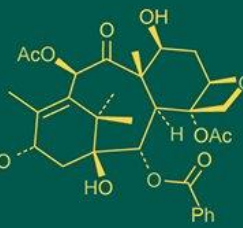
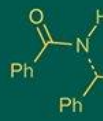


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Nutritional profile of jamun (*Syzygium cumini* L.) Seed powder-based value-added laddu

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Abstract

Jamun (*Syzygium cumini* L. Skeels) seeds are a rich source of dietary fibre, minerals, and bioactive compounds with recognized antioxidant and antidiabetic properties; however, their utilization in traditional value-added food products remains limited. The present study aimed to develop a functional Jamun Seed Powder Laddu and evaluate its nutritional composition, anti-nutrient content, sensory acceptability, and shelf-life stability. Jamun seeds were processed into powder and incorporated into a standardized laddu formulation. Proximate composition was determined using standard AOAC (1990, 2000, 2016) [2, 3, 4] methods, calcium and iron were estimated by Atomic Absorption Spectrophotometry, and phytic acid was determined by the method of Jain and Mogra (2006) [12]. Shelf-life was evaluated under ambient storage conditions for 30 days through sensory evaluation using a 9-point hedonic scale and oxidative stability by peroxide value. Statistical analysis was performed using descriptive statistics and one-way analysis of variance (ANOVA) at $p < 0.05$. The standardized Jamun Seed Powder Laddu contained 12.81 per cent moisture, 24.58 g crude fat, 6.53 g crude fibre, 9.71 g crude protein, 2.28 g ash, 44.09 g carbohydrate, and 436.42 kcal energy per 100 g, along with 182.0 mg calcium, 3.54 mg iron, and 0.87 per cent phytic acid. The product maintained good sensory acceptability for up to 25 days under ambient storage, while significant declines in appearance, flavour, colour, taste, and overall acceptability were observed on the 30th day ($p < 0.05$). The peroxide value increased gradually from 0.00 to 4.50 meq/kg during storage but remained within the acceptable limit for edible fats, indicating satisfactory oxidative stability. The findings demonstrate that jamun seed powder can be effectively incorporated into a traditional laddu to develop a nutritionally enriched functional food with acceptable sensory quality and storage stability.

Keywords: Jamun seed powder, laddu, nutritional composition, peroxide value, phytic acid, shelf life, *Syzygium cumini*

Introduction

Functional foods have attracted considerable attention due to their potential to improve health and reduce the risk of chronic diseases. Plant-based foods rich in bioactive compounds are increasingly being explored to create value-added products with enhanced nutritional and therapeutic properties. Among these, *Syzygium cumini* (L.) Skeels (Jamun or Indian Blackberry), a member of the Myrtaceae family, is known for its rich nutritional composition and diverse pharmacological properties. Jamun seeds are particularly rich in polyphenols, flavonoids, tannins, anthocyanins, alkaloids, and other phytochemicals that exhibit antioxidant, antidiabetic, anti-inflammatory, antimicrobial, and cardioprotective activities (Singh *et al.*, 2019; Kumar and Singh, 2021; Rizvi *et al.*, 2022; Poonia *et al.*, 2025) [13, 15, 17, 18].

Jamun seeds, which are typically discarded as agro-industrial waste, have significant nutritional and functional potential. They contain appreciable amounts of protein, dietary fibre, minerals and phenolic compounds, as well as bioactive compounds such as ellagic acid, gallic acid, and jambolin, which are associated with improved glucose metabolism and reduced oxidative stress (Sood *et al.*, 2018; Marufa *et al.*, 2019) [19]. Previous studies have shown the potential of jamun seed powder as a functional ingredient in the development of nutritionally enriched foods or functional foods, especially for the dietary management of diabetes mellitus and other metabolic diseases (Ayenampudi *et al.*, 2023; Hemavathi *et al.*, 2024) [6, 11]. However, its use in traditional value-added foods remains limited. The

Development of functional foods requires not only superior nutritional quality but also good sensory properties and storage stability. The incorporation of complementary ingredients such as flaxseed, basil seeds, dates and Fructooligosaccharides (FOS) can further improve the nutritional quality of the product by increasing dietary fibre, essential fatty acids, minerals and prebiotic components while enhancing its sensory acceptability. Dates are a rich source of easily digestible sugars, dietary fibre, vitamins (riboflavin, thiamine, folic acid and ascorbic acid) and essential minerals, including potassium, calcium, magnesium, phosphorus, iron and zinc. They also possess antioxidant properties, making them a valuable functional ingredient for the development of nutrient-rich food products (Wadhawan and Bansal, 2018)^[21].

Therefore, the present study aimed to develop a functional Jamun Seed Powder Laddu and evaluate its proximate composition, mineral content, phytic acid, sensory acceptability and shelf-life stability. The study also assessed the suitability of jamun seed powder as a functional ingredient for the development of a nutritionally enriched traditional food product.

Methodology

The study was conducted using an experimental research design in the laboratories of the Department of Food Science and Nutrition, College of Community and Applied Sciences, and the College of Dairy and Food Technology, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, Rajasthan.

Procurement of raw material

Jamun seeds were procured in a single lot from authorized suppliers and local markets in Udaipur. The remaining ingredients (flax Seeds, dry dates powder, wet dates, gram flour, basil seeds, cardamom powder, stevia, ghee, and fructooligosaccharides) required for laddu preparation were purchased from the local market and stored under hygienic conditions until use.

Processing of selected raw materials (jamun seeds)

Jamun seeds were processed into fine powder prior to product formulation following the unit operations shown in Figure 1.

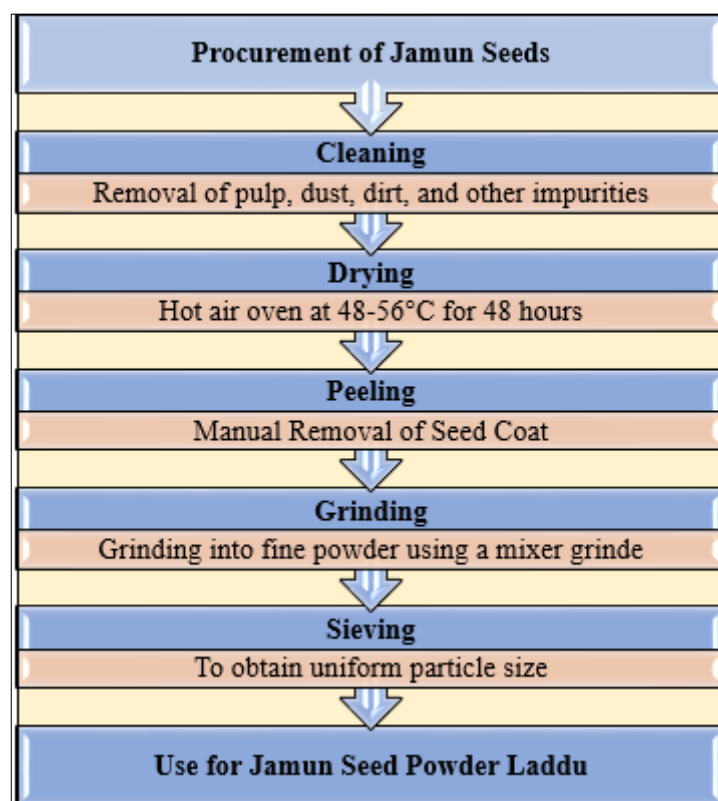


Fig 1: Processing of selected raw materials (jamun seeds) formulation of standardized jamun seed powder laddu

Table 1: Ingredients use for the standardization of jamun seed powder laddu (per 100 g)

Ingredients	Quantity
Jamun Seed Powder	10.00g
Gram flour	31.00g
Dry Dates Powder	17.54g
Stevia	1.00g
Ghee	14.00g
Flax Seeds	4.31g
Cardamom Powder	0.40g
FOS (fructooligosaccharides)	2.11g
Wet Dates	17.54g
Basil Seeds	2.10g

The ingredients listed in Table 1 were weighed according to the standardized formulation. Gram flour was roasted with ghee over low heat, followed by the addition of jamun seed powder. Wet dates, dry date powder, stevia and Fructooligosaccharides (FOS) were incorporated and mixed uniformly. Finally, roasted flax seeds, basil seeds and cardamom powder were added. The mixture was cooled to room temperature and shaped manually into laddus of uniform size before packaging in airtight containers.

Nutritional composition, anti-nutrient analysis and shelf-life evaluation of jamun seed powder laddu

Proximate composition, including moisture, crude protein, crude fat, crude fibre, ash, carbohydrate and energy, was determined using standard AOAC (1990, 2000, 2016) [2, 3, 4] procedures. Mineral estimation for calcium and iron was carried out using Atomic Absorption Spectrophotometry, while phytic acid was estimated by the method of Jain and Mogra (2006) [12]. The shelf-life of the standardized jamun seed powder laddu was evaluated under ambient storage conditions for 30 days. Sensory quality was assessed at 5-day intervals using a nine-point hedonic scale for appearance, colour, flavour, taste, texture and overall acceptability. Oxidative stability was evaluated by determining peroxide value during storage.

Statistical analysis: The experimental data were statistically analyzed using Microsoft Excel. Mean, Standard Deviation (SD) and Standard Error (SE) were calculated. One-way analysis of variance (ANOVA) was performed to determine significant differences among treatment means, and significance was considered at $p < 0.05$.

Results and discussion

Nutritional composition and anti-nutrient analysis of standardized jamun seed powder laddu

Tables 2-4 and Figures 2-3 present the nutritional composition, mineral composition and phytic acid content of the standardized Jamun Seed Powder Laddu. The analysis was carried out in triplicate, and the results are expressed as mean±Standard Deviation (SD) along with the Standard Error (SE). The standardized Jamun Seed Powder Laddu contained 12.81±0.72 per cent moisture, 24.58±0.47 g crude fat, 6.53±0.38 g crude fibre, 9.71±0.45 g crude protein, 2.28±0.07 g ash, 44.09±0.18 g carbohydrate and 436.42±1.42 kcal energy per 100 g, along with 182.0±1.54 mg calcium, 3.54±0.61 mg iron and 0.87±0.14 per cent phytic acid. The proximate composition of the standardized Jamun Seed Powder Laddu was comparable to previous reports on jamun seed-based functional foods. The moisture content agreed with that reported by Marufa *et al.* (2019), while the higher fat and energy contents may be attributed to the incorporation of ghee and flaxseed, similar to the observations of Biswas *et al.* (2023) [7]. The improved protein and dietary fibre contents were also consistent with studies on flaxseed-enriched traditional products (Awasthi *et al.*, 2024) [5]. The calcium and iron contents support the findings of Tak *et al.* (2022) [20] and Sood *et al.* (2018) [19], who reported that jamun seed-based products are good sources of essential minerals. The observed phytic acid content was comparable to that reported for cereal and legume-based products, and thermal processing such as roasting may have reduced phytate levels, thereby improving mineral bioavailability (Reddy *et al.*, 1982; Jain and Mogra, 2006) [12, 16].

Table 2: Proximate composition of standardized jamun seed powder laddu (per 100 g)

S. No.	Nutrient	Mean±SD	SE
1	Moisture (%)	12.81±0.72	0.42
2	Crude Fat (g)	24.58±0.47	0.27
3	Crude Fibre (g)	6.53±0.38	0.22
4	Crude Protein (g)	9.71±0.45	0.26
5	Ash (g)	2.28±0.07	0.04
6	Carbohydrate (g)	44.09±0.18	0.10
7	Energy (Kcal)	436.42±1.42	0.82

All values are (Mean±SD) of three independent observations

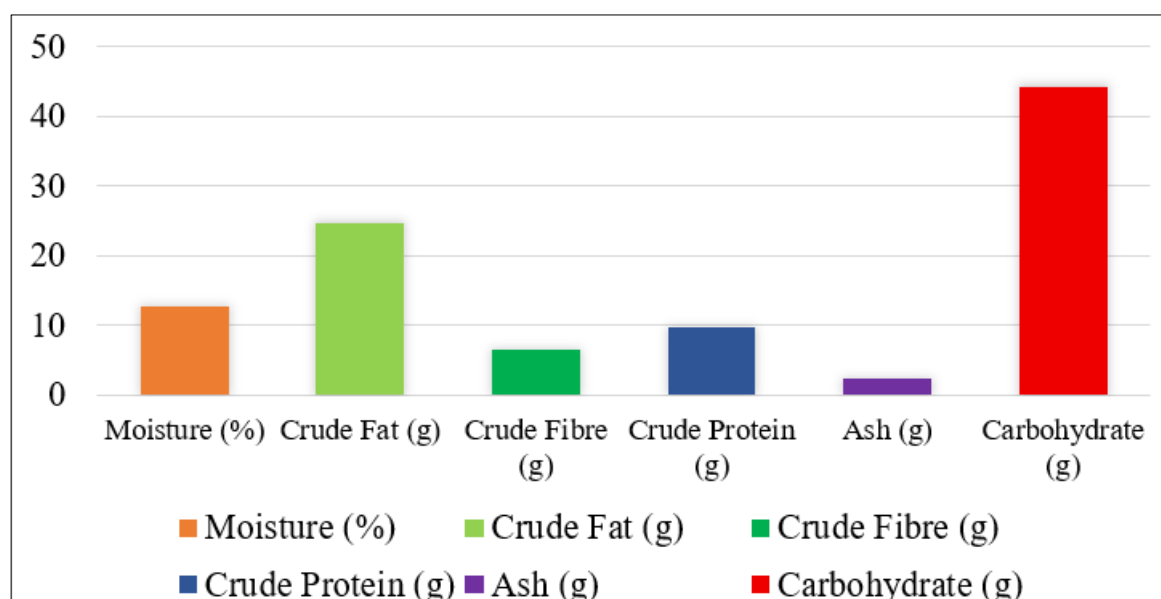
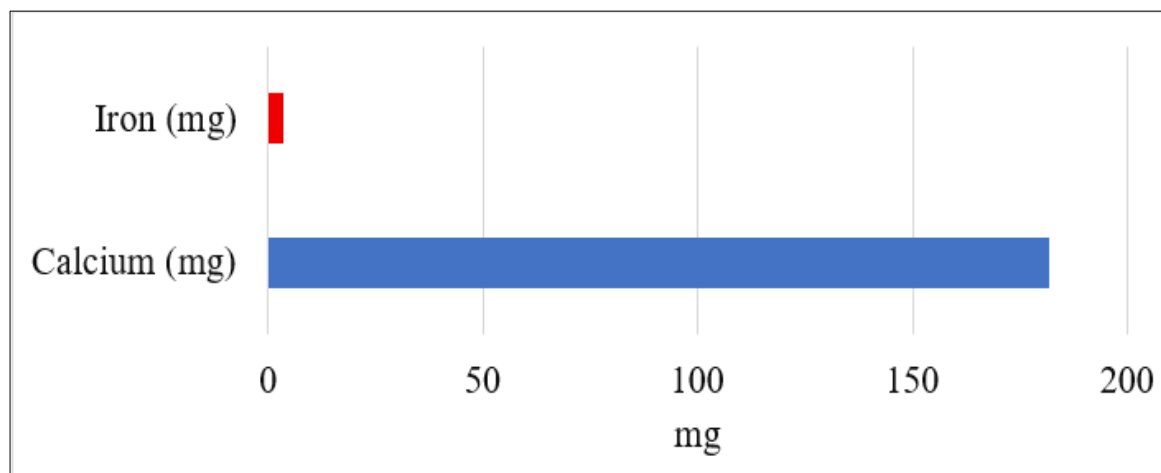


Fig 2: Proximate composition of standardized jamun seed powder laddu (per 100 g)

Table 3: Mineral composition of standardized jamun seed powder laddu (per 100 g)

S. No.	Mineral (per 100 g)	Mean±SD
1	Calcium (mg)	182.0±1.54
2	Iron (mg)	3.54±0.61

All values are (Mean±SD) of three independent observations

**Fig 3:** Mineral composition of standardized jamun seed powder laddu (per 100 g)**Table 4:** Phytic acid content of standardized jamun seed powder laddu (per 100 g)

S. No.	Nutrient	Mean±SD	SE
Jamun Seed Powder Laddu	Phytic acid (%)	0.87±0.14	0.08

All values are (Mean±SD) of three independent observations

Shelf-life assessment of standardized Jamun Seed Powder Laddu

The shelf life of standardized jamun seed powder laddus was evaluated for 30 days under ambient storage conditions. Table 5 and Figure 4 present the changes in sensory attributes of the standardized Jamun Seed Powder Laddu during ambient storage. Sensory evaluation was conducted at 5-day intervals using a 9-point hedonic scale to assess appearance, flavour, colour, taste, texture and overall acceptability. The standardized Jamun Seed Powder Laddu maintained acceptable sensory quality up to the 25th day of storage. However, a significant decline ($p < 0.05$) was observed in appearance, flavour, colour, taste, and overall acceptability on the 30th day, while texture showed no significant change ($p > 0.05$) during storage. Table 6 and Figure 5 present the changes in peroxide value of the standardized Jamun Seed Powder Laddu during ambient storage. Oxidative stability was assessed by determining peroxide value at 5-day intervals. Peroxide values gradually

increased from 0.00 ± 0.00 meq/kg on day 0 to 4.50 ± 0.50 meq/kg on day 30, indicating progressive lipid oxidation during storage. However, peroxide values remained within the acceptable limits for edible fats during storage.

The standardized Jamun Seed Powder Laddu maintained acceptable sensory quality during ambient storage, with a gradual decline in sensory attributes after prolonged storage. Similar reductions in sensory scores during storage have been reported by Godara (2022)^[10] and Ananthanarayan *et al.* (2019)^[1] for traditional value-added products. The progressive increase in peroxide value was consistent with the findings of Cho and Min (2006) and Waraho *et al.* (2011)^[22], who reported gradual lipid oxidation during storage of fat-containing foods. However, the peroxide value remained below the acceptable limit recommended by the Codex Alimentarius Commission (2019)^[9], indicating satisfactory oxidative stability of the developed Jamun Seed Powder Laddu.

Table 5: Changes in sensory attributes of standardized jamun seed powder laddu during ambient storage

Day	Sensory attributes					
	Appearance	Flavour	Colour	Taste	Texture	Overall
0 th	8.03±0.45	8.18±0.50	7.97±0.60	8.53±0.57	7.78±0.65	8.33±0.42
5 th	8.03±0.45	8.18±0.50	7.97±0.60	8.53±0.57	7.78±0.65	8.33±0.42
10 th	8.03±0.42	8.17±0.40	7.97±0.45	8.52±0.53	7.78±0.62	8.32±0.39
15 th	8.02±0.43	8.16±0.29	7.96±0.64	8.52±0.50	7.77±0.61	8.32±0.34
20 th	8.01±0.45	8.15±0.52	7.96±0.30	8.51±0.53	7.77±0.60	8.31±0.41
25 th	8.00±0.38	8.13±0.54	7.95±0.49	8.49±0.50	7.75±0.69	8.29±0.43
30 th	7.80±0.45	7.46±0.50	7.02±0.50	6.53±0.57	7.70±0.65	6.33±0.42
p-value	0.031	<0.001	<0.001	<0.001	0.284	<0.001

Non-significant ($p > 0.05$), Significant at $p < 0.05$ and highly significant at $p < 0.01$

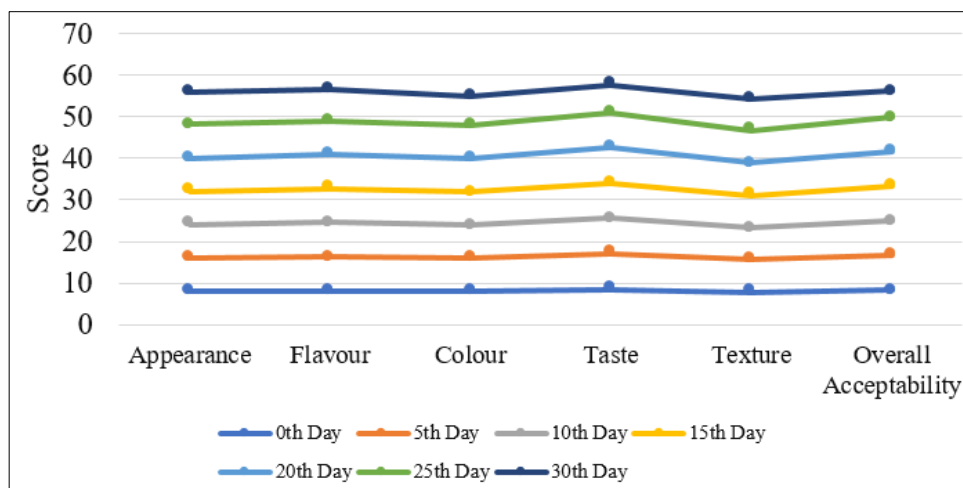


Fig 4: Changes in sensory attributes of standardized jamun seed powder laddu during ambient storage

Table 6: Changes in peroxide value of standardized jamun seed powder laddu during ambient storage

Day	Mean±SD
0 th	0.00±0.00 meq/kg
5 th	0.01±0.01 meq/kg
10 th	0.03±0.01 meq/kg
15 th	1.0±0.02 meq/kg
20 th	1.5±0.02 meq/kg
25 th	2.5±0.03 meq/kg
30 th	4.5±0.5 meq/kg

All values are (Mean±SD) of three independent observations

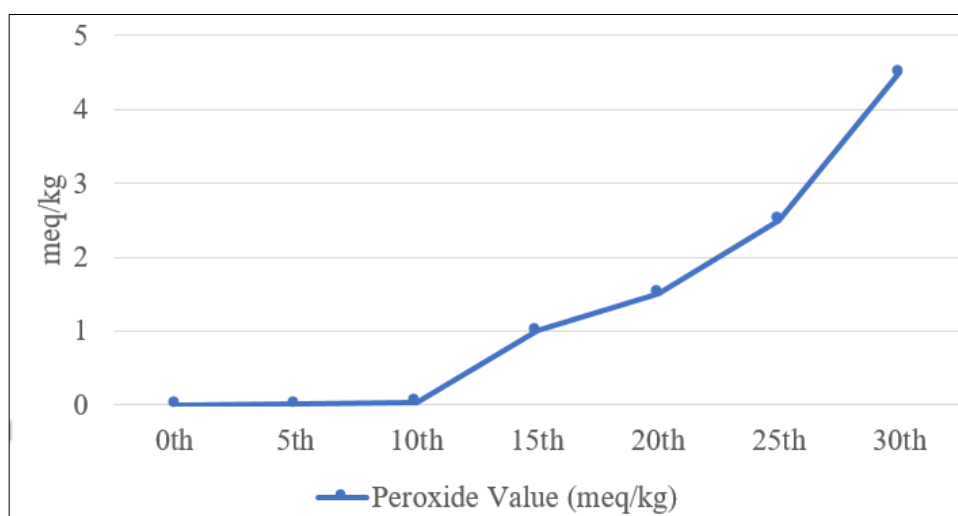


Fig 5: Changes in peroxide value of standardized jamun seed powder laddu during ambient storage

Conclusion

The present study demonstrated the successful development of a standardized Jamun Seed Powder Laddu with satisfactory nutritional composition, sensory acceptability, and storage stability. The developed product was a good source of protein (9.71 g), crude fibre (6.53 g), calcium (182.0 mg), and iron (3.54 mg) per 100 g, while the phytic acid content ($0.87 \pm 0.14\%$) remained within the expected range for cereal- and legume-based food products. During ambient storage, the standardized laddu retained acceptable sensory quality for up to 25 days, and the peroxide value remained within the acceptable limit, indicating satisfactory oxidative stability. These findings indicate that jamun seed powder can be effectively incorporated into traditional food products to enhance their nutritional quality while maintaining acceptable sensory and storage characteristics.

Further research should focus on evaluating the glycaemic response, antioxidant activity, and nutrient bioavailability through *in vivo* or clinical studies, as well as exploring improved packaging and preservation techniques to extend the shelf life of the developed product.

References

- Ananthanarayan L, Dubey KK, Muley AB, Singhal RS. Indian traditional foods: preparation, processing and nutrition. In: Kristbergsson K, Oliveira J, editors. Traditional Foods: History, Preparation, Processing and Safety. Cham: Springer International Publishing; 2019. p. 127-199.
- AOAC International. Official Methods of Analysis. 15th ed. Arlington (VA): Association of Official Analytical Chemists; 1990.

3. AOAC International. Official Methods of Analysis of AOAC International. 17th ed. Gaithersburg (MD): AOAC International; 2000.
4. AOAC International. Official Methods of Analysis of AOAC International. 20th ed. Gaithersburg (MD): AOAC International; 2016.
5. Awasthi P, Singh K, Singh SC. Assessment of functional quality changes in water chestnut enriched flaxseed nutritional laddu during storage. *Bangladesh J Bot.* 2024;53(3):561-566.
6. Ayenampudi SB, Verma R, Adeyeye SAO. The potential health benefits and food applications of jamun (*Syzygium cumini* L.), an indigenous fruit of India. *Nutr Food Sci.* 2023;53(5):793-809.
7. Biswas S, Islam F, Imran A, Zahoor T, Noreen R, Fatima M, et al. Phytochemical profile, nutritional composition, and therapeutic potentials of chia seeds: a concise review. *Cogent Food Agric.* 2023;9(1):2220516.
8. Choe E, Min DB. Mechanisms and factors for edible oil oxidation. *Compr Rev Food Sci Food Saf.* 2006;5(4):169-186.
9. Codex Alimentarius Commission. Standard for Named Vegetable Oils (CXS 210-1999). Rome: Food and Agriculture Organization of the United Nations and World Health Organization; 2019.
10. Godara P. Doctor of Philosophy in Foods and Nutrition [doctoral dissertation]. Hisar: Chaudhary Charan Singh Haryana Agricultural University; 2022.
11. Hemavathi KN, Middha SK, Dwivedi N, Hemalatha P, Nisa A, Kavyashree B, et al. Selected medicinal plants for combating diabetes: a green anti-hyperglycemic approach. In: *Metabolites of Medicinal Plants: Insightful Approaches*. 2024. p. 142-181.
12. Jain S, Mogra R. Analysis of Food Components. Udaipur: College of Home Science, Maharana Pratap University of Agriculture and Technology; 2006. p. 63-103.
13. Kumar S, Singh B. *Syzygium cumini* (Jamun): its medicinal uses. *Int J Pharmacogn.* 2021;8:361-372.
14. Marufa MA, Das PC, Iqbal A. Utilization of jamun seed powder in composite cake formulation. *J Bangladesh Agric Univ.* 2019;17(4):599-605.
15. Poonia MP, Kumar A, Meena KK, Gupta L, Wadhawan N, Mishra S, et al. Recent advances in functional dairy products enriched with herbal extracts: a comprehensive review. *Eur J Nutr Food Saf.* 2025;17(7):242-257.
16. Reddy NR, Sathe SK, Salunkhe DK. Phytates in legumes and cereals. *Adv Food Res.* 1982;28:1-92.
17. Rizvi MK, Rabail R, Munir S, Inam-Ur-Raheem M, Qayyum MMN, Kieliszek M, et al. Astounding health benefits of jamun (*Syzygium cumini*) toward metabolic syndrome. *Molecules.* 2022;27(21):7184.
18. Singh Y, Bhatnagar P, Kumar S. A review on bio-active compounds and medicinal strength of jamun (*Syzygium cumini* Skeels). *Int J Chem Stud.* 2019;7(4):3112-3117.
19. Sood M, Bandral JD, Kaur M. Development and quality evaluation of jamun seed powder supplemented noodles. *J Pharmacogn Phytochem.* 2018;7(3):1411-1416.
20. Tak Y, Kaur M, Jain MC, Samota MK, Meena NK, Kaur G, et al. Jamun seed: a review on bioactive constituents, nutritional value and health benefits. *Pol J Food Nutr Sci.* 2022;72(3):211-228.
21. Wadhawan N, Bansal R. A study on microbial characteristics of food products developed from dates (*Phoenix dactylifera* L.). *Int J Curr Microbiol Appl Sci.* 2018;7(8):441-451.
22. Waraho T, McClements DJ, Decker EA. Mechanisms of lipid oxidation in food dispersions. *Trends Food Sci Technol.* 2011;22(1):3-13.