Ratio. Where t represents tapped density and b represents bulk density.

$$\text{Hausner Ratio} = \rho_t / \rho_b$$

Where,  $\rho_t$  = tapped density,

$\rho_b$ =bulk density.

Hausner's ratios between 1.25 and 1.5 show middling flow properties, while those over 1.5 show bad flow. Lower Hausner's ratios (1.25) suggest better flow properties than larger ones [34]. Good flowability in tea bag formulations ensures even filling, seamless processing, and improved control, preventing inconsistent bag weights, equipment clogs, and decreased product quality [30].

**e. Determination of Ash Value:** The International Organization for Standardization (ISO) 1575, methods for determination of total ash in tea reviewed and confirmed in 2015 was used (ISO-1575 2015). Five tea bags were randomly selected from each formulation and the content emptied in a large Petri dish. A 2 g quantity of the herbal tea was weighed and transferred into a crucible which has initially been heated to 105 °C for 5 min and placed in a desiccator until use. The crucible containing the herbal material was then incinerated. The heating temperature was 525 ± 25 °C. The crucible was allowed to cool before the weight was determined. Then it was again heated for 30 min and reweighed. This was repeated twice until a constant weight was obtained.

The percentage of ash value was determined using Equation 1.

$$\% \text{ ash value} = \frac{w_3 - w_1}{w_2 - w_1} \times 100$$

Where,  $W_1$  = weight of empty crucible

$W_2$  = weight of crucible + sample before ashing

$W_3$  = weight of crucible + ash [31].

**f. Dust Leak test:** Two tea bags of the herbal tea were selected at random, weighed and placed in a friability tester. The machine was operated for 4 min to undergo the abrasive fall. After the expiration of the 4 min, the tea bags were dusted and weighed [31].

The percentage leak was evaluated using Equation 3:

$$\frac{w_1 - w_2}{w_1} \times 100$$

Where,  $W_1$  is the initial weight before the leak test

$W_2$  is the weight after the test [31].

## RESULT AND DISCUSSION

### 1. Phytochemical screening of Syzygium cumini tea bag Preliminary

phytochemical screening of the formulated tea bag containing Syzygium cumini (jamun seed) along with other herbal ingredients revealed the presence of several bioactive constituents responsible for its therapeutic potential.

Sr no	Phytoconstituents	Test	Result
1	Alkaloids	Mayer's test Wagner's test	Present (+) Present (+)
2	Saponin	Foam test	Present (+)
3	Tannin	Ferric chloride test	Present (+)
4	Glycoside	Borntrager test Killer Killani test	Present (+) Present (+)
5	Carbohydrates	Benedicts test	Present (+)
6	Terpenoids	Salkowski test	Present (+)

**Table 3:** Phytochemical screening of Syzygium cumini tea bag

**Discussion:** Alkaloids were present in jamun seed, Krishna Tulsi, cinnamon, star anise, and ginger, while absent in turmeric, stevia, and menthol crystals. Saponins are present in most plants, but not found in cinnamon, ginger, and menthol crystals. Tannins were present in jamun seed, Krishna Tulsi, cinnamon, star anise, ginger, and turmeric, while absent in menthol crystals and stevia. Glycosides were present in jamun seed, Krishna Tulsi, cinnamon, star anise, and turmeric, while absent in ginger, stevia, and menthol crystals. Carbohydrates were present in jamun seed, Krishna Tulsi, turmeric, stevia, cinnamon, and ginger, while absent in star anise and menthol crystals. Terpenoids were present in Krishna Tulsi, turmeric, ginger, and cinnamon, while absent in jamun seed, stevia, star anise, and menthol crystals.

### 3. Physio-chemical Evaluation of Syzygium cumini Tea Bag:

Sr no.	Parameter	Result
1	Colour	Light brown
2	Odour	Astringent, pungent
3	Taste	Slightly sweet
4	Moisture content	9.90g/kg

5	Uniformity of mass	1.95gm
6	Angle of repose	33.69 (Good flow)
7	Bulk density	0.5g/cm <sup>3</sup>
8	Tapped density	0.66g/cm <sup>3</sup>
9	Hausner's ratio	1.32 (Passable)
10	Carr's index	24.24% (Slightly poor)
11	Dust leak test	0.94%
12	Ash value	13.16%

**Table 4:** Evaluation parameter

### Discussion:

The **moisture content (9.90 g/kg)** indicates a moderate amount of moisture present in the formulation, which may affect stability if not properly stored. The **uniformity of mass (1.95 g)** shows that the tea bags were uniformly filled, ensuring dose consistency. The **bulk density (0.5 g/cm<sup>3</sup>)** and **tapped density (0.66 g/cm<sup>3</sup>)** indicate good packing ability of the powder. The **Hausner's ratio (1.32)** suggests passable flow properties, while the **Carr's index (24.24%)** indicates slightly poor flowability of the powder. The **dust leak (0.94%)** shows good physical quality and packaging integrity of the tea bags. The **ash value (13.16%)** shows that the tea bags contain a relatively high amount of natural minerals, which is acceptable for seed-based products, but proper processing is important to avoid contamination.

### CONCLUSION

The study successfully formulated a polyherbal antidiabetic tea containing *Syzygium cumini* and other herbs. Phytochemical screening confirmed key bioactive compounds, and evaluation showed acceptable physicochemical properties. The formulation demonstrates promising potential as a safe, cost-effective natural option for diabetes management, though further in vivo and clinical studies are needed.

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