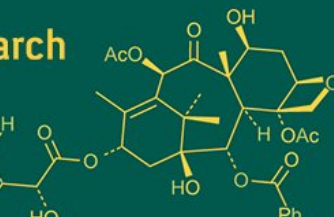
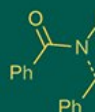
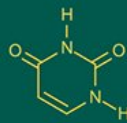


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Influence of granular sugar and sugar syrup on physicochemical quality of rose gulkand

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Abstract

Gulkand is a traditional value-added product prepared from rose petals and sugar and is valued for its pleasant taste, aroma and nutritional properties. An experiment was conducted at the Department of Floriculture and Landscaping, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2025-2026 to study the effect of different levels and forms of sugar on the quality of gulkand prepared from *Rosa centifolia* and to determine the suitable sugar combination for its preparation. The experiment was laid out in Completely Randomized Design (CRD) with ten treatment combinations and three replications. Treatments T₁ to T₅ comprised granular sugar at 800g, 900g, 1000g, 1100g and 1200 g, respectively, while T₆ to T₁₀ comprised sugar syrup treatments with 80%, 90%, 100%, 110% and 120% sugar, respectively. The samples were evaluated for pH, TSS (°Brix), moisture content (%), total sugars (%) and reducing sugars (%) at initial, 30th, 60th, 90th, 120th and 150th day of storage. The results revealed that pH decreased, whereas TSS (°Brix), moisture content (%), total sugars (%) and reducing sugars (%) increased with advancement of storage. Among the treatments, T₅ - Rose petals + Granular sugar (1:1.20) recorded the highest TSS (72.25 °Brix) and total sugar content (66.23%) at 150 days of storage and showed favourable overall physico-chemical quality. Thus, treatment T₅ - Rose petals + Granular sugar (1:1.20) was found to be the most suitable treatment for preparation of gulkand from rose.

Keywords: Rose, Gulkand, *Rosa centifolia*, granular sugar, sugar syrup, storage

Introduction

Rose is an economically important flower crop with considerable potential for value addition through products such as rose water, rose oil, syrup and gulkand. It belongs to the family Rosaceae and has wide applications in the food, medicinal and cosmetic industries. The petals of *Rosa centifolia* contain bioactive constituents and are used in the preparation of various value-added products, including gulkand (Mabellini *et al.*, 2011; Nadaf *et al.*, 2012) [7, 8]. Gulkand is a traditional rose-petal preserve prepared by combining fresh petals with sugar and is valued for its pleasant flavour, nutritional attributes and traditional uses. It also provides an effective means of utilizing perishable rose flowers and reducing post-harvest losses (Kumar *et al.*, 2017; Shukla *et al.*, 2024) [6, 12]. The quality and storage stability of gulkand are influenced by the amount and form of sugar used during preparation. Changes in physicochemical constituents such as moisture and sugars have been reported in gulkand during processing and storage (Bors *et al.*, 2014) [4]. Therefore, the present investigation was undertaken to evaluate the effect of different levels and forms of sugar on the physicochemical quality of gulkand prepared from *Rosa centifolia* during storage and to identify a suitable sugar combination for its preparation.

2. Materials and Methods

The present investigation entitled "Studies on Preparation of Gulkand from Rose" was carried out at the Department of Floriculture and Landscaping, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2025-2026. Fresh flowers of *Rosa centifolia* were procured from the field. The flowers were cleaned and unwanted floral parts were removed, followed by washing and shade drying of the petals.

The experiment was laid out in Completely Randomized Design (CRD) with ten treatments and three replications. For each treatment, 1 kg rose petals were used.

Treatments T₁ to T₅ comprised 1kg of rose petals and granular sugar of 800g, 900g, 1000g, 1100g and 1200g, respectively, whereas T₆ to T₁₀ comprised 1 kg of rose petals and sugar syrup treatments with 80%, 90%, 100%, 110% and 120% sugar, respectively. Sugar syrup was prepared at 75 °Brix. The respective quantities of petals and sugar and sugar syrup were filled in sterilized glass jars, sealed and labelled. The jars were exposed to sunlight at 30-35 °C and stirred on alternate days to facilitate uniform impregnation.

Table 1: Treatments for preparation of gulkand

Tr. No.	Treatments
T ₁	Petals: Granular sugar (1:0.80)
T ₂	Petals: Granular sugar (1:0.90)
T ₃	Petals: Granular sugar (1:1.00)
T ₄	Petals: Granular sugar (1:1.10)
T ₅	Petals: Granular sugar (1:1.20)
T ₆	Petals: Sugar syrup by adding 80% sugar (1:0.80)
T ₇	Petals: Sugar syrup by adding 90% sugar (1:0.90)
T ₈	Petals: Sugar syrup by adding 100% sugar (1:1.00)
T ₉	Petals: Sugar syrup by adding 110% sugar (1:1.10)
T ₁₀	Petals: Sugar syrup by adding 120% sugar (1:1.20)

Observations were recorded at initial, 30th, 60th, 90th, 120th and 150th day of storage. The gulkand samples were evaluated for pH, TSS, moisture content, total sugars and reducing sugars using standard analytical procedures. The pH was measured using a Perkin Elmer pH meter, while TSS was determined using a digital refractometer and expressed in °Brix (AOAC, 1995) [2]. Moisture content was determined using the hot air oven method following AOAC (2005) [1]. About 10 g of gulkand sample was dried at 105 ± 2°C until a constant weight was obtained, and the moisture content was expressed as per cent. Reducing sugar content was estimated by the 3,5-dinitrosalicylic acid (DNS) method described by Sadasivam and Manickam (1997) [10], with absorbance measured at 540 nm using a spectrophotometer. Total sugar content was determined by the phenol-sulphuric acid method of Sadasivam and Manickam (1997) [10], and absorbance was recorded at 490 nm. The results for both reducing and total sugars were expressed as per cent. The data was statistically analysed using Completely Randomized Design (CRD) and the significance of treatment differences was tested at the 5% level of significance.

3. Result and Discussion

3.1 pH

The data pertaining to pH of gulkand under different treatments during storage revealed a gradual decline with the advancement of storage period. At initial day of storage, the highest pH (5.20) was recorded in treatment T₅, whereas the lowest pH (4.91) was observed in treatment T₆. The differences among the treatments were found to be non-significant at the initial stage. From 30th day onwards, significant differences were observed among the treatments. Treatment T₅ maintained a comparatively higher pH throughout the storage period, with a decrease from 5.18 at 30 days to 5.04 at 150th day. In contrast, treatment T₆ recorded the lowest pH, declining from 4.79 to 3.95 during the corresponding storage period. Tamrakar *et al.* (2020) [13] reported a similar decline in pH during the storage of gulkand, which is similar to the trend observed in the present investigation. The reduction in pH during storage

might be attributed to the formation and accumulation of organic acids along with progressive biochemical changes occurring in the product. Sarfarazi *et al.* (2024) [11] also observed a comparable decrease in pH of gulkand during storage.

Table 2: Effect of different sugar formulations on pH of rose gulkand during storage

Treatments	pH					
	Storage period (day)					
	0 th	30 th	60 th	90 th	120 th	150 th
T ₁	5.09	5.03	4.97	4.92	4.84	4.78
T ₂	5.11	5.07	5.01	4.95	4.88	4.83
T ₃	5.15	5.10	5.05	5.00	4.96	4.91
T ₄	5.18	5.14	5.10	5.06	5.02	4.98
T ₅	5.20	5.18	5.14	5.11	5.07	5.04
T ₆	4.91	4.79	4.58	4.40	4.16	3.95
T ₇	4.95	4.81	4.63	4.47	4.24	4.00
T ₈	5.00	4.90	4.80	4.67	4.54	4.41
T ₉	5.06	5.00	4.95	4.89	4.80	4.73
T ₁₀	5.10	5.05	5.00	4.96	4.90	4.84
F test	NS.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	-	0.08	0.06	0.06	0.05	0.07
CD at 5%	-	0.23	0.17	0.18	0.14	0.19

3.2 Total soluble solids (°Brix)

The total soluble solids (TSS) of gulkand showed a progressive increase with the advancement of storage period. At initial day of storage, the highest TSS (70.50 °Brix) was recorded in treatment T₅, whereas the lowest TSS (59.83 °Brix) was observed in treatment T₆. Treatment T₅ maintained the highest TSS throughout the storage period, increasing from 70.50 °Brix initially to 72.25 °Brix at 150 days of storage. In comparison, treatment T₆ exhibited an increase in TSS from 59.83 to 66.13 °Brix during the corresponding storage period. Ajai *et al.* (2022) [3] also reported significant variation in TSS among different rose gulkand formulations prepared using natural sweeteners, supporting the influence of formulation on soluble solids. The increase in TSS during storage may be attributed to the concentration of soluble constituents and progressive biochemical changes occurring in the product. Jat *et al.* (2022) [5] observed an increase in TSS during storage of rose petal jam, which is in agreement with the present findings.

Table 3: Effect of different sugar formulations on TSS (°Brix) of rose gulkand during storage

Treatments	TSS (°Brix)					
	Storage period (day)					
	0 th	30 th	60 th	90 th	120 th	150 th
T ₁	63.53	64.94	65.45	66.05	67.46	68.41
T ₂	64.80	65.55	66.43	67.31	68.84	69.78
T ₃	66.78	68.50	69.72	70.33	70.48	70.67
T ₄	69.53	70.27	70.55	70.68	71.29	71.77
T ₅	70.50	70.91	71.23	71.46	72.02	72.25
T ₆	59.83	60.93	62.63	64.14	66.13	66.13
T ₇	60.55	63.63	64.52	66.31	67.05	67.64
T ₈	62.59	65.48	66.37	67.90	68.49	69.03
T ₉	64.56	65.90	67.53	69.20	69.41	69.73
T ₁₀	65.53	67.98	68.97	69.53	70.36	70.65
F test	NS.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	-	0.56	0.57	0.57	0.56	0.55
CD at 5%	-	1.65	1.68	1.69	1.52	1.42

3.3 Moisture content (%)

A gradual reduction in the moisture content of gulkand was observed as the storage period progressed. At the beginning of storage, treatment T₆ recorded the highest moisture content (82.98%), while the lowest value (78.98%) was noted in treatment T₅. The treatments differed significantly at all storage intervals. In treatment T₆, moisture content decreased from 82.98% at initial day to 51.03% at 150th day, whereas treatment T₅ showed a more pronounced decline from 78.98% to 41.96% over the same period. This reduction might be associated with the gradual loss of water from the product due to the moisture gradient between gulkand and the surrounding atmosphere, further influenced by the osmotic action of the concentrated sugar. The relatively lower moisture content in treatment T₅ has led to better storage stability by limiting the availability of water required for microbial growth and other moisture dependent deteriorative changes. Venkateshan *et al.* (2023) ^[14] reported a gradual reduction in moisture content during storage, corroborating the trend observed in the present study. Similarly, Ochelle *et al.* (2024) ^[9] documented a decline in moisture content during storage of jam, further supporting the present observations.

Table 4: Effect of different sugar formulations on moisture content (%) of rose gulkand during storage

Treatments	Moisture content (%)					
	Storage period (day)					
	0 th	30 th	60 th	90 th	120 th	150 th
T ₁	81.07	74.44	67.99	62.02	54.76	49.02
T ₂	80.52	74.00	67.50	61.49	54.00	47.87
T ₃	79.99	72.01	64.01	56.99	50.00	44.00
T ₄	79.52	70.98	63.01	55.97	48.99	42.95
T ₅	78.98	70.00	62.00	55.00	47.97	41.96
T ₆	82.98	78.03	72.99	68.02	57.01	51.03
T ₇	81.96	77.00	71.94	65.99	55.99	49.99
T ₈	81.48	75.03	69.03	62.99	53.02	47.01
T ₉	80.00	72.98	65.98	59.00	52.00	45.99
T ₁₀	79.77	72.52	65.01	58.00	51.00	44.99
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.44	0.45	0.45	0.44	0.44	0.48
CD at 5%	1.30	1.34	1.32	1.30	1.31	1.41

3.4 Total sugars (%)

The total sugar content of gulkand showed a steady increase with the advancement of storage period. At initial day of storage, treatment T₅ recorded the highest total sugar content (63.04%), whereas the lowest value (53.02%) was observed in treatment T₆. The differences among the treatments were significant at all storage intervals. Treatment T₅ retained the highest total sugar content throughout storage, increasing from 63.04% at initial day to 66.23% at 150th day, while treatment T₆ exhibited a comparatively smaller increase from 53.02% to 55.47% during the same period. The rise in total sugar content may be attributed to the hydrolysis of complex carbohydrates into simpler sugars, along with the concentration of soluble constituents resulting from moisture loss during storage. Tamrakar *et al.* (2020) ^[13] reported an increase in total sugar content of gulkand during storage, which corroborates the trend observed in the present study. Sarfarazi *et al.* (2024) ^[11] also documented a progressive increase in total sugar content during storage, further supporting the present findings.

Table 5: Effect of different sugar formulations on Total sugar (%) of rose gulkand during storage

Treatments	Total sugar (%)					
	Storage period (day)					
	0 th	30 th	60 th	90 th	120 th	150 th
T ₁	61.02	61.34	61.81	62.19	62.46	62.88
T ₂	61.48	61.95	62.37	62.73	63.08	63.52
T ₃	62.01	62.43	62.96	63.38	63.87	64.43
T ₄	62.47	63.05	63.46	63.94	64.48	65.03
T ₅	63.04	63.62	64.11	64.79	65.42	66.23
T ₆	53.02	53.41	53.86	54.28	54.82	55.47
T ₇	54.01	54.46	54.92	55.36	55.88	56.52
T ₈	55.03	55.44	55.96	56.42	56.97	57.56
T ₉	57.01	57.43	57.94	58.36	58.96	59.54
T ₁₀	58.52	58.96	59.47	59.92	60.13	61.02
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.35	0.42	0.31	0.34	0.37	0.32
CD at 5%	0.92	1.18	0.84	0.91	0.93	0.87

3.5 Reducing sugars (%)

The reducing sugar content of gulkand exhibited a steady increase with the advancement of storage period. At initial day of storage, the highest reducing sugar content (3.65%) was recorded in treatment T₁₀, while the lowest (3.04%) was observed in treatment T₁. The differences among the treatments were significant at all storage intervals. A progressive rise in reducing sugar content was observed in all treatments during storage, with treatment T₁₀ increasing from 3.65% at initial day to 12.92% at 150th day, whereas treatment T₁ increased from 3.04% to 10.34% over the same period. This increase may be associated with the inversion and hydrolysis of sucrose into simpler reducing sugars, predominantly glucose and fructose, along with the breakdown of complex carbohydrates during storage. Tamrakar *et al.* (2020) ^[13] observed a progressive increase in reducing sugar content during storage of gulkand, which is in accordance with the present findings. Sarfarazi *et al.* (2024) ^[11] also reported an increasing trend in reducing sugars during storage, further corroborating the results of the present investigation.

Table 6: Effect of different sugar formulations on reducing sugar (%) of rose gulkand during storage

Treatments	Reducing sugar (%)					
	Storage period (day)					
	0 th	30 th	60 th	90 th	120 th	150 th
T ₁	3.04	4.89	6.13	7.03	8.84	10.34
T ₂	3.10	4.96	6.24	7.14	8.92	10.44
T ₃	3.17	5.03	6.33	7.26	9.01	10.56
T ₄	3.24	5.11	6.44	7.38	9.12	10.70
T ₅	3.31	5.19	6.57	7.52	9.24	10.86
T ₆	3.36	5.26	6.97	7.97	9.57	11.22
T ₇	3.42	5.34	7.22	8.27	9.87	11.57
T ₈	3.49	5.43	7.52	8.62	10.22	11.97
T ₉	3.57	5.53	7.87	8.97	10.62	12.42
T ₁₀	3.65	5.63	8.22	9.37	11.07	12.92
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.07	0.08	0.19	0.22	0.19	0.23
CD at 5%	0.21	0.24	0.57	0.64	0.56	0.67

4. Conclusion

The present investigation revealed that the physicochemical quality of rose gulkand was influenced by the form and level of sugar used during preparation. As storage progressed, pH and moisture content gradually decreased, while total

soluble solids, total sugars and reducing sugars showed a steady increase. Among the treatments, rose petals + granular sugar (1:1.20) exhibited the most favourable overall physicochemical characteristics, with higher TSS and total sugar content, lower moisture content and comparatively better retention of pH during storage. The overall response of treatment rose petals + granular sugar (1:1.20) indicates a favourable balance of quality attributes and storage stability. Therefore, treatment rose petals + granular sugar (1:1.20) can be considered the most promising formulation for the preparation of rose gulkand under the conditions of the present investigation.

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