Formulation And Characterization of Edible Jelly for The Diabetic Patients

Mr.Shivprasad T. Bhambure[1], Mr.Shubham D. Borate[2], Dr. Bhagyesh U. Janugade[3]
[1,2]*Student, Krishna Foundation's Jaywant Institute of Pharmacy*
[3]*Research Guide, Krishna Foundation's Jaywant Institute of Pharmacy*

***Abstract*—Diabetes mellitus is a chronic metabolic illness characterized by high blood glucose levels that necess it a tesrigorous food controland sugar reduction. Conventional jelly formulations have high levels of sugar, rendering the min appropriate for diabetic individuals. As a result, the current study focuses on the development and testing of a sugar-free edible jelly using diabetic-friendly ingredients. The jelly was made with pectin as a gelling agent, stevia as a natural non-caloric sweetener, and citric acid for pH adjustment and flavor enhancement. Glycerin was added to improve texture and avoid drying, while sodium benzoate was used as a preservative to increase shelf life. Purified water was used as the foundation, coupled with appropriate flavoring and coloring chemicals to increase organoleptic qualities. Aloe vera extract was optionally used to enhance the medicinal properties.**

The prepared jelly compositions were assessed on a variety of criteria, including appearance, texture, pH, spread ability, taste, and stability. The results showed that the created jelly had acceptable physicochemical qualities and satisfactory patient acceptability without the addition of sugar. This study shows that sugar-free edible jelly may be successfully created with safe and low- cost ingredients, making it a viable option for diabetes people. The formulation has the potential for further development in the nutraceutical and functional food sectors.

Food Intake→ Glucose in Blood↑
↓
Insulin Secretion (Pancreas)
↓
Glucose enters cells→ Energy (In Diabetes)
↓
Insulin/Insulin Resistance
↓
Glucose remains in blood→
Hyperglycemia

Mechanism of diabetes mellitus

I. INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent elevation of blood glucose levels due to defects in insulin secretion, insulin action, or both [1,8]. It is one of the most prevalent non-communicable diseases worldwide and has become a major global health concern [2,9]. According to recent reports, the incidence of diabetes is increasing rapidly due to changes in lifestyle, dietary habits, and reduced physical activity [3,10]. If not properly managed, diabetes can lead to serious complications such as cardiovascular diseases, kidney failure, neuropathy, and vision impairment [1,8]. Effective management of diabetes requires a comprehensive approach that includes pharmacological therapy, regular physical activity, and strict dietary regulation.

Among these, dietary management plays a crucial role in controlling blood glucose levels. Patients are often advised to reduce or eliminate the intake of high-sugar foods and beverages [10]. However, complete restriction of sweet foods can reduce dietary satisfaction and may lead to poor compliance with treatment regimens [4,5]. Therefore, there is a growing need to develop alternative food products that are both enjoyable and safe for diabetic individuals [15,16].

Jelly is a widely consumed semi-solid food product known for its attractive appearance, smooth texture, and pleasant taste [17]. It is particularly popular among children and elderly individuals due to its ease of consumption. Conventional jelly formulations

primarily consist of sucrose, water, flavoring agents, and gelling agents. The high sugar content in these products contributes to a high glycemic index, making them unsuitable for diabetic patients [3,10]. As a result, the development of sugar-free or low-glycemic index jelly has gained significant importance in recent years [15,16].

Advancements in food and pharmaceutical sciences have enabled the use of alternative sweeteners that can replace sugar without affecting blood glucose levels [13]. Natural sweeteners such as stevia have emerged as promising substitutes due to their high sweetness intensity and zero-calorie content [1,13]. Stevia is derived from the plant Stevia rebaudiana and is considered safe for consumption. It provides sweetness without contributing to hyperglycemia, making it an ideal choice for diabetic formulations.
In addition to sweeteners, the selection of appropriate gelling agents is essential for the preparation of jelly with desirable consistency and texture [19,20,22]. Pectin, a natural polysaccharide obtained from plant sources such as citrus fruits, is widely used as a gelling agent in food products. It forms a stable gel network in the presence of acid and water, providing the required firmness and structure to the jelly [19,22]. Pectin is non-toxic, biodegradable, and widely accepted for use in food and pharmaceutical formulations.

The formulation of sugar-free edible jelly also involves the use of various excipients to improve its quality, stability, and acceptability. Glycerin is commonly used as a humectant to retain moisture and prevent drying of the jelly, thereby enhancing its texture and mouthfeel. Citric acid is added to maintain an acidic pH, which is necessary for proper gel formation and also enhances the flavor of the product. Sodium benzoate is used as a preservative to prevent microbial growth and extend the shelf life of the formulation [11,14].

Diabetic Patient
↓
Diet Control
↓
Sugar-Free Foods
↓
Sugar-Free Jelly

Roleofsugar-freeproductsindiabeticdietmanagement
Furthermore, the incorporation of herbal or functional ingredients can enhance the therapeutic value of the jelly. Natural extracts such as aloe vera are known for their antioxidant, anti-inflammatory, and potential antidiabetic properties [3,7]. The inclusion of such ingredients can transform the jelly from a simple food product into a functional or nutraceutical formulation that offers additional health benefits.

To ensure the quality, safety, and effectiveness of the formulated jelly, it is necessary to perform various evaluation tests. These include organoleptic evaluation (appearance, color, odor, and taste), physicochemical analysis (pH, texture, spread ability, and gel strength), and stability studies [11,12]. These parameters help in determining whether the formulation meets the required standards and is suitable for consumption by diabetic patients.In recent years, there has been increasing interest in developing functional food products that not only provide nutrition but also offer health benefits. Sugar-free edible jelly represents one such innovative approach that combines pharmaceutical and food technology principles to create a patient-friendly dosage form. It can improve compliance, especially among pediatric and geriatric populations, due to its palatability and ease of administration.

Thus, the present study focuses on the formulation and evaluation of a sugar-free edible jelly using safe, natural, and cost-effective ingredients. The aim is to develop a product that is not only acceptable in terms of taste and texture but also suitable for diabetic patients by eliminating the use of sugar. The study also aims to evaluate the physicochemical properties and stability of the formulation to ensure its quality and effectiveness.

In conclusion, the development of sugar-free edible jelly holds significant potential as a dietary alternative for diabetic individuals. It addresses the need for low-sugar, patient-friendly food products while maintaining desirable sensory and physicochemical characteristics. This formulation can serve as a promising option in the field of nutraceuticals and functional foods, contributing to better management of diabetes and improved quality of life.

II. LITERATURE REVIEW

The development of sugar-free and functional food products, particularly herbal jelly formulations, is supported by extensive research in the fields of food science, phytochemistry, and nutrition.

The following review presents a comprehensive analysis of previous studies related to extraction techniques, food hydrocolloids, natural sweeteners, and diabetic-friendly formulation.[13]

1. Myers, N.W. et al.(1982)

Myers and co-workers provided significant insights into laboratory techniques used in extraction and concentration processes, particularly emphasizing the role of rotary evaporators.

Rotary evaporation Is a widely used method in laboratories for the efficient removal of solvents under reduced pressure. This technique is especially important in phytochemical extraction, where heat-sensitive compounds such as phenolics and flavonoids must be preserved.

The study highlights that controlled temperature and pressure conditions help prevent degradation of bioactive compounds, ensuring the quality and efficacy of plant extracts. Proper handling techniques and operational safety measures were also discussed, which are essential to avoid contamination and ensure reproducibility of results. In the context of herbal jelly formulation, such extraction techniques are crucial for obtaining concentrated plant extracts that can be incorporated into food products without losing their therapeutic properties. The study forms a foundational basis for laboratory-scale extraction processes used in functional food development.

2. Sanderson, G.R.et al.(1988)

Sanderson and colleagues extensively studied therole of gums and polysaccharides in food systems. Gums are complex carbohydrates that function as hydrocolloids and are widely used in the food industry due to their ability to modify texture and stability.

The study explains that gums act as:

- Gelling agents–forming a three-dimensional network that traps water
- Thickening agents –increasing viscosity
- Stabilizers–preventing separation of ingredients

These properties are particularly important in jelly preparation, where a firm yet elastic texture is required. There search also discusses different types of gums such as pectin, agar, and xanthan gum, each having specific functional properties.

In sugar-free formulations, gums become even more critical because sugar itself contributes to gel formation and texture. Therefore, the replacement of sugar necessitates the use of suitable hydrocolloids to maintain product quality. This study provides essential knowledge for selecting appropriate gelling agents in low-calorie jelly formulations.

3. J.B. Harborne et al.(1998)–Phytochemical Methods

Harborne's book is a cornerstone in phytochemical research, offering detailed methodologies for the extraction, isolation, and identification of plant constituents. It covers a wide range of compounds including alkaloids, terpenoids, phenolics, and glycosides.

The book describes various extraction methods suchas:

- Solvent extraction
- Soxhlet extraction
- Maceration and percolation

It also outlines analytical techniques like chromatography and spectroscopy for compound identification. These methods are essential for ensuring the presence and purity of bioactive compounds in herbal formulations.

For herbal jelly development, phytochemical analysis ensures that the plant extracts used possess therapeutic benefits such as antioxidant, anti-diabetic, or anti-inflammatory properties. Harborne's work supports the scientific validation of herbal ingredients used in functional foods.

4. Amos Russinovich et al. (2009)

Russinovich and colleagues focused on plant gum exudates and their applications in food systems.Plant gums are natural hydrocolloids obtained from tree exudates and are widely used due to their biodegradability, non-toxicity, and functional versatility.

The study discusses:

- Classification of gums (natural vs. modified)
- Physicochemical properties such as solubility, viscosity, and gel strength
- Applications in food, pharmaceuticals, and cosmetics

In jelly formulations, plant gums improve texture,

water retention, and shelf stability. They also act as fat replacers and can enhance mouthfeel in low-calorie products.

The research emphasizes that natural gums are preferred over synthetic additives due to increasing consumer demand for clean-label and natural products. This is particularly relevant in herbal jelly preparation, where natural ingredients are prioritized.

5. Sharma, H. & Agrawal, R. et al. (2014)

Sharma and Agrawal addressed the growing health concerns associated with high sugar consumption, including obesity, diabetes, and cardiovascular diseases. Their study highlights the increasing demand for low-calorie and sugar-free food products.

The authors emphasize the use of natural sweeteners such as stevia, which is derived from plant sources and contains zero or negligible calories.

Stevia is significantly sweeter than sucrose and does not raise blood glucose levels, making it suitable for diabetic individuals. The study also discusses challenges associated with sugar replacement, such as:

- Taste differences
- Aftertaste issues
- Stability during processing

Despite these challenges, natural sweeteners are gaining popularity due to their safety and health benefits. This research supports the use of stevia in sugar-free jelly formulations as a viable alternative to traditional sweeteners.

6. Patel, J.& Patel, N.et al. (2016)

Patel and Patel conducted a comprehensive review of natural sweeteners and their advantages over artificial sweeteners. The study concludes that natural sweeteners are safer, non-toxic, and environmentally friendly.

The authors compare different sweeteners based on:

- Caloric value
- Glycemic index
- Safety profile

They highlight that natural sweeteners do not cause the adverse health effects often associated with artificial sweeteners, such as metabolic disturbances or toxicity concerns.

For diabetic-friendly products, maintaining low glycemic response is crucial. The study supports the incorporation of natural sweeteners in functional foods, including jelly, to improve health outcomes while maintaining palatability.

7. Kumar, S.& Mittal , A.et al.(2020)

Kumar and Mittal explored the role of herbal plants in diabetes management. Their study emphasizes that herbal remedies are cost-effective and have fewer side effects compared to conventional pharmaceutical drugs.

The research highlights several plant-based compounds that exhibit:

- Hypoglycemic activity
- Antioxidant properties
- Anti-inflammatory effects

These properties make herbal extracts valuable ingredients in functional food formulations aimed at managing chronic diseases like diabetes.

The study also suggests that integrating herbal extracts into daily diet products, such as jelly, can provide therapeutic benefits without requiring major lifestyle changes. This approach aligns with the concept of functional foods that combine nutrition with health benefits.

8. World Health Organization (2023)

The World Health Organization emphasizes the urgent need to reduce free sugar intake globally. According to their guidelines, excessive sugar consumption is a major contributor to the rising prevalence of diabetes, obesity, and other non-communicable diseases.

The WHO recommends:

- Limiting sugar intake to less than 10% of total daily energy
- Promoting healthier food alternatives
- Encouraging food manufacturer store formulate products

The organization strongly supports the development of sugar-free and low-sugar food products. This recommendation provides a global health perspective and validates the importance of research in sugar-free jelly formulations.

9. Han, H. et al.(2024)

Han and colleagues conducted recent research on sugar-free jelly formulations and their impact on blood glucose levels. Their findings indicate that

sugar-free jelly significantly reduces postprandial blood glucose response compared to conventional jelly.

The study demonstrates that:

- Replacement of sugar with natural sweeteners lowers glycemic impact
- Texture and sensory properties can be maintained with proper formulation
- Sugar-free products are suitable for diabetic and health-conscious consumers

This research provides strong experimental evidence supporting the development of diabetic-friendly jelly products. It also highlights the importance of balancing taste, texture, and nutritional value in product formulation.

The reviewed literature clearly indicates a strong scientific foundation for the development of sugar-free herbal jelly formulations. Extraction techniques ensure the preservation of bioactive compounds, while hydrocolloids and plant gums play a critical role in achieving desired texture and stability.

Natural sweeteners emerge as a key component in replacing sugar, offering health benefits without compromising taste. Additionally, herbal extracts provide therapeutic advantages, particularly in managing diabetes.

Global health recommendations further reinforce the need for low-sugar products, and recent studies confirm their effectiveness in controlling blood glucose levels. Overall, the integration of phytochemistry, food science, and nutrition supports the development of innovative functional foods such as sugar-free herbal jelly.

10. Soomro, M. A. et al.(2024)

Soomro and colleagues highlighted the multifunctional role of pectin in food and health applications. Traditionally recognized as a gelling agent, pectin is widely used in jelly and jam formulations due to its ability to form stable gels in the presence of acid and appropriate conditions. However, the study extends beyond its technological function and emphasizes its therapeutic potential.

The authors report that pectin exhibits antidiabetic properties, including improvement in glucose metabolism and enhancement of insulin sensitivity. These effects are primarily attributed to its soluble fiber nature, which slows down glucose absorption in the gastrointestinal tract and helps regulate postprandial blood sugar levels'

Furthermore, pectin contributes to gut health by acting as a prebiotic, promoting beneficial gut microbiota, which is increasingly linked to metabolic health. In the context of sugar-free jelly formulation, the dual role of pectin as both a structural and functional ingredient makes it highly valuable. This study supports the incorporation of pectin not only for texture development but also for its potential health benefits, particularly in diabetic-friendly food products.

11. Gorjanović, S.et al. (2024)

Gorjanović and co-researchers focused on the development of functional jelly enriched with plant-based ingredients. The study highlights how incorporating natural bioactive compounds from plant sources can significantly improve the nutritional profile of jelly products.

The research demonstrates that such formulations can effectively reduce the glycemic index (GI) of the final product. A lower glycemic index is crucial for managing blood sugar levels, especially for diabetic individuals. The addition of plant extracts rich in antioxidants, polyphenols, and dietary fiber contributes to improved metabolic responses.

Moreover, the study emphasizes that functional jellies can serve as nutraceutical products, combining both nutritional and therapeutic benefits. The authors also note improvements in sensory attributes when formulations are optimized properly, ensuring consumer acceptability.

This research reinforces the idea that jelly is no longer just a confectionery product but can be transformed into a health-promoting functional food through strategic ingredient selection.

12. Angelin, M. et al. (2024)

Angelin and colleagues investigated the health impacts of high sugar consumption and its strong association with metabolic disorders such as diabetes, obesity, and cardiovascular diseases.

Their findings provide further scientific evidence linking excessive intake of refined sugars to impaired glucose metabolism and insulin resistance.

The study highlights that frequent consumption of high-sugar foods leads to:

a. Increased risk of type2diabetes
b. Elevated blood glucose levels
c. Long-term metabolic complications

The authors strongly advocate for reducing sugar intake and replacing it with healthier alternatives. They emphasize the role of food innovation in addressing these concerns by developing sugar-free and low-calorie products.

In relation to jelly formulations, this study provides a strong justification for eliminating or reducing sugar content and incorporating alternative sweeteners. It aligns with global health recommendations and strengthens the rationale for developing diabetic-friendly food products.

13. Simonović, M. et al.(2025)

Simonović and co-authors explored recent advancements in low-sugar jelly formulations, with a particular focus on there tention of bioactive compounds during processing. One of the major challenges in functional food development is maintaining the stability and efficacy of bioactive ingredients under thermal and processing conditions.

The study reports that modern formulation techniques, including optimized processing parameters and the use of protective agents, can significantly improve the retention of phytochemicals such as antioxidants and polyphenols.

Additionally, the research highlights:

a. Improved nutritional quality of low-sugar jellies
b. Enhanced functional properties

Better consumer acceptance through balanced taste and texture

These advancements support the development of next-generation functional foods that are both health-oriented and commercially viable. The study concludes that low-sugar jelly products enriched with bioactive compounds can serve as effective dietary options for health-conscious and diabetic populations.

The inclusion of recent studies (2024–2025) further strengthens the scientific basis for sugar-free and functional jelly development. Emerging research highlights the dual functionality of ingredients such as pectin, the importance of glycemic index reduction, and advancements in preserving bioactive compounds during. Processing.

III. AIM AND OBJECTIVES

Aim

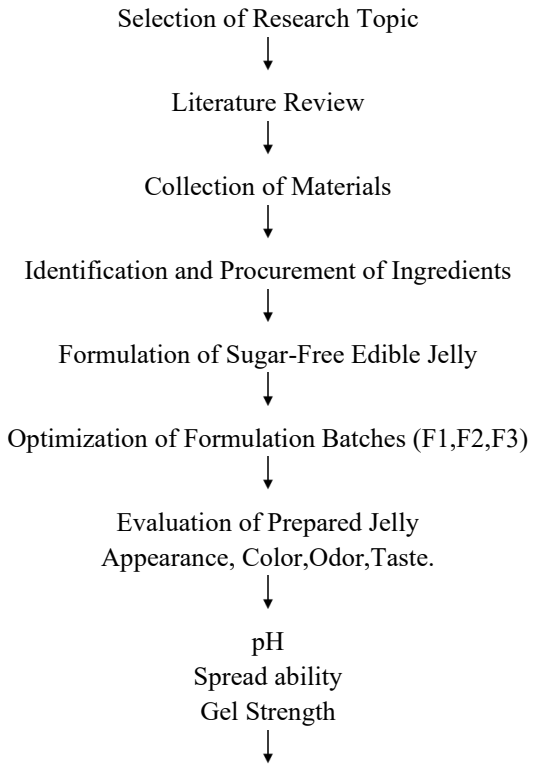
To formulate and evaluate a sugar-free edible jelly for diabetic patients using suitable natural and safe ingredients with good stability and acceptability.

Objectives

1. To develop a sugar-free jelly formulation using pectin as a gelling agent.
2. To incorporate stevia as a natural sweetener suitable for diabetic patients.
3. To optimize the formulation using excipients like citric acid, glycerine, and preservatives for better stability and texture.
4. To evaluate the prepared jelly for physicochemical parameters such as pH, consistency, and appearance.
5. To assess organoleptic properties including taste, color, texture, and overall acceptability.
6. To study the stability and shelf life of the formulated jelly.

To develop a cost-effective and patient-friendly formulation suitable for diabetic use

IV. PLAN OF THE WORK



Stability study
↓
Result and Discussion
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Conclusion
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References

V. MATERIALS AND THEIR RESOURCES

The formulation of sugar-free herbal jelly requires careful selection of ingredients that not only provide desirable physicochemical properties but also contribute to the overall nutritional and therapeutic value of the product.

Each material used in the formulation plays a specific role in ensuring proper gel formation, stability, taste, preservation, and health benefits. The following section provides a detailed description of all materials used in the preparation of the jelly formulation along with their sources, properties, and functions. [14,15]

1. Pectin

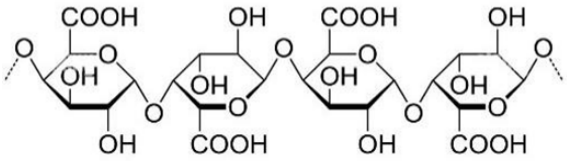
Pectin is a naturally occurring polysaccharide widely used in the food industry as a gelling agent. It is primarily extracted from citrus fruits such as oranges and lemons, as well as from apple pomace, which is a by-product of juice processing. Due to its plant origin, pectin is considered a sustainable, biodegradable, and environmentally friendly ingredient.

The primary function of pectin in jelly formulation is to act as a gelling agent.It forms a three- dimensional network structure when dissolved in water and combined with acid under suitable conditions. This network traps water molecules and other ingredients, resulting in the formation of a semi-solid gel structure characteristic of jelly products.

Pectin significantly influences the texture, firmness, and viscosity of the final product. A well-balanced concentration of pectin ensures that the jelly is neither too soft nor too rigid. Additionally, it contributes to the clarity and appearance of the jelly, which is an important quality parameter for consumer acceptance.

In sugar-free formulations, the role of pectin becomes even more critical. Normally, sugar assists in gel formation by interacting with pectin molecules; however, in the absence of sugar, pectin must independently maintain the structural integrity of the gel. Therefore, proper selection and optimization of pectin concentration are essential.

Beyond its functional properties, pectin also offers health benefits.It is a soluble dietary fiber known to aid in digestion and may help in reducing cholesterol levels. Recent studies also suggest that pectin can contribute to better blood glucose regulation, making it beneficial for diabetic individuals. [14,15,16]



Pectin

Poly-α-(1→4)-galacturonic acid – Section of the pectin main chain

2. Stevia

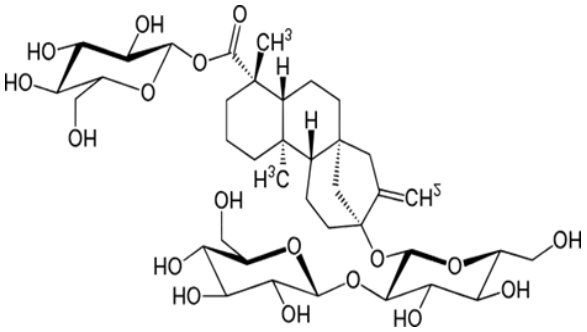
Stevia is a natural, plant-based sweetener derived from the leaves of Stevia rebaudiana. It has gained significant popularity as a substitute for sugar due to its zero-calorie nature and high sweetness intensity. Stevia is approximately 200 to 300 times sweeter than sucrose, which allows it to be used in very small quantities. One of the most important advantages of stevia is that it does not raise blood glucose levels, making it highly suitable for individuals suffering from diabetes.

Unlike conventional sugar, stevia does not contribute to caloric intake, which makes it an ideal ingredient for low-calorie and sugar-free food formulations.

Stevia is also known for its thermal stability, meaning it can withstand heating processes involved in jelly preparation without losing its sweetness. This property makes it highly compatible with food processing techniques.

In addition to its functional role as a sweetener, stevia also contributes to oral health, as it does not promote tooth decay. However, one limitation of stevia is its slightly bitter or licorice-like aftertaste, which may affect consumer acceptability. This issue can be managed by combining it with suitable flavoring agents. Overall, stevia serves as a safe, natural, and effective alternative to sugar in jelly formulation, supporting the development of diabetic-friendly

product. [17



3. Citric Acid

Citric acid is a weak organic acid naturally present in citrus fruits such as lemons, limes, and oranges. It is widely used in food processing due to its multifunctional properties. In jelly formulation, citric acid plays a crucial role in maintaining the optimal pH range (approximately 3–3.5) required for effective gel formation. Pectin requires an acidic environment to form a stable gel structure, and citric acid ensures that this condition is achieved. Apart from facilitating gel formation, citric acid enhances the taste and flavor of the jelly by imparting a pleasant sourness that balances the sweetness of stevia.

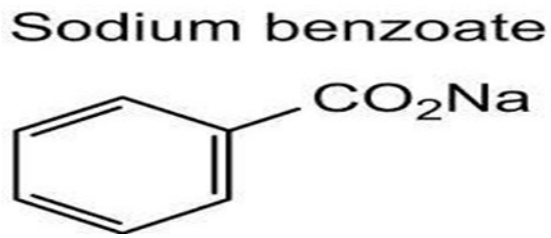
It also acts as a preservative, inhibiting the growth of microorganisms in acidic conditions. Another important function of citric acid is its ability to act as a chelating agent, which means it binds with metal ions that could otherwise cause spoilage or discoloration. This helps in improving the stability and shelf life of the product. Citric acid also contributes to maintaining the color and freshness of the jelly, preventing oxidative reactions that could degrade the quality of the product over time. [14,17]

4. Sodium Benzoate

Sodium benzoate is a commonly used food preservative known for its antimicrobial properties. It is particularly effective in acidic environments, making it suitable for use in jelly formulations.

The primary function of sodium benzoate is to inhibit the growth of bacteria, yeast, and molds, there by preventing spoilage and extending the shelf life of the product. This is especially important in products with high moisture content like jelly, which are more susceptible to microbial contamination.

Sodium benzoate works by disrupting the metabolic processes of microorganisms, effectively stopping their growth. It is widely used in beverages, sauces, jams, and jellies due to its efficiency and safety. When used within the recommended limits set by food safety authorities, sodium benzoate is considered safe for consumption. Its inclusion in the formulation ensures that the product remains stable and safe during storage and distribution [16,17]



5. Glycerin

Glycerin, also known as glycerol, is a polyol compound widely used in food and pharmaceutical formulations. It functions primarily as a humectant, which means it helps retain moisture within the product. In jelly formulation, glycerin prevents the product from becoming dry or hard over time. It helps maintain the softness and flexibility of the gel, ensuring a pleasant texture throughout its shelf life.

Glycerin also enhances the mouthfeel and smoothness of the jelly, making it more appealing to consumers.

It contributes to the overall sensory quality of the product by improving its consistency. Additionally, glycerin has mild sweetening properties, which can complement the sweetness provided by stevia. It also acts as a stabilizing agent, helping maintain uniformity and preventing phase separation. Due to its non-toxic and safe nature, glycerin is widely used in food products and is considered suitable for consumption.[16]

6. Purified Water

Purified water serves as the base medium for the jelly formulation. It acts as a solvent in which all other ingredients are dissolved or dispersed. Water plays a crucial role in the hydration of pectin, which is essential Hydration of pectin, which is essential for gel formation. Without adequate hydration, pectin cannot form the desire gel structure.

It also ensures the uniform distribution of ingredients, leading to a consistent and homogeneous product. The quality of water used is extremely important as impurities can affect the taste, stability, and safety of the final product.

Using purified water ensures that the formulation remains free from contaminants, thereby maintaining the quality and shelf life of the jelly. [16]

7. Flavorings Agents

Flavoring agents are added to enhance the taste and aroma of the jelly. In sugar-free formulations, they play an even more important role in improving palatability and masking any undesirable aftertaste from ingredients like stevia. Flavoring agents can be derived from natural sources, such as fruit extracts and essential oils, or can be synthetic, depending on formulation requirements.

They significantly improve consumer acceptability, especially when the product is intended for long-term consumption. The choice of flavor should complement the overall composition of the jelly and enhance its sensory appeal. Flavoring agents also contribute to creating a pleasant eating experience, which is essential for the success of any food product in the market.[16]

8. Aloe Vera Extract

Aloe Vera extract is a valuable ingredient known for its medicinal and nutritional properties. It contains various bioactive compounds such as polysaccharides, vitamins, enzymes, and antioxidants. IN the context of jelly formulation, aloe Vera enhances the product by providing functional health benefits. It has been reported to exhibit antidiabetic properties, helping in the regulation of blood glucose levels.

Additionally, aloe Vera possesses anti-inflammatory, antimicrobial, and healing properties, making it beneficial for overall health. Its inclusion in the formulation transforms the jelly from a simple food product.

VI. EXPERIMENTALWORK

Method of Preparation of Sugar-Free Edible Jelly

The experimental work involves the formulation and preparation of sugar-free edible jelly using natural and functional ingredients such as pectin, stevia, aloe vera extract, and other additives.

The procedure is carefully designed to ensure proper gel formation, uniform consistency, and enhanced therapeutic value. Each step in the process plays a critical role in determining the quality, texture, stability, and acceptability of the final product. [16,17]

Step1: Preparation of Pectin Solution

The first and most critical step in jelly preparation is the formation of the pectin solution. An accurately weighed quantity of pectin is taken using a digital weighing balance to ensure precision in formulation. Pectin is then slowly dispersed into purified water with continuous stirring. This gradual addition is essential to prevent lump formation, as pectin has a strong tendency to clump when added directly to water. Continuous stirring ensures uniform hydration of pectin particles.

The solution is then gently heated to a temperature of approximately 60–70°C. Heating facilitates complete dissolution and activation of pectin, resulting in a clear and homogeneous solution. Care must be taken to avoid excessive heating at this stage, as it may affect the gelling properties of pectin. This step lays the foundation for gel formation, as proper hydration and dispersion of pectin are crucial for achieving the desired texture in the final product.

- Accurately weigh the required quantity of pectin.
- Disperse it slowly in purified water with continuous stirring to avoid lump formation.
- Heat the solution gently (60–70°C) until a clear solution is obtained.

Step2: Addition of Sweetener

Once the pectin solution is prepared, the required quantity of stevia is added. Stevia, being a high-intensity sweetener, is used in very small amounts compared to conventional sugar. The sweetener is

added gradually with continuous stirring to ensure complete dissolution. Proper mixing is essential to achieve uniform sweetness throughout the formulation.

Unlike sugar, stevia does not contribute to gel formation; therefore, careful formulation is necessary to maintain the balance between sweetness and texture. This step ensures that the jelly remains low-calorie and suitable for diabetic individuals without compromising taste

- Add measured quantity of stevia to the pectin solution.
- Stir continuously until it is completely dissolved.

Step3: Incorporation of Glycerin

Glycerin is added to the mixture as a humectant and texture-enhancing agent. The measured quantity of glycerin is introduced slowly into the solution while stirring continuously.

Glycerin helps in retaining moisture within the jelly, preventing it from becoming dry or brittle during storage. It also improves the smoothness, softness, and mouthfeel of the product. Proper mixing at this stage ensures uniform distribution of glycerin, which contributes to the overall stability and quality of the jelly.

- Add glycerin to the mixture.
- Mix properly to improve texture and moisture retention.

Step4: Addition of Citric Acid

Citric acid is first dissolved in a small amount of purified water to ensure easy incorporation into the mixture. This solution is then added slowly to the main mixture with continuous stirring.

The addition of citric acid is a crucial step, as it helps in maintaining the optimum pH (3– 3.5) required for pectin gel formation. Without the correct pH, the gel structure may not form properly.

In addition to facilitating gel formation, citric acid enhances the flavor profile by imparting a mild sour taste that balances the sweetness of stevia. It also contributes to preservation by creating an acidic environment unfavorable for microbial growth.

- Dissolve citric acid in a small quantity of water.

Add it slowly to the mixture to maintain required pH for gel formation

Step5: Addition of Preservative

Sodium benzoate is added as a preservative to extend the shelf life of the jelly.The required quantity is carefully measured and added to the mixture.

The preservative must be mixed thoroughly to ensure uniform distribution throughout the formulation. This prevents

localized microbial growth and ensures product safety. Sodium benzoate is particularly effective in acidic conditions, which makes it suitable for jelly formulations. Its addition helps in preventing spoilage caused by bacteria, yeast, and molds.

- Add sodium benzoate in required quantity.
- Mix thoroughly to ensure uniform distribution.

Step6: Addition of Flavor and Color

At this stage, suitable flavoring agents such as strawberry or orange flavor are added to enhance the taste and aroma of the jelly.

Food-grade color is also added to improve the visual appeal of the product. Both flavor and color are added in controlled quantities and mixed thoroughly to ensure uniformity. This step is important for consumer acceptability, as appearance and taste are key factors influencing product preference. Proper blending ensures that the jelly has a consistent flavor and attractive appearance throughout.

- Add suitable flavor(strawberry/orange) and food-grade color.
- Stir well to obtain uniform appearance and taste.

Step7: Incorporation of Aloe Vera Extract

Aloe Vera extract is added to the formulation to enhance its functional and therapeutic value. The extract is carefully measured and incorporated into the mixture with continuous stirring. This step ensures that the bioactive compounds present in aloe vera are evenly distributed throughout the jelly. Aloe vera contributes additional health benefits, such as antidiabetic and antioxidant properties. Care must be taken to avoid excessive heating after adding aloe vera, as high temperatures may degrade its active components.

Add aloe vera extract to enhance therapeutic value.

- Mix properly to ensure uniform distribution.

Step8: Heating and Concentration

The entire mixture is then subjected to controlled

heating with continuous stirring. This step helps in achieving the desired consistency and concentration of the jelly.

Heating promotes evaporation of excess water and enhances interaction between pectin, acid, and other components, leading to gel formation. Continuous stirring is necessary to prevent burning and ensure uniform heating.

It is important to avoid overheating, as excessive heat can lead to degradation of ingredients such as stevia and aloe vera extract, as well as negatively affect the texture of the jelly.

- Heat the mixture with continuous stirring until desired consistency is achieved.
- Avoid overheating to prevent degradation of ingredients.

Step9: Molding and Cooling

Once the desired consistency is achieved, the hot jelly solution is carefully poured into pre- cleaned and dry molds. The pouring process should be done carefully to avoid air bubble formation. The filled molds are then allowed to cool at room temperature. During cooling, the gel structure begins to form as the temperature decreases.

Proper handling during this stage is important to ensure smooth surface formation and uniform shape of the jelly.

- Pour the hot jelly solution into molds.
- Allow it to cool at room temperature.
-

Step10: Setting of Jelly

After pouring, the molds are kept undisturbed for a sufficient period to allow complete gel formation. Disturbance during this stage may disrupt the gel network and affect the final texture.

The setting process may take several hours depending on environmental conditions. Once fully set, the jelly is carefully removed from the molds. A properly set jelly should exhibit firmness, elasticity, and clarity, indicating successful formulation.

- Keep them old sun disturbed for proper gel formation.
- After complete setting, remove the jelly from molds.

Step11: Packaging and Storage

The prepared jelly is transferred into clean, dry, and airtight containers to prevent contamination and moisture loss. Proper packaging is essential to maintain product quality and extend shelf life.

The packaged jelly is stored in a cool and dry place, away from direct sunlight and excessive heat.

Controlled storage conditions help preserve the texture, flavor, and stability of the product. Proper labeling and handling further ensure safety and usability during storage and distribution.

- Store the prepared jelly in airtight containers.
- Keep in a cool and dry place for stability.

The experimental procedure for the preparation of sugar-free edible jelly involves a series of carefully controlled steps, each contributing to the quality and stability of the final product. From pectin hydration to gel setting, every stage requires precision and proper handling.

The use of natural ingredients such as stevia and aloe vera, combined with functional additives like pectin and glycerin, results in a low-calorie, diabetic-friendly, and functional food product. The method ensures that the jelly achieves desirable texture, taste, and therapeutic value, making it suitable for modern health-conscious consumers

VII. EVALUATION TESTS

The formulated sugar-free edible jelly was subjected to various evaluation tests to determine its physicochemical properties, organoleptic characteristics, and stability. The tests were carried out as follows: [17,18]

1. Appearance

The prepared jelly was visually inspected under normal lighting conditions for clarity, transparency, and overall physical appearance.

- Observation Criteria:Presence of air bubbles, uniformity, and consistency
- Result:The formulation showed a clear, glossy, and uniform semi-solid appearance without any visible air bubbles or particulate matter.
- Inference: Indicates proper formulation and homogeneity. [19]

2. Color

The color of the jelly was evaluated by visual observation.

- Observation Criteria: Uniformity and attractiveness

• Result: The jelly exhibited a uniform and appealing color without any uneven distribution.
• Inference: Confirms proper mixing of coloring agents. [19,20]

3. Odor
Odor was assessed by gently smelling the prepared jelly.
• Observation Criteria: Presence of pleasant or undesirable smell
• Result: The jelly had a pleasant fruity odor with no signs of rancidity or unpleasant smell.
• Inference: Indicates good stability and acceptability.[21]

4. Taste
Taste was evaluated using sensory analysis by a small group of volunteers.
• Observation Criteria: Sweetness, after taste, and overall acceptability
• Result: The jelly exhibited a pleasant sweet taste due to stevia, with no noticeable bitter after taste.
• Inference: Suitable for patient compliance. [22]

5. Texture
Texture was examined manually by touch and feel.
• Observation Criteria: Smoothness, softness, and presence of grittiness
• Result: The jelly was smooth, soft, and free from grittiness.
• Inference: Indicates proper gel formation and uniform distribution of ingredients. [22,23]

6. PH Determination
The pH of the formulation was determined using a calibrated digital pH meter.
• Procedure: A small quantity of jelly was dispersed in distilled water and measured.
• Result: The pH was found to be in the range of 3.2–3.5.
• Inference: Suitable acidic environment for pectin gel formation and microbial stability. [23,24]

7. Spreadability
Spreadability was evaluated to determine the ease of application and consistency.
• Method: A small quantity of jelly was placed between two glass slides and a known weight was applied. The spread diameter was measured.
• Result: The jelly exhibited good spreadability.
• Inference: Indicates optimal consistency and ease of use. [23,24]

8. Gel Strength
Gel strength was determined by applying slight pressure manually on the jelly.
• Observation Criteria: Firmness and elasticity
• Result: The jelly showed adequate firmness and elasticity.
• Inference: Confirms proper pectin network formation. [24]

9. Stability Study
The formulation was subjected to stability studies at room temperature
• Parameters Observed: Color, odor, texture, and consistency
• Duration:15days
• Result: No significant changes were observed during the study period.
• Inference: Indicates good stability and shelf life. [23,24,25]

10. Microbial Limit Test
The formulation was evaluated for microbial contamination.
• Observation Criteria:Presence or absence of microbial growth
• Result: No microbial growth was observed.
• Inference: Confirms effectiveness of preservative (sodium benzoate) and safety of the formulation. [24,25]

VIII. RESULT AND DISCUSSION

The present study was carried out to formulate and evaluate a sugar-free edible jelly suitable for diabetic patients using pectin, stevia, and other excipients. The prepared formulations (F1,F2,and F3) were evaluated for various physicochemical and organoleptic parameters. [22,23,24]

1. Appearance and Organoleptic Properties
All formulations were found to be clear, glossy, and uniform in appearance, with no visible air bubbles or particulate matter. Among the batches, formulation F2 showed the most desirable appearance and

consistency.

The color was uniformly distributed, and the odor was pleasant due to the addition of flavoring agents. Taste evaluation indicated that the jelly possessed a pleasant sweetness provided by stevia without any significant bitter after taste, which is commonly associated with artificial sweeteners. The average taste rating was found to be 4.4 out of 5, indicating good patient acceptability. [23,24,25]

Table1: Organoleptic Evaluation

Parameter	Observation
Color	Light orange/pink
Appearance	Clear and glossy
Odor	Pleasant fruity odor
Taste	Sweet and acceptable
Texture	Smooth and soft

1. PH Determination

The pH of all formulations was found to be within the range of 3.2–3.4, which is ideal for pectin gel formation. This acidic pH also helps in maintaining microbial stability and enhances the shelf life of the formulation. Among all batches, F2 (pH 3.3) was found to be optimal. [24,25]

Table2:pH Determination

Sample code	PH value
F1	3.2
F2	3.3
F3	3.4
Average	3.3

2. Spreadability

Spreadability results showed that formulation F2 exhibited the highest spread diameter (5.5cm)
Compared to F1and F3.

This indicates that F2 had better consistency and could be easily applied or consumed. Proper spreadability is essential for improving patient convenience and product usability. [24,25,26]

Table3: Spreadability Test

Sample	Weight Applied(g)	Diameter Spread (cm)	Spreadability (cm)
F1	500	5.2	Good
F2	500	5.5	Very good
F3	500	5.3	Good

3. Texture and Gel Strength

Texture analysis revealed that all formulations were smooth and soft, but F2 showed superior elasticity and firmness, indicating effective pectin gel network formation. The absence of stickiness and grittiness further confirms the uniform dispersion of ingredients.

Gel strength evaluation also supported that F2 had the most stable and well-formed gel structure compared to other batches[25,26].

Table 4:Texture Evaluation

Sample	Firmness	Smoothness	Stickiness
F1	Moderate	Smooth	Non-sticky
F2	Soft	Very Smooth	Non-sticky
F3	Moderate	Smooth	Slight

4. Stability Studies

Stability studies conducted over a period of 15 days at room temperature showed no significant changes in color, odor, texture, or consistency for any formulation.

This indicates that the jelly remained stable during storage. The presence of sodium benzoate effectively prevented microbial growth, ensuring the safety and shelf life of the formulation.

Table5: Stability Study(15Days)

Day	Color	Odor	Texture	Stability
0	Normal	Pleasant	Soft	Stable
5	No change	Pleasant	Soft	Stable
10	No change	Pleasant	Slightly firm	Stable
15	No change	Pleasant	Slightly firm	Stable

5. Overall Comparison of Formulations

Based on all evaluation parameters, formulation F2 was selected as the optimized formulation
Due to its: [26]

- Optimal pH
- Best spreadability
- Superior texture
- High taste acceptability
- Good stability

IX. DISCUSSION

The successful formulation of sugar-free jelly demonstrates that natural sweeteners like stevia can effectively replace sugar without compromising taste and acceptability. Pectin played a crucial role in forming a stable gel network under acidic conditions. The addition of glycerine improved the texture and prevented drying, while sodium benzoate ensured microbial stability. Aloe vera extract contributed additional functional benefits, enhancing the formulation's potential as a nutraceutical product. The results obtained agree with previous studies that support the use of pectin and natural sweeteners in low-calorie and diabetic-friendly food formulations. [25,26]

X. CONCLUSION

The present study successfully achieved the formulation and evaluation of a sugar-free edible jelly using safe, natural, and cost-effective ingredients. The use of stevia as a natural sweetener provided the desired sweetness without increasing blood glucose levels, making the formulation suitable for diabetic patients. Pectin proved to be an effective gelling agent, producing a jelly with desirable texture, consistency, and stability. The incorporation of glycerin improved the moisture content and prevented drying, while sodium benzoate ensured microbial stability.

All evaluation parameters, including appearance, pH, spreadability, texture, taste, and stability, were found to be within acceptable limits. The formulation showed good patient acceptability and stability during storage. Thus, the developed sugar-free edible jelly can be considered a promising alternative to conventional jelly products and has potential applications in the development of nutraceutical and functional food products for diabetic patients.

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