



JAMUN POWDER-INFUSED MASALA NOODLES: A NOVEL APPROACH TO DIABETES MANAGEMENT

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ABSTRACT

The study were designed to develop jamun seed powder incorporated multigrain noodles. Efforts were made to prepare multigrain noodles having different combinations of foxtail millet flour (FMF), ragi flour, sorghum flour and jamun seed powder (JSP) were prepared by mixing them in different proportions. The prepared multigrain noodles were subjected to organoleptic and nutritional quality analysis. The results revealed that multigrain noodles with incorporation of jamun seed powder was organoleptically secured maximum score for colour, taste, flavour and overall acceptability compared to all other samples and found to contain moisture, ash, protein, fat, crude fiber and carbohydrate. Jamun (*Syzygium cumini*) is a nutrient-rich fruit with potential health benefits. This study aimed to develop jamun powder noodles, leveraging its nutritional value. The noodles were evaluated for texture, sensory attributes, nutritional content, and microbiological

safety. Results showed that jamun powder noodles had improved nutritional profile, acceptable texture, and sensory attributes. Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels, which necessitates the development of functional foods with therapeutic potential. Jamun (*Syzygium cumini*), a fruit traditionally recognized for its antidiabetic properties due to bioactive compounds such as jamboline, ellagic acid, and anthocyanins, was utilized in this study to formulate a novel food product—jamun powder-based noodles. The findings suggest that jamun powder noodles can serve as a

functional food with promising antidiabetic activity, offering a convenient dietary intervention for individuals seeking natural alternatives in diabetes management.

KEYWORDS: Jamun seed powder, multigrain noodles, Diabetes mellitus, functional food.

1) INTRODUCTION

Noodles are widely consumed throughout the world, and it is a fast-growing sector because noodles are convenient, low cost, easy to cook and have a relatively long shelf-life. Noodles belongs to China as early as 5000 BC, and then spread to other Asian countries such as Japan, Thailand, Korea and Malaysia, and now days it has become one of the fastest budding sectors in the world with the compound annual growth rate (CAGR) reaching 4%. Worldwide, China ranks first in the consumption of noodles followed by Indonesia, Japan, and Vietnam. Noodles are one of the favorite food products that are well loved by many people of all ages. Refined wheat flour which is usually used to make noodles are rich in carbohydrates however they lack nutrients like dietary fibre, protein, minerals and vitamins.

Consumers all around the world, nowadays, are more at the risk of many diseases such as cardiovascular diseases and diabetes due to obesity, high cholesterol, high blood pressure and irregular blood sugar levels. These risk factors are because of the diet which is low in dietary fibre, phytochemicals and antioxidants. Foods that are excess in antioxidants and low in Glycemic Index (GI) can decrease the risk of increased postprandial oxidative stress, which is responsible for chronic diseases.

Jamun (*Syzygium cumini*) also known as *Syzygium jambolanum*, *Eugenia jambolanum* and *Eugenia cumini* is an evergreen tropical tree in the flowering plant family Myrtaceae and is native to Bangladesh, India, Nepal, Pakistan, Sri Lanka, the Philippines, and Indonesia. The jamun seeds are claimed to contain alkaloid, jambosine, and glycoside jambolin or antimellin, which halts the diastatic conversion of starch into sugar. The seeds have been reported to be rich in flavonoids, a well-known antioxidant, which accounts for the scavenging of free radicals and protective effect on antioxidant enzymes and also found to have high total phenolics with significant antioxidant activity and are fairly rich in protein and calcium.

Diabetes mellitus (DM) is a common endocrinal disorder of carbohydrate, fat, and protein metabolism. It is characterized by chronic hyperglycemia due to relative insulin deficiency, resistance, or both. Hyperglycemia in DM leads to vascular complications, which is the major

cause of morbidity and mortality in diabetic patients. Side effects of insulin and oral hypoglycemic have increased the popularity of traditional and complimentary medicines. Seeds of *Syzygium cumini* were found to have anti-diabetic, anti-inflammatory, and anti-dyslipidemic activities, attributed to its saponins, tannins, and flavonoids. Jamun seed powder should be explored as an easily available, cheap alternative to currently available drugs that decrease complications; leading to decrease in health care and economical burden on family, society, and nation.

1.1 Morphological Characteristics Of *Syzygium Cumini* (Jamun)

Jamun is a large evergreen and dense tree with dense gray bark, which produces wood scales. The wood is white, strong and durable; gets black dye and gum Kino type. The leaves are leathery, ovate-ovate to elliptic or obovate-elliptic with a length of 6 to 12 inches (extremely flexible, smooth and shiny with many nerve fibers within the border), the tip is broad and very thin. The panicles are mainly taken from the lower branches of the leaves, which are usually axillary or terminal and are 4 to 6 inches long. The flowers are fragrant, greenish-white, with only a few clusters of 10 to 40 and are round or oblong and are found in dichotomous paniculate cymes. The calyx is shaped, about four inches [4 mm] long, and has teeth. The leaves are joined together and fall together like a small disk. The stamens are as large and long as the calyx. Several varieties have been developed, varying in color and size of the fruit, including improved varieties that produce blue or white flesh and fruitless seeds. The fruits are berry and are usually oblong, 1.5 to 3.5 cm long, dark-purple or almost dark, shiny, fleshy and edible; contains one large seed. The plant produces small purple plums, with a very sweet flavor, which turns slightly to the edges of the pulp as the fruit grows. The ripe fruits of dark violet give the appearance of an olive tree both in weight and shape and have an astringent taste.

1.2 Mechanism Of Action of Jamun seed:

Jamun (*Syzygium cumini*) seed powder helps in diabetes management through multiple mechanisms: its bioactive compounds such as jamboline, jambosine, flavonoids, and ellagic acid inhibit carbohydrate-digesting enzymes like α -amylase and α -glucosidase, thereby slowing the breakdown of starch into glucose and reducing post-meal sugar spikes; it enhances insulin secretion and sensitivity by stimulating pancreatic β -cells and improving glucose uptake in tissues; and its strong antioxidant properties protect β -cells from oxidative stress, preserving their function over time. Together, these effects contribute to better

glycemic control and may also improve lipid metabolism, making Jamun powder a supportive natural adjunct in diabetes care under medical supervision.

The antidiabetic activity of jamun *Syzygium cumini* is mediated through a multi-step pathway that begins with the activation of PPAR γ by its bioactive phytoconstituents like jamboline and ellagic acid. This activation leads to inhibition of NF-kB, resulting in suppression of inflammation and oxidative stress which are key factors in insulin resistance. The reduction in oxidative stress further promotes the activation of β -cells of the pancreas, causing upregulation of insulin secretion. Increased insulin enhances glucose metabolism and stimulates glycogen synthesis in liver and muscle tissues. The combined effect of these actions ultimately produces a significant hypoglycemic effect, thereby helping in blood glucose regulation.

2) MATERIALS & METHODS:

A) DRUG & EXCIPIENT PROFILE

- 1) **Jamun powder**- Jamun (*Syzygium cumini*) seed powder. Active Components : Jamboline & Jambosine.
- 2) **Foxtail/ Pearl millet flour** – Adds nutrition& Texture. Gluten free alternative, High in fiber and protein. .
- 3) **Sorghum (Jawar) Flour** – Gluten free, High in fiber and protein.
- 4) **Ragi millet** – Provide slightly coarse, earthy texture, Supports bone health, Rich in iron, calcium and protein.
- 5) **Gaur Gum** – Helps to bind ingredients, Improve noodles texture, elasticity and improve shelf life.
- 6) **Salt** – Use as a flavour enhancer, Helps control microbial growth.
- 7) **Water** – Dough formation and cooking medium.

1) Jamun powder

Jamun (*Syzygium cumini*) seed powder is widely recognized for its antidiabetic properties, making it a valuable ingredient in the formulation of functional foods such as noodles. The seeds contain bioactive compounds like jamboline, ellagic acid, flavonoids, and tannins, which help regulate blood glucose by inhibiting carbohydrate-digesting enzymes such as α -amylase and α -glucosidase, thereby slowing starch breakdown and reducing postprandial sugar spikes. In addition, its antioxidant activity protects pancreatic β -cells from oxidative stress, supporting insulin secretion and sensitivity. When incorporated into gluten-free noodle

formulations using alternative flours such as millet, rice, or chickpea, jamun seed powder not only enhances the nutritional profile but also contributes to lowering the glycemic index of the product. This makes jamun powder noodles a promising dietary intervention for diabetes management, offering both therapeutic benefits and consumer-friendly convenience.

2) Foxtail/ Pearl millet flour

Foxtail millet (*Setaria italica*) is a highly suitable grain for developing jamun powder noodles targeted at diabetic management because of its naturally low glycemic index, high dietary fiber, and rich antioxidant profile. Its slow-release carbohydrates help maintain steady blood glucose levels, while its polyphenols and micronutrients such as magnesium and iron support metabolic health and insulin function. Being gluten-free, foxtail millet provides an excellent base for noodles without wheat flour, ensuring better digestibility and suitability for diabetic individuals. When combined with jamun seed powder, which contains bioactive compounds like jamboline and ellagic acid that inhibit carbohydrate-digesting enzymes, the formulation offers synergistic antidiabetic benefits. This combination not only enhances therapeutic potential but also creates a functional food product that is nutritionally balanced, palatable, and convenient for daily consumption in diabetes management.

3) Sorghum (Jawar) Flour

Sorghum flour is a valuable ingredient for formulating jamun powder noodles in diabetic management because it is naturally gluten-free, rich in dietary fiber, and has a relatively low glycemic index compared to refined grains. Its complex carbohydrates digest slowly, helping to regulate blood sugar levels, while its polyphenols and antioxidants provide additional metabolic and cardiovascular benefits. Sorghum flour also contributes essential nutrients such as iron, magnesium, and protein, making the noodles nutritionally balanced. When combined with jamun seed powder, which contains bioactive compounds like jamboline and ellagic acid that inhibit carbohydrate-digesting enzymes, the formulation offers synergistic antidiabetic effects. This combination not only enhances therapeutic potential but also produces a functional food product that is convenient, palatable, and supportive of long-term diabetes management.

4) Ragi millet

Ragi flour (*Eleusine coracana*), also known as finger millet flour, is a highly beneficial ingredient for formulating jamun powder noodles with antidiabetic activity. It is naturally gluten-free, rich in dietary fiber, and has a low glycemic index, which helps in maintaining

steady blood glucose levels. Ragi is also abundant in calcium, iron, and essential amino acids, making it nutritionally superior to many other cereals. Its slow-digesting carbohydrates and polyphenols contribute to improved insulin sensitivity and reduced postprandial sugar spikes. When combined with jamun seed powder, which contains bioactive compounds like jamboline and ellagic acid that inhibit carbohydrate-digesting enzymes, the formulation offers synergistic hypoglycemic and antioxidant effects. This combination not only enhances therapeutic potential but also results in a functional food product that is wholesome, palatable, and convenient for diabetic individuals seeking natural dietary interventions.

5) Gaur gum

Guar gum, a natural polysaccharide derived from the seeds of *Cyamopsis tetragonoloba*, plays an important role in the formulation of jamun powder noodles for antidiabetic activity. It functions primarily as a hydrocolloid and soluble dietary fiber, improving the texture, elasticity, and binding capacity of gluten-free noodles while also contributing to health benefits. In diabetic management, guar gum slows gastric emptying and carbohydrate digestion, thereby reducing postprandial blood glucose spikes and enhancing glycemic control. When combined with jamun seed powder, which contains bioactive compounds like jamboline and ellagic acid that inhibit carbohydrate-digesting enzymes, the synergy provides both functional and therapeutic advantages. Thus, guar gum not only ensures desirable noodle quality but also enhances the antidiabetic potential of jamun powder noodles, making them a convenient and nutritionally beneficial option for individuals managing diabetes.

3) EXPERIMENTAL WORK

A) Requirements:

- **Apparatus** -Beaker, Measuring cylinder, Spatula, Soxhlet apparatus.
- **Equipments** -Weighing balance, Hot air oven, pH meter, Hot plate.
- **Chemicals** – Petroleum ether, Distilled water.

B) Procedure:

Processing of jamun seed powder

Collection of jamun fruit



Removal of pulp

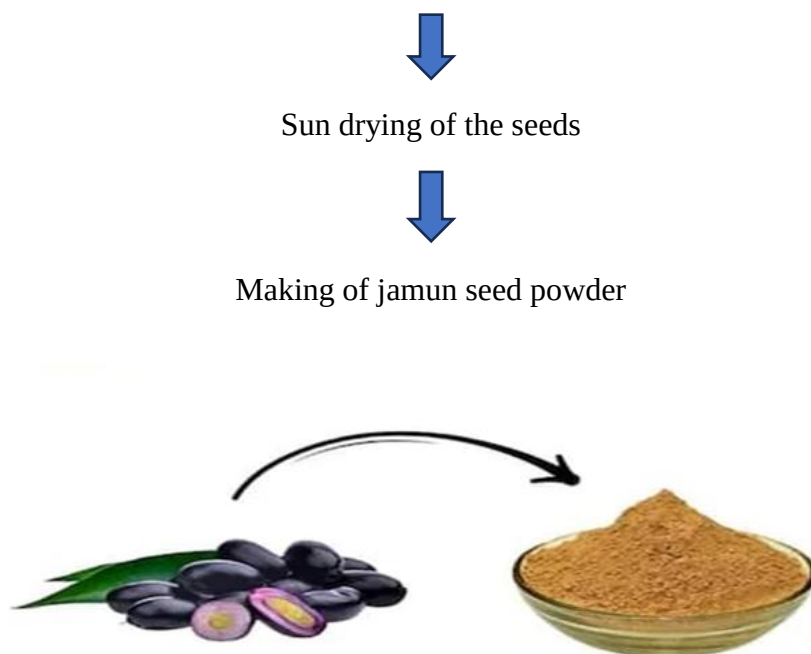


Fig. No. 1: Jamun seed powder.

Preparation of Noodles

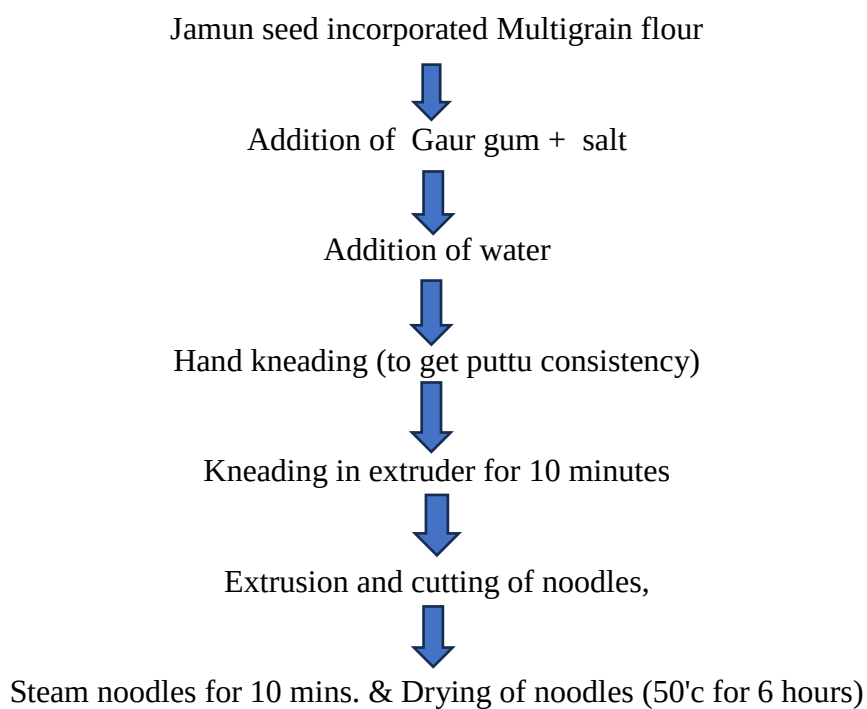




Fig. No. 2: Noodles.

Formulation of Masala

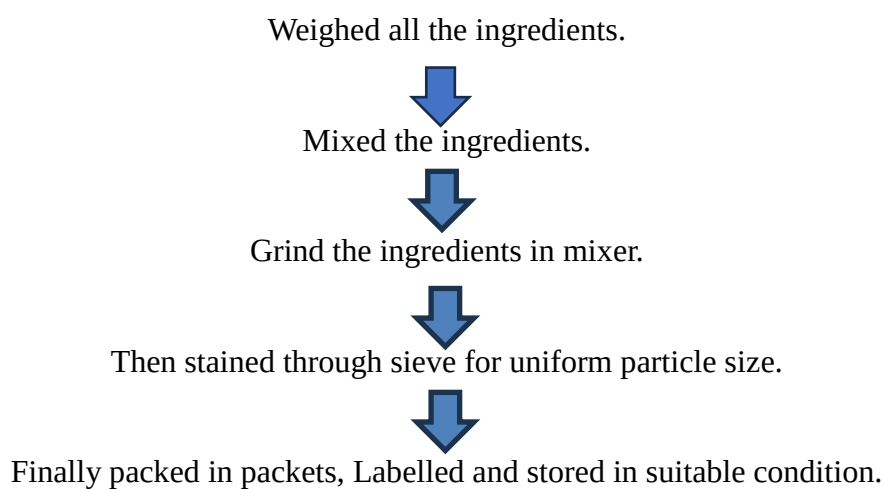


Fig. No. 3: Masala

4) EVALUATION TEST

A) Organoleptic Properties

Colour: - Yellow

Taste: - Salty, umami, mild spice

Texture: - Slightly Rough.

B) Physical Properties

Cooking properties -

Cooking Time: - 5 to 7 minutes

Cooking Loss: - 8 %

Weight Increase: - Wt. Increase- 80 gm

C) Chemical properties

1) Moisture Content

Method: Oven drying method

To determine the chemical composition of the samples, standard methods outlined by the AOAC (2000) were employed. Moisture content was measured by drying a 5gm sample in a pre-weighed petri dish in a hot air oven at 100°C for 6 hours. The weight loss due to drying was used to calculate moisture content. Moisture content (%) = $(W2 - W3) / (W2 - W1) \times 100$ Where: - W1 is the weight of the empty petri dish (grams) - W2 is the weight of the petri dish with sample before drying (grams) - W3 is the weight of the petri dish with dried sample (grams)

W1 = wt of empty petri dish = 34.320 gm

W2 = wt of petri dish + sample before drying = 39.320 gm

W3 = wt of petri dish + dried sample = 38.870 gm

$$\begin{aligned}\text{Formula} &= (W2 - W3) / (W2 - W1) \times 100 \\ &= (39.320 - 38.870) / (39.320 - 34.320) \times 100 \\ &= 0.45 / 5 \times 100 \\ &= 0.09 \times 100 \\ &= 9 \%\end{aligned}$$

2) Crude Fat

To measure crude fat content, a standardized AOAC (2000) method was employed. The extraction apparatus (Automatic SOCS plus) used petroleum ether (auto solvent) as the

extraction solvent. Two grams of sample were placed in thimbles and extracted for 1:30 hours using hexane. The extract was collected in pre-weighed beakers, which were dried in a hot air oven at 100°C overnight and cooled in desiccators to obtain a constant weight. The fat percentage was calculated as $[(W2 - W1) / W] \times 100$. Where, W is the sample weight (gm), W1 is the empty beaker weight (gm), and W2 is the beaker with fat weight (gm).

W1 = sample wt = 7 gm

W2 = empty RBF wt = 98.580 gm

W3 = RBF + sample wt = 98.720 gm

W4 = (W3 – W2)

= (98.720 – 98.580)

= 0.14 gm

Formula = $W4 / W1 \times 100$

= $0.14 / 7 \times 100$

= 2 %



Fig. No. 4: Soxhlet Extraction.

3) Ash Content

To determine the ash content, the AOAC (2000) method was used. A two-gram sample was placed in a pre-weighed crucible and charred. The crucible was then heated in a muffle furnace at 550-650°C for six hours, or until the weight remained constant. The crucible was then removed from the furnace, cooled in desiccators, and weighed. The ash content was calculated using the following formula: $\text{Ash (\%)} = (W3 - W1) / W2 \times 100$

W1 = wt of crucible = 15.910 gm

W2 = wt of crucible + sample wt = 17.900 gm

W = W2 – W1 (wt of sample)

= 17.900 -15.910 gm

= 1.99 gm

W3 = wt of crucible + Ash wt = 16.420 gm

Formula = Ash (%) = (W3 – W1) / W2 x 100

= (16.420 – 15.910) / 17.900 x 100

= 0.51 / 17.900 x 100

= **2.8 %**



Fig. No. 5: Ash Content.

4) pH

The pH of jamun powder noodles was determined as part of chemical evaluation to assess product stability and acceptability. For the test, 10 gm of finely powdered noodle sample was accurately weighed and transferred to a 250 mL conical flask, to which 100 mL of freshly boiled and cooled distilled water was added. The flask was shaken vigorously for 30 minutes on a mechanical shaker to ensure uniform extraction of water-soluble components, followed by filtration through Whatman No. 1 filter paper. The filtrate was collected and its pH was

measured using a calibrated digital pH meter at 25°C, after standardizing the instrument with pH 4.0, 7.0, and 9.2 buffer solutions. The test was performed in triplicate and the average value was recorded. The pH of jamun powder noodles was found to be in the range of 5.5–6.5, which is slightly acidic due to the natural organic acids present in jamun seed powder.

Result - pH value - 6.07



Fig. No. 6: pH Test.

5) RESULT

The preparation of Jamun powder noodles involves incorporating Jamun seed powder into a composite flour mixture to create a nutritious and potentially therapeutic treat. Studies have shown that adding Jamun seed powder to noodles can improve their sensory quality characteristics, such as taste and texture.

Jamun, *Syzygium cumini* has been used in traditional medicine to treat diabetes. The hypoglycemic and hypolipidemic activities of Jamun may be triggered by free radicals as diabetes is caused by excessive oxidative stress, high activity of catalase glutathione peroxidase, glutathione-s-transferase and increased glutathione concentration are associated with and decreased lipid peroxidation. This findings underscore the potential of innovative formulation to meet consumer demand for healthier food option while maintaining sensory appeal and product stability. This inventive extruded food items can meet the growing need for wholesome yet enticing food options in the market as customers are becoming more health conscious.

Incorporating jamun seed powder noodles formulations resulted in notable improvements in various nutritional aspects. The fat content decreased, while ash, crude fiber, calcium, zinc, and polyphenols content increased, indicating a shift towards a more nutrient-rich profile. Additionally, protein digestibility was enhanced. During the storage study, lower fat acidity and peroxide values were observed compared to the control, suggesting improved stability and freshness retention. In conclusion, the incorporation of jamun seed powder presents a promising avenue for enhancing the nutritional quality and stability of pasta and noodles. The observed changes in nutrient content signify potential health benefits for consumers. Moreover, the improved protein digestibility further adds to the nutritional value of the products. Overall, the changes in organoleptic scores varying between pasta and noodles with jamun seed incorporation during storage highlight the potential influence of the extrusion process and formulation on the sensory attributes of the final products. These findings underscore the potential of innovative formulations to meet consumer demand for healthier food options while maintaining sensory appeal and product stability. These inventive extruded food items can meet the growing need for wholesome yet enticing food options in the market as customers are becoming more health conscious.

6) CONCLUSION

The present study successfully developed jamun seed powder-based noodles as a functional food for diabetes management, wherein incorporation of 10–15% jamun powder significantly enhanced the dietary fiber, polyphenol content, and antioxidant activity while lowering the estimated glycemic index compared to conventional wheat noodles. The optimized 10 gm masala sachet complemented the sweet-astringent taste of jamun and ensured good sensory acceptability with a hedonic score >7. The bioactive compounds like jamboline and ellagic acid in jamun exhibit α -amylase and α -glucosidase inhibitory activity, supporting postprandial glucose control, while the high fiber content improves satiety and aids weight management. With good cooking quality, 6-month shelf life, and consumer acceptability, these noodles provide a convenient, palatable, and nutritionally superior alternative to refined flour noodles for diabetic individuals. However, the product is intended as a dietary supplement to support glycemic control and not a replacement for prescribed medication, and clinical validation is recommended for future commercialization.

The present study successfully formulated and evaluated jamun powder noodles by incorporating jamun seed powder and foxtail millet flour as functional ingredients with

refined wheat flour. The developed noodles exhibited acceptable physical characteristics such as good cooking time, optimum water uptake, and firm texture, indicating technological feasibility for commercial production.

Although direct in vitro antidiabetic activity was not performed, the chemical evaluation revealed significant supportive evidence for potential glycemic benefits. The product showed a low pH of 5.5–6.5, high dietary fiber content from foxtail millet, and elevated total ash indicating rich mineral profile, particularly magnesium and iron. Jamun seed powder is well documented for bioactive compounds like jamboline, ellagic acid, and tannins that inhibit α -amylase and α -glucosidase enzymes. The presence of foxtail millet further contributes low-GI starch and polyphenols. Thus, based on chemical composition and ingredient profile, the formulated noodles can be considered a functional food with promising potential for glycemic management in diabetic individuals.

Since no in vitro or in vivo antidiabetic assays were conducted in the present work, the antidiabetic claim is based only on literature and physicochemical data of raw ingredients. Further studies involving α -amylase inhibition assay, starch digestibility, glycemic index determination, and clinical trials are required to scientifically validate the antidiabetic efficacy of the formulated jamun powder noodles. However, the product meets the nutritional and quality parameters of a health-oriented noodle and may serve as a dietary adjunct for diabetes management after proper biological evaluation.

Table No. 1: Phytochemical Constituents.

Sr. No.	Plant Part	Phytochemical Constituents
1.	Fruit Pulp	Anthocyanins, diglucosides of delphinidin, petunidin, malvidin, peonidin, and cyanidin. Volatile oils (α -pinene, β -pinene, β -myrcene, cis-ocimene, trans-ocimene, terpinolene, linalool, 4 terpineol, α -terpineol, cis-dihydrocarvone, caryophyllene, α humelene, cis- β -farnesene, cis- α -farnesene, trans- α -farnesene, cis-nerolidol, geranyl butyrate, globulol, widdrol, torreyol, neocedranol, β -bisabolol
2.	Seed	Ellagitannins, Jambosine, gallic acid, ellagic acid, corilagin, 3, 6-hexahydroxy diphenoylglucose, 1-galloylglucose, 3 galloylglucose, quercetin, β -sitosterol, and 4,6 hexahydroxy diphenoyl glucose
3.	Stem Bark	Bark Friedelin, friedelan-3- α -ol, betulinic acid, β -sitosterol, kaempferol, β -sitosterol-Dglucoside, gallic acid, ellagic acid, gallotannin, ellagitannin, and myricetine.
4.	Leaves	β -sitosterol, betulinic acid, mycaminose, crategolic (maslinic) acid, n-hepatcosane, nnonacosane, n-hentriacontane, noctacosanol, n-triacontanol, n-dotricontanol, quercetin, myricetin, myricitrin and the

		flavonol glycosides myricetin 3-O-(4''-acetyl)- α -L-rhamnopyranosides. Essential oils (α -terpeneol, myrtenol, eucarvone, muurolol, α -myrtenal, 1, 8-cineole, geranyl acetone, α -cadinol, pinocarvone)
5.	Flowers	Flowers Oleanolic acid, ellagic acids, isoquercetin, quercetin, kampferol, and myricetin.
6.	Roots	Isohamnetin-3-O-rutinside and flavonoid glycosides

Table No. 2: Noodles Formulation table. (For 200 gm)

Ingredients	Quantity Given (gm)
Jamun Powder	15 gm
Foxtail millet flour	120 gm
Sorghum flour	30 gm
Ragi flour	30 gm
Gaur Gum	3 gm
Salt	2 gm
Water	As Needed

Table No. 3: Masala formulation table.

(10 gm masala packet)

INGREDIENTS	QUANTITY (gm)
Salt	1 gm
Chilli powder	1 gm
Coriander powder	1.5 gm
Onion powder	1.5 gm
Garlic powder	1.5 gm
Ginger powder	1 gm
Black pepper powder	1 gm
Turmeric powder	1 gm
Kasuri methi	0.5 gm

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