

Development of a Millet-Based Low-Glycemic Gulab Jamun Infused with Rose-Hibiscus Reduction: A Fusion of Tradition and Wellness

Sonia Devi, Sachin Pathania, Abhishek Kumar

Assistant Professor Department of Hotel Management, Sri Sai Group Of Institutes, Badhani, Pathankot, Punjab, India.

Abstract

The modern era has witnessed a shift in dietary preferences toward health-conscious, functional, and low-glycemic food choices. Traditional Indian sweets like Gulab Jamun, although widely loved, are calorie-dense, high in refined sugars, and contribute to rising lifestyle disorders. This research explores the formulation and development of a novel, millet-based Gulab Jamun using pearl millet flour, almond meal, natural jaggery syrup, and a floral, antioxidant-rich rose-hibiscus infusion. The study aimed to balance taste, texture, and nutrition by replacing conventional ingredients with functional alternatives while preserving the sensory appeal. The resulting dessert offers an innovative solution for health-conscious consumers seeking traditional flavours with improved nutrition. The recipe was tested for consistency, flavour profile, visual appeal, and texture. This work proposes a new direction for culturally rooted food innovations with wellness-driven formulations. This research demonstrates that by integrating functional ingredients such as pearl millet, almond flour, and natural sweeteners, along with baking techniques and herbal infusions, it is possible to retain the essence of a culturally beloved dessert while significantly improving its health profile. The proposed formulation achieved a favourable balance between texture, flavour, and visual appeal, while addressing key concerns associated with sugar content, fat intake, and glycemic load.

Keywords: Gulab Jamun, Recipe Innovation, Indian Desserts

1. Introduction

Indian cuisine has long held a revered place for its vibrant, flavourful, and diverse dessert culture. Among these, Gulab Jamun remains one of the most iconic sweets. Traditionally made using khoya (milk solids) or all-purpose flour (maida) deep-fried and soaked in sugar syrup, this dessert, though delicious, is laden with sugar and fat. Amid rising concerns about obesity, diabetes, and lifestyle disorders, reimagining such traditional dishes is both a culinary and health imperative. Indian sweets, often rich in culture, tradition, and emotional value, hold a prominent place in celebratory meals and festive rituals. Among these, Gulab Jamun stands as a quintessential dessert, celebrated for its soft texture, rich taste, and aromatic syrup. Traditionally crafted from khoya or refined flour, deep-fried in clarified butter, and soaked in a sugary rose-flavoured syrup, it epitomizes indulgence. However, its high content of refined carbohydrates, saturated fats, and processed sugar renders it less compatible with modern-day nutritional goals. With the rising incidence of lifestyle diseases such as diabetes, obesity, and hypertension, there has been a paradigm shift in food preferences toward functional and health-supportive foods. Consumers are increasingly demanding innovations that align with wellness, yet do not compromise on cultural familiarity and sensory satisfaction. The integration of ancient grains like millets—especially pearl millet (bajra) into mainstream cuisine is gaining momentum due to their high fibre content, low glycemic index, and rich mineral profile. Concurrently, the use of natural sweeteners like jaggery and stevia is being favoured over processed sugar. Complementing these nutritional strategies is the incorporation of herbal and floral infusions, such as rose petals and hibiscus flowers, which not only enhance flavour and colour but also contribute to antioxidant activity and digestive wellness.

This research introduces a fusion-style Gulab Jamun that seeks to redefine the traditional recipe by:

- Replacing Maida with pearl millet and almond flour,
- Substituting refined sugar syrup with a rose-hibiscus herbal reduction sweetened with jaggery and stevia,
- Replacing deep-frying with baking, to reduce fat intake.

Such an approach blends culinary heritage with nutritional innovation, creating a dessert that honours tradition while catering to the evolving dietary needs of a health-conscious population. The study involves the formulation, development, and qualitative evaluation of this novel product, with the aim of setting a precedent in functional dessert innovation. This paper aims to develop a new-age Gulab Jamun using nutritionally dense ingredients such as pearl millet (bajra), almond flour, and stevia-jaggery syrup, paired with a novel syrup made from rose and hibiscus flowers. This not only reduces the glycemic load but introduces natural antioxidants and fibre. The study aims to formulate, test, and optimize this fusion dessert suitable for both festive indulgence and regular consumption.

2. Literature Review

Ahiduzzaman, M., Islam, M. N., Jannati, S. F. T., Ali, M. A., & Hossain, M. M. (2024)¹. Preserving jackfruit: unlocking year-round availability as industrial ingredient for value-added food products. In order to address the seasonal availability of jackfruit, which frequently leads to large waste, the research sought to preserve jackfruit and create value-added food products. Jackfruit must be preserved in order to increase its availability all year round because of its short shelf life and the possibility of waste during times of plenty.

Hosaagrahara Ramakrishna, S., Shah, N., Acharyya, B. C., Durairaj, E., Verma, L., Sankaranarayanan, S., ... & Venter, C. (2023). The need for culturally appropriate food allergy management strategies: the Indian Milk ladder. This is the first time a milk ladder has been designed with cultural dietary preferences—such as those of people in India and other countries—in mind. We have created a milk ladder with detailed instructions for use with kids who have a cow's milk allergy. Additionally, this is the first ladder to offer verified milk protein content together with information on cooking temperature and duration. For paediatricians who treat children with CMA as well as for parents of these children around the world, we hope that "The Indian Milk Ladder" will be a very useful resource and practical tool. This is especially true for clinicians who are not well-versed in Indian cuisine.

Sarkar, T., Salauddin, M., Paul, A., & Chakraborty, R. Bengal's Ethnic Sweetmeats—An Unconventional Food: History, Tradition, Culture. *Tradition, Culture* The captivating sweet flavour that captivates eastern India—more especially, the undivided Bengal region, which includes West Bengal and Bangladesh—is revealed. Due to differences in the geographical, cultural, and religious contexts, the ethnic sweetmeats that emerged in Bengal differed in terms of their main components, size, shape, and production method. The total number of sweet goods that originated in Bengal is thirty-eight.

Pai Kotabagilu, N., Umralkar, S., Shivanna, L. M., Dasappa, I., & Urooj, A. (2022). Impact of Stevia rebaudiana substitution on physico-chemical characteristics, sensory profile and microstructure in selected Indian desserts. Because stevia extract has no calories and no sugar, it has been shown to be advantageous to people when used to make stevia-based goods. People with diabetes can enjoy desserts that contain stevia because it lowers the product's sugar content. The texture, colour, and storage research outcomes of the stevia-based goods in our investigation were similar to those of the control. According to sensory analysis, using stevia in place of all the sugar in carrot halwa and a combination of sugar and stevia in kesar peda was superior. For this reason, adding stevia to desserts can be beneficial for people who enjoy sweets but are also health-conscious.

Valecha, D. (2021). *Go-To-Market Strategy for Amul Mithai Range and Business Development* Amul is a fast-moving consumer goods company that manufactures and distributes a range of dairy products nationwide. The company's USP is the quality and cost of its products. I worked on developing a go-to-market strategy for Amul's Mithai line throughout my internship. My research into the markets where Amul has already introduced its Mithai line during the project gave me the basis for developing a GTM strategy for a new market. From creating the Amul Mithai range's marketing plan to offering appropriate project implementation ideas,

Sreeraj, J., Madhavankutty, K. G., & Anoop, M. (2020). Physicochemical and microbiological examination of food preservation strategies of Indian dishes Kalan and Gulab Jamun. After the anticipated expiration term, the product's flavour and taste were confirmed to be unaltered. The majority of the pollutants are removed throughout the gula

jamun production process by using drying and frying techniques, which results in a sterile final product. Additional preservation is provided by the sugar syrup. Thus, this preservation method can be successful. The paper demonstrated an effort to investigate the impact of preservation and processing methods.

Sharanabasava, Ravindra, M. R., Praveen Kumar, Y. S., Manjunatha, M., Mahesh Kumar, G., & Nath, B. S. (2019). Evaluation of vacuum impregnation as a novel approach for soaking of fried Gulabjamun balls. In order to produce a product of the highest acceptable quality, vacuum impregnation of sugar syrup into sub-baric fried gulabjamun was assessed as a technological approach. The impact of different sugar syrup concentrations (40, 50, and 60 °Brix) and processing times (2, 4, and 6 minutes) on the final product's acceptability, expansion ratio, hardness, juiciness, and sugar content was examined. Using response surface methods and a second order polynomial equation, the impact of the process conditions on the five mentioned responses during the vacuum impregnation process was assessed.

Using commonly consumed ingredients such as joha rice (*Oryza sativa* L.), lentil (*Lens culinaris*), green gramme dhal (*Vigna radiata*), sweet corn (*Zea mays*), carrot (*Daucus carota* L.), french beans (*Phaseolus vulgaris*), tomato, and green gramme dhal (*Vigna radiata*), the current study aims to create a ready-to-eat instant rice-based meal. (*Solanum lycopersicum*), rice bran oil, green peas (*Pisum sativum*), broccoli (*Brassica oleracea* var. *italica*), cabbage (*Brassica oleracea* var. *capitata*), spices, and condiments. To create one base meal and the other three formulations, the components were prepared and combined in different ratios. For the foundation meal and each of three distinct formulations, 35g of Joha rice and 5ml of rice bran oil were used, respectively; however, the other ingredients were blended and proportioned differently.

Agrawal, A. K., Sandey, K. K., & Dewangan, K. (2017). Introspection on Mechanization of Traditional Indian Dairy Products. Chatterjee, L., Bhattacharyya, R., Das, P., & Das, M. (2020). Process standardization of instant rice based meal. Though on a small scale, the organised sector has begun producing peda, paneer, mishit doi, gulabjamun, shrikhand, lassi, and other items. Adopting technology for more or less comparable western products would be a practical and cost-effective choice for TIDP manufacturing. Since now is the best moment to mechanise, Indian citizens and migrants of Indian descent worldwide may have access to TIDPs of consistent quality, balanced nutrition in hygienic packaging.

Vasava, N. M., Pinto, S., Paul, P., & Gokhale, A. (2018). Development of gluten-free Faraali gulabjamun. The current study was designed and carried out to create a method for producing Faraali gulabjamun that is gluten-free. It was discovered that sago and potato starch could be used together to make Faraali gulabjamun. When guar gum and xanthan gum were added at a ratio of 0.05 to 0.15 percent (w/w of khoa), the most coveted sensory qualities across all hydrocolloid levels examined. Khoa, which is made from 4.5% fat, was used to make Faraali gulabjamun due to its excellent flavor, body, and acceptance ratings.

3. Objectives of the Study

- To develop a novel Gulab Jamun using pearl millet and almond flour
- To substitute refined sugar with jaggery and stevia
- To create a naturally flavoured and coloured syrup using rose and hibiscus infusion
- To evaluate texture, visual appeal, aroma, and overall acceptability

4. Materials and Methods

4.1 Ingredients Used

Ingredient	Quantity	Function
Pearl Millet Flour	100g	Base
Almond Flour	30g	Texture enhancer
Paneer (Low-Fat)	50g	Softness, fat content

Ingredient	Quantity	Function
Baking Soda	1/4 tsp	Leavening agent
Ghee	2 tsp	Moisture, flavour
Stevia + Jaggery Syrup	3 tbsp	Sweetness
Cardamom Powder	1/2 tsp	Aroma

4.2 For Syrup (Rose-Hibiscus Reduction)

- Rose Petals (dry): 2 tbsp
- Hibiscus (dry): 1 tbsp
- Stevia Powder: 2 tbsp
- Water: 1.5 cups
- Lemon Juice: Few drops (for balancing pH and flavour)
- Boil for 10 minutes and filter.

5. Recipe Development Process

Step 1: Dough Preparation

Mix dry ingredients. Add crumbled paneer and ghee. Add jaggery syrup slowly to bind the dough. Let it rest for 15 mins. And check the dough the softness is very important and dough colour is light brown. Then finally dough is ready.

Step 2: Shaping

Shape small round balls of uniform size. And the all balls shape sem. Finally balls are ready for baking

Step 3: Baking

Bake at 180°C for 20 minutes till golden brown. This replaces deep-frying and reduces oil absorption.

Step 4: Infusion

Warm the rose-hibiscus syrup. Soak baked balls in it for at least 60 minutes. Finally your gulab jamun is ready for taste.

6. Results and Product Characteristics

Parameter	Result
Texture	Soft inside, firm outside
Colour	Reddish-brown (natural)
Flavour	Floral, cardamom-forward
Sweetness	Mild to Medium
Oil Content	Reduced (as compared to fried)

Visual Observation: The Gulab Jamuns showed a rich reddish tinge from the hibiscus, making them visually appealing and distinct from the traditional golden-brown appearance.

7. Nutritional Comparison (Estimated)

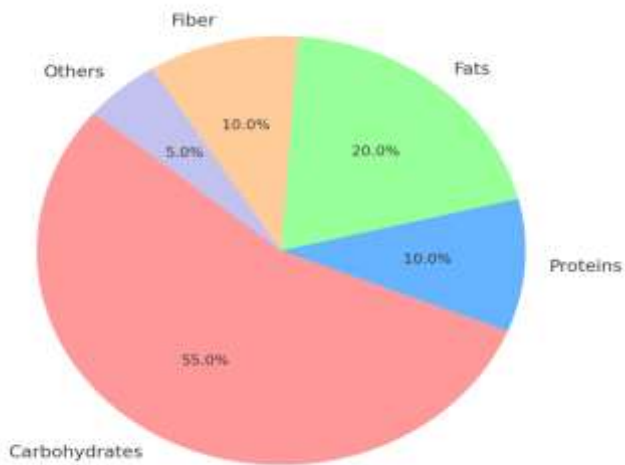
Nutritional Element	Traditional (per piece)	Modified (per piece)
Calories	~180 kcal	~110 kcal
Fat	9g	4g
Sugar	22g	5g
Fiber	0.3g	2.1g
Glycemic Index	High (~80)	Low (~45)

7.1 Nutritional Distribution per Piece (Modified Recipe)

Title: Nutrient Composition of Millet-Based Gulab Jamun

Nutrient	% Contribution (Approx)
Carbohydrates	55%
Proteins	10%
Fats	20%
Fiber	10%
Others	5%

Nutrient Composition of Millet-Based Gulab Jamun

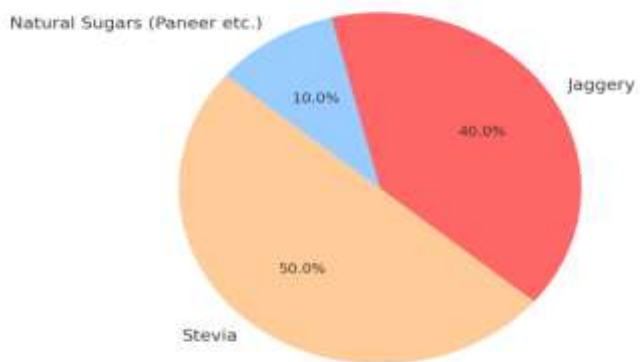


7.2 Sweetener Source Distribution

Title: Sweetener Contribution in Final Product

Sweetener Source	Percentage
Stevia	50%
Jaggery	40%
Natural Sugars (Paneer etc.)	10%

Sweetener Contribution in Final Product

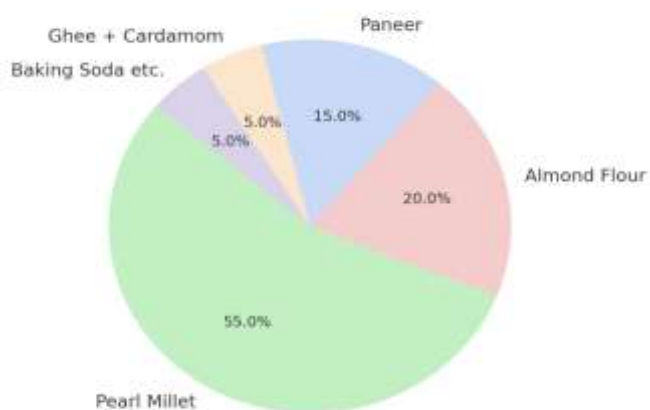


7.3 Ingredient Base Distribution (by weight)

Title: Ingredient Composition (Base Dough)

Ingredient	Percentage
Pearl Millet	55%
Almond Flour	20%
Paneer	15%
Ghee + Cardamom	5%
Baking Soda etc.	5%

Ingredient Composition (Base Dough)



7.4 Consumer Preference (testing)

(10 Tasters) Mother, Father, Sister, and my Seven Friends inviting from my side

The Main motive of this practical is my mother because my mother don't like refined sugar so 1st consumer was my mother and she was like this recepie, including my father ,sister and my 7 friends like this recipe

This is Final observation and reviews:

Parameter	Liked by %
Aroma	90%
Texture	80%
Sweetness	70%
Appearance	85%

8. Discussion

This study demonstrated that traditional Indian desserts like Gulab Jamun can be reimaged using functional ingredients without compromising taste. The use of pearl millet adds fiber and reduces glycemic load. Rose and hibiscus infusion add aesthetic and nutritional value. The baking method cuts down fat significantly. The formulation caters to modern demands for healthier sweets and addresses a niche in the market.

10. Conclusion

A healthier version of Gulab Jamun was successfully developed using millet flour, natural sweeteners, and herbal infusions. This dessert holds potential in the wellness food and festive functional food market, promoting both tradition and health. It meets the growing demands for low-sugar, nutrient-dense sweets among diabetic and fitness-conscious consumers. The development of a millet-based, low-glycemic Gulab Jamun infused with rose-hibiscus reduction offers a promising blueprint for reimagining traditional Indian desserts through the lens of nutritional innovation. This research demonstrates that by integrating functional ingredients such as pearl millet, almond flour, and natural sweeteners, along with baking techniques and herbal infusions, it is possible to retain the essence of a culturally beloved dessert while significantly improving its health profile. The proposed formulation achieved a favourable balance between texture, flavour, and visual appeal, while addressing key concerns associated with sugar content, fat intake, and glycemic load. The rose-hibiscus syrup not only elevated the flavour profile but also introduced antioxidant benefits, adding therapeutic potential to the dessert. This fusion-style innovation opens new avenues for culinary researchers, food technologists, and health-oriented chefs to re-engineer Indian sweets that cater to diabetics, fitness enthusiasts, and wellness-conscious consumers. Furthermore, the study showcases how traditional dishes can evolve with changing nutritional demands without compromising on sensorial satisfaction or cultural value. In an era where functional foods are gaining traction across global markets, this research sets the stage for the next generation of Indian desserts — where heritage meets health. Future applications of this work include industrial-scale production, commercialization, and the development of ready-to-mix or frozen variants for convenience consumption.

11. Future Scope

- Industrial-scale production
- Shelf-life and microbial studies
- Expansion to other flower infusions: lavender, jasmine, blue pea
- Ready-to-cook mix development

12. Acknowledgement:

I would like to express my heartfelt gratitude and appreciation to my Mother his valuable guidance and support throughout my research work. His in-depth knowledge in the Cooking Also, I would like to thank to my Father and Sister for their assistance and support. I am truly thankful to all those who have helped me in completing my research work.

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