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BIOCHEMICAL ASSESSMENT OF JAMUN (*Syzygium cumini* L.) SQUASH IN TERMS OF QUALITY PARAMETERS

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ABSTRACT

The present research was conducted during 2025–2026 in the Post-Harvest Laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh. The experiment was laid out in a Completely Randomized Design (CRD) with eight treatments and three replications. Different formulations of Jamun squash were prepared using varying levels of fruit juice (35, 40, 45 and 50%) and Total Soluble Solids (35 and 40 °Brix) and were stored under ambient conditions for 60 days. The objective of the study was to evaluate the effect of different juice and sugar combinations on the biochemical quality attributes of jamun squash during storage. Observations were recorded on Total Soluble Solids (TSS), titratable acidity, ascorbic acid, total sugars, and reducing sugars at regular intervals throughout the storage period. The results revealed that TSS, total sugars, reducing sugars, and titratable acidity increased progressively with advancement of storage, whereas ascorbic acid content decreased in all treatments. Among the treatments, squash prepared with 45% juice and 40 °Brix (T₅) recorded the highest TSS (47.62°Brix), total sugars (46.57%) and reducing sugars (10.75%) after 60 days of storage, while maintaining the lowest titratable acidity (0.65%). The highest ascorbic acid content (17.67 mg/100 g) was retained in treatment T₁ (35% juice + 35 °Brix). The observed changes in biochemical parameters were mainly attributed to hydrolysis of complex carbohydrates into simpler sugars, formation of organic acids during storage, and oxidation of ascorbic acid. The study concluded that jamun squash can be successfully stored for up to 60 days under ambient conditions with acceptable quality. Based on overall biochemical quality and storage stability, treatment T₅ (45% juice + 40°Brix) was found to be the most suitable formulation for the preparation of high-quality jamun squash. The findings highlight the potential of jamun for value addition and development of nutritious fruit-based beverages.

Key words : Squash, *Syzygium cumini*, Total Soluble Solids, Titratable acidity, Ascorbic acid, Reducing sugars, Value addition.

Introduction

Fruit-based beverages are gaining increasing importance owing to their nutritional value, refreshing taste, and health-promoting properties. Among various processed fruit products, squash is a popular non-alcoholic concentrated beverage prepared from fruit juice, sugar, and water. The growing demand for natural and functional foods has encouraged the utilization of underexploited fruits for the development of value-added products with

enhanced nutritional and sensory qualities (Nida-Saleem *et al.*, 2011). Jamun (*Syzygium cumini* L.), belonging to the family Myrtaceae, is an important indigenous fruit crop of India and is widely distributed throughout tropical and subtropical regions of Asia, Africa, and South America. The fruit is highly nutritious and contains appreciable amounts of sugars, vitamin C, minerals, iron, pectin, and phenolic compounds (Singh *et al.*, 1967). Jamun is also rich in anthocyanins, flavonoids, tannins,

and other bioactive constituents that exhibit antioxidant, antimicrobial, anti-inflammatory and antidiabetic properties. Owing to these therapeutic attributes, jamun has been extensively used in Ayurvedic and Unani systems of medicine for the management of diabetes, digestive disorders, and various other ailments (Jadhav *et al.*, 2009). Despite its nutritional and medicinal significance, jamun fruits are highly perishable and available only for a short period during the harvesting season, resulting in considerable post-harvest losses. Processing of jamun into value-added products such as squash offers an effective means of extending shelf life, enhancing utilization, and providing consumers with nutritious beverages throughout the year (Veigas *et al.*, 2007). The quality of jamun squash is largely determined by its biochemical characteristics, including total soluble solids, acidity, sugars, ascorbic acid and anthocyanin content, as well as organoleptic attributes such as colour, flavour, taste, and overall acceptability. Assessment of these biochemical and sensory properties is essential for developing high-quality jamun squash with improved consumer preference and market potential. Therefore, the present investigation was undertaken to assess the biochemical and organoleptic properties of jamun squash in terms of quality and acceptability.

Materials and Methods

The present investigation entitled was conducted during 2025–2026 in the Post-Harvest Laboratory, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India. According to the Department of Land Development and Water Resources, Government of Uttar Pradesh, Prayagraj is located in the Central Plain sub-zone of Agro-climatic Zone V of Uttar Pradesh. In particular, the Naini region is located between latitudes 20°33'40" and 21°50" N and longitudes 73°27'58" and 73°56'36" E. The region has a tropical climate, with hot summers, mildly chilly winters, and a warm, muggy monsoon season. The southwest monsoon, especially in July and August, brings the most precipitation to the area, which receives a lot of it from June to September. The university is conveniently accessible due to its strategic location along the Prayagraj–Rewa National Highway, about 5 kilometres from Prayagraj City. The experiment was laid out in a Completely Randomized Design (CRD) comprising eight treatments with three replications. Fresh, mature and healthy jamun fruits of local varieties were procured from the local market of Prayagraj and used for the preparation of squash. Other materials used during the investigation included sugar, water, citric acid, sodium benzoate,

weighing balance, juicer, knives, pulper, bowls, muslin cloth, glass bottles and a refractometer. Eight treatment combinations were formulated using different levels of fruit juice and total soluble solids (°Brix), namely 35% juice + 35°Brix (T_1), 40% juice + 35°Brix (T_2), 45% juice + 35°Brix (T_3), 50% juice + 35°Brix (T_4), 35% juice + 40°Brix (T_5), 40% juice + 40°Brix (T_6), 45% juice + 40°Brix (T_7) and 50% juice + 40°Brix (T_8). The prepared squash samples were filled in sterilized glass bottles and stored under ambient conditions for a period of 60 days. Observations on biochemical quality parameters were recorded at regular intervals during the storage period. Total Soluble Solids (TSS) were determined using a hand refractometer and expressed in °Brix. Reducing sugar content was estimated by standard chemical methods and expressed as percentage. Total sugar content was determined by calculating the sum of reducing and non-reducing sugars and expressed as percentage. Titratable acidity was measured by titrating the squash sample against standard sodium hydroxide solution using phenolphthalein as an indicator and expressed as percentage of citric acid. Ascorbic acid content was estimated by the dye titration method using 2,6-dichlorophenol indophenol dye and expressed as mg per 100 g of sample. The biochemical properties of the squash were assessed to determine the effect of different juice and TSS combinations on product quality during storage. The data obtained from various observations were subjected to statistical analysis following the procedure of analysis of variance (ANOVA) appropriate for Completely Randomized Design as described by Gomez and Gomez (1984). The significance of treatment effects was tested at the 5 per cent level of probability, and treatment means were compared accordingly.

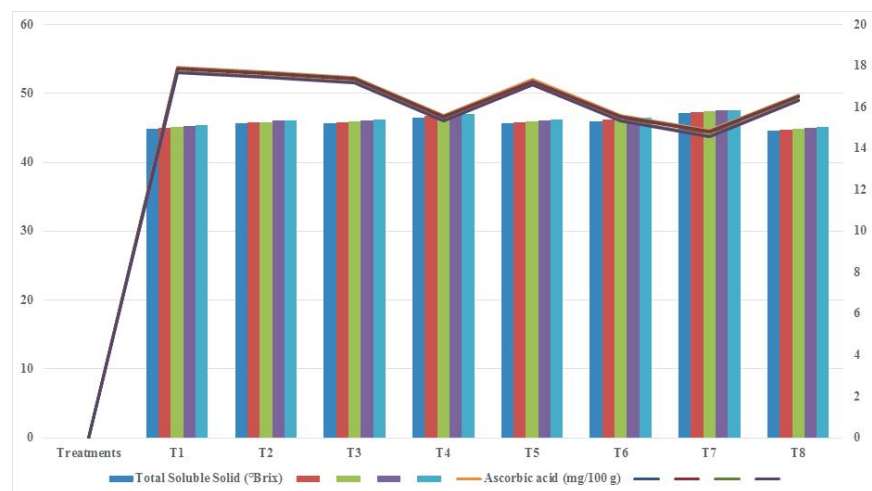
Results and Discussion

Total Soluble Solids (°Brix)

The data pertaining to Total Soluble Solids (TSS) content of jamun squash during storage revealed a gradual increase in all treatment combinations over the storage period of 60 days (Table 1 and Fig. 1). Initially, TSS values ranged from 44.60 to 47.11 °Brix, which increased to 45.12–47.62 °Brix at the end of storage (Table 1). Among the treatments, squash prepared with 45 per cent juice and 40 °Brix (T_7) recorded the highest TSS throughout the storage period, increasing from 47.11 °Brix at preparation to 47.62 °Brix after 60 days of storage. The lowest TSS was observed in treatment T_8 (50% juice + 40 °Brix), where values increased from 44.60 to 45.12 °Brix during the same period. The progressive increase in TSS during storage could be attributed to the hydrolysis

Table 1 : Effect of various treatment combinations on total soluble solids (TSS) of Jamun squash at different days of storage.

		Total Soluble Solid (°Brix)				
Treatments		0 days	15 days	30 days	45 days	60 days
T ₁	35% Juice + 35 °Brix	44.83	45.00	45.10	45.29	45.35
T ₂	40% Juice + 35 °Brix	45.62	45.79	45.88	46.07	46.13
T ₃	45% Juice + 35 °Brix	45.67	45.84	45.93	46.12	46.18
T ₄	50% Juice + 35 °Brix	46.52	46.69	46.78	46.97	47.03
T ₅	35% Juice + 40 °Brix	45.68	45.85	45.95	46.14	46.20
T ₆	40% Juice + 40 °Brix	46.00	46.17	46.27	46.46	46.52
T ₇	45% Juice + 40 °Brix	47.11	47.28	47.37	47.56	47.62
T ₈	50% Juice + 40 °Brix	44.60	44.77	44.87	45.06	45.12
F' test		S	S	S	S	S
CD (5%)		0.37	0.39	0.39	0.52	0.73
SE. m (±)		0.12	0.13	0.13	0.17	0.24
C.V. (%)		0.47	0.48	0.49	1.08	1.01


Fig. 1 : Effect of various treatment combinations on TSS and acidity of Jamun squash at different days of storage.

of complex carbohydrates, pectic substances and polysaccharides into simpler soluble sugars, thereby increasing the concentration of dissolved solids in the squash. Furthermore, slight moisture loss during storage may have contributed to the concentration of soluble constituents. The superior performance of treatment T₇ may be associated with the optimum balance between fruit juice and sugar concentration, which helped maintain desirable quality attributes throughout storage. Similar observations regarding the increase in TSS during storage of fruit beverages were reported by Barwal and Shreya (2009), Muhammad *et al.* (2009), Shah Nawaz and Shiekh (2011) and Babu *et al.* (2011).

Titrateable acidity

A gradual rise in titrateable acidity was observed in all

treatments during the storage period (Table 2 and Fig. 1). The acidity content varied from 0.56 to 0.84 per cent at the initial stage and increased to 0.65–0.91 per cent after 60 days of storage. The highest acidity was recorded in treatment T₁ (35% juice + 35 °Brix), which increased from 0.84 per cent at preparation to 0.91 per cent at the end of storage. Conversely, the lowest acidity was observed in treatment T₇ (45% juice + 40°Brix), where acidity increased only from 0.56 to 0.65 per cent during storage. The increase in acidity during storage may be due to the breakdown of sugars and other organic constituents into organic acids through various biochemical reactions. Continuous metabolic changes occurring during storage also contribute to the accumulation of acidic compounds, resulting in higher titrateable acidity. The comparatively lower acidity maintained by treatment T₇ indicates its superiority in preserving the quality and palatability of jamun squash. These findings are in close agreement with those reported by Muhammad *et al.* (2009), Shah Nawaz and Shiekh (2011), and Babu *et al.* (2011), who also observed increasing acidity in fruit-based beverages during storage.

Ascorbic acid

The ascorbic acid content of jamun squash exhibited a declining trend throughout the storage period irrespective of treatments (Table 3). At the beginning of

Table 2 : Effect of various treatment combinations on acidity of Jamun squash at different days of storage.

		Titratable acidity (%)				
Treatments		0 days	15 days	30 days	45 days	60 days
T ₁	35% Juice + 35 °Brix	0.84	0.85	0.88	0.89	0.91
T ₂	40% Juice + 35 °Brix	0.79	0.81	0.84	0.85	0.87
T ₃	45% Juice + 35 °Brix	0.76	0.78	0.81	0.82	0.84
T ₄	50% Juice + 35 °Brix	0.64	0.65	0.68	0.69	0.71
T ₅	35% Juice + 40 °Brix	0.69	0.71	0.75	0.76	0.78
T ₆	40% Juice + 40 °Brix	0.64	0.66	0.70	0.71	0.73
T ₇	45% Juice + 40 °Brix	0.56	0.58	0.62	0.63	0.65
T ₈	50% Juice + 40 °Brix	0.67	0.68	0.72	0.73	0.75
F' test		S	S	S	S	S
CD (5%)		0.06	0.21	0.57	0.12	0.21
SE. m (±)		0.02	0.07	0.18	0.04	0.07
C.V. (%)		4.91	5.11	5.68	6.16	6.24

Table 3 : Effect of various treatment combinations on Ascorbic Acid (mg/100g) of Jamun squash at different days of storage.

		Ascorbic acid (mg/100 g)				
Treatments		0 days	15 days	30 days	45 days	60 days
T ₁	35% Juice + 35 °Brix	17.96	17.88	17.84	17.70	17.67
T ₂	40% Juice + 35 °Brix	17.74	17.68	17.64	17.50	17.47
T ₃	45% Juice + 35 °Brix	17.46	17.40	17.36	17.22	17.18
T ₄	50% Juice + 35 °Brix	15.62	15.56	15.52	15.38	15.35
T ₅	35% Juice + 40 °Brix	17.36	17.29	17.24	17.11	17.07
T ₆	40% Juice + 40 °Brix	15.62	15.56	15.52	15.38	15.35
T ₇	45% Juice + 40 °Brix	14.90	14.84	14.78	14.64	14.59
T ₈	50% Juice + 40 °Brix	16.61	16.55	16.51	16.37	16.33
F' test		S	S	S	S	S
CD (5%)		0.25	0.22	0.19	0.19	0.20
SE. m (±)		0.08	0.07	0.06	0.06	0.07
C.V. (%)		0.87	0.76	0.68	0.68	0.70

storage, ascorbic acid content ranged between 14.90 and 17.96 mg/100 g, which declined to 14.59–17.67 mg/100 g after 60 days. Treatment T₁ (35% juice + 35°Brix) recorded the highest ascorbic acid content both at the initial stage and at the end of storage, decreasing from 17.96 to 17.67 mg/100 g. The lowest ascorbic acid content was observed in treatment T₇ (45% juice + 40°Brix), which declined from 14.90 to 14.59 mg/100 g during storage. The reduction in ascorbic acid content during storage can be attributed primarily to oxidative degradation of vitamin C in the presence of residual oxygen trapped within the storage containers. The conversion of ascorbic

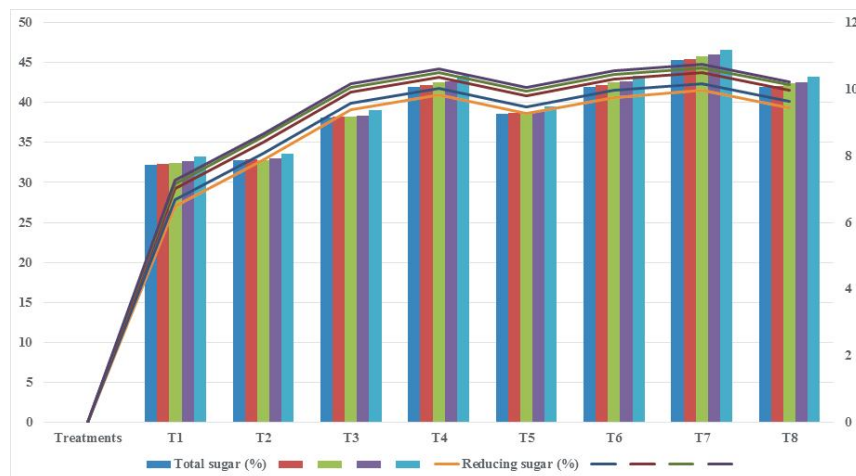
acid into dehydroascorbic acid and subsequent degradation products under storage conditions is a common phenomenon in fruit beverages. The greater retention of ascorbic acid in treatment T₁ suggests better preservation of nutritional quality during storage. Similar reductions in ascorbic acid content during storage of fruit beverages have been reported by Barwal and Shriera (2009), Muhammad *et al.* (2009), Shahnawaz and Shiekh (2011) and Babu *et al.* (2011).

Total sugar

The total sugar content increased progressively during

Table 4 : Effect of various treatment combinations on Total Sugar of Jamun squash at different days of storage.

		Total sugar (%)				
Treatments		0 days	15 days	30 days	45 days	60 days
T ₁	35% Juice + 35 °Brix	32.16	32.29	32.46	32.62	33.24
T ₂	40% Juice + 35 °Brix	32.77	32.90	32.81	32.98	33.63
T ₃	45% Juice + 35 °Brix	38.10	38.23	38.22	38.39	39.06
T ₄	50% Juice + 35 °Brix	41.99	42.18	42.49	42.67	43.32
T ₅	35% Juice + 40 °Brix	38.56	38.69	38.72	38.89	39.54
T ₆	40% Juice + 40 °Brix	41.99	42.18	42.49	42.67	43.32
T ₇	45% Juice + 40 °Brix	45.31	45.50	45.82	46.00	46.57
T ₈	50% Juice + 40 °Brix	41.93	42.12	42.38	42.55	43.20
F' test		S	S	S	S	S
CD (5%)		0.47	0.49	0.52	0.51	1.03
SE. m (±)		0.15	0.16	0.17	0.17	0.34
C.V. (%)		0.68	0.71	0.75	0.74	1.45


Fig. 2 : Effect of various treatment combinations on total and reducing sugar of Jamun squash at different days of storage.

the storage period in all treatments. Initially, total sugars ranged from 32.16 to 45.31 per cent and increased to 33.24–46.57 per cent after 60 days of storage (Table 4 and Fig. 2). The highest total sugar content was recorded in treatment T₇ (45% juice + 40 °Brix), where values increased from 45.31 to 46.57 per cent. The lowest total sugar content was observed in treatment T₁ (35% juice + 35°Brix), which increased from 32.16 to 33.24 per cent during storage. The increase in total sugars during storage may be due to the hydrolysis of polysaccharides, pectin substances and other complex carbohydrates into simple sugar molecules. Enzymatic and non-enzymatic conversion processes occurring during storage contribute to the accumulation of soluble sugars, thereby enhancing total sugar content. The consistently higher sugar content observed in treatment T₇ could be attributed to its

favourable juice-to-sugar ratio, which supported better quality retention and sweetness. The present findings corroborate the results of Barwal and Shrera (2009), Muhammad *et al.* (2009), Shahnawaz and Shiekh (2011), and Babu *et al.* (2011).

Reducing sugar

The reducing sugar content of jamun squash increased steadily throughout the storage period across all treatments (Table 5 and Fig. 2). The initial reducing sugar content ranged from 6.49 to 9.97 per cent, which increased to 7.27–10.75 per cent after 60 days of storage. Treatment T₇ (45% juice + 40°Brix)

recorded the maximum reducing sugar content, increasing from 9.97 per cent at the initial stage to 10.75 per cent at the end of storage. The minimum reducing sugar content was recorded in treatment T₁ (35% juice + 35°Brix), where values increased from 6.49 to 7.27 per cent during storage. The observed increase in reducing sugars may be attributed to the inversion of non-reducing sugars, particularly sucrose, into reducing sugars such as glucose and fructose during storage. In addition, the breakdown of complex carbohydrates into simpler sugars contributes significantly to the rise in reducing sugar concentration. Treatment T₇ maintained the highest reducing sugar content throughout storage, indicating its favourable influence on sweetness and overall product quality. The present findings are in conformity with the reports of

Table 5 : Effect of various treatment combinations on Reducing sugar (%) of Jamun squash at different days of storage.

		Reducing sugar (%)				
Treatments		0 days	15 days	30 days	45 days	60 days
T ₁	35% Juice + 35 °Brix	6.49	6.69	7.02	7.17	7.27
T ₂	40% Juice + 35 °Brix	7.89	8.09	8.42	8.57	8.67
T ₃	45% Juice + 35 °Brix	9.38	9.59	9.92	10.06	10.16
T ₄	50% Juice + 35 °Brix	9.83	10.03	10.36	10.51	10.61
T ₅	35% Juice + 40 °Brix	9.27	9.47	9.80	9.95	10.05
T ₆	40% Juice + 40 °Brix	9.76	9.97	10.30	10.44	10.55
T ₇	45% Juice + 40 °Brix	9.97	10.18	10.51	10.65	10.75
T ₈	50% Juice + 40 °Brix	9.45	9.65	9.98	10.13	10.23
F' test		S	S	S	S	S
CD (5%)		0.58	1.19	1.31	0.61	0.62
SE. m (±)		0.19	0.39	0.43	0.20	0.21
C.V. (%)		3.69	4.12	4.49	3.59	3.63

Zanwar *et al.* (2018), Singh *et al.* (2023) and Awais *et al.* (2025), who also reported an increase in reducing sugars during storage of fruit-based beverages.

Conclusion

The present investigation on the assessment of biochemical and organoleptic properties of jamun squash revealed that storage duration significantly influenced the quality attributes of the product. A gradual increase in Total Soluble Solids (TSS), total sugars, reducing sugars, and titratable acidity was observed in all treatments during the 60-day storage period, whereas ascorbic acid content showed a declining trend. These changes may be attributed to the hydrolysis of complex carbohydrates into simpler sugars, formation of organic acids, and oxidation of vitamin C during storage. Among the various treatment combinations, squash prepared with 45 per cent jamun juice and 40°Brix (T₇) exhibited superior quality characteristics by maintaining the highest TSS, total sugar, and reducing sugar contents along with the lowest titratable acidity throughout the storage period. The treatment also demonstrated better overall stability and quality retention, indicating the suitability of this juice-sugar combination for the preparation of jamun squash. However, the highest retention of ascorbic acid was recorded in treatment T₁ (35% juice + 35°Brix), suggesting that lower juice and sugar concentrations may help preserve vitamin C during storage. Overall, the study demonstrated that jamun squash can be successfully stored under ambient conditions for up to 60 days with acceptable quality. Based on the biochemical attributes evaluated, treatment T₇ (45% juice + 40°Brix) was found

to be the most promising formulation for producing high-quality jamun squash with desirable storage stability and consumer acceptability. The findings highlight the potential of jamun as a valuable raw material for the development of nutritious and commercially viable fruit beverages, thereby promoting value addition and reducing post-harvest losses of this highly perishable fruit.

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Conflict of interest

The authors declare that they have no conflict of interest.

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