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Sensory evaluation and microbial analysis of gulkand under ambient storage

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ABSTRACT

An experiment was carried out at Post Harvest Lab, Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan) to analyze sensory evaluation, hunter colour *(L* values)*, non-enzymatic browningand microbial count of bourbon rose gulkand product at ambient storage. All sensory characters i.e., taste, flavour, texture, and overall acceptability showed decreasing trend, whereas fungal growth, bacterial growth and non-enzymatic browning showed increased trends at ambient storage duration. The C_9-Bourbon rose petals + sugar candy (1.0:2.0 ww^{-1}) was found to be the best among all ingredient combinations with regard to non-enzymatic browning (0.70), lightness *(L*)* value (20.10) and no microbial and fungus growth, as well as attainment highest organoleptic score for taste, flavour, texture and overall acceptability as compared to C_{11}-Check I market product from Rajsamund (Khamnore), C_{12}-Check II market product from Chittorgarh (Ghodakheda) and C_1-Bourbon rose petals + Sugar (1.0:1.25 ww^{-1}- Check III) at 0 to 120 days ambient storage.

Key words: Bourbon rose, lightness, microbial count, non-enzymatic browning, sensory score

INTRODUCTION

Floriculture is the largest sector in terms of profit-making. Since flower crops are called "High profit, low volume crops,", flower supply and value addition play an important role in determining market value. As flower crops are highly perishable, proper post harvest techniques and value addition are required to increase their value. *Rosa hybrida* contains the diploid chromosome number 2n=14 belonging to the family Rosacea. Gulkand has several benefits on human health, viz. heat problems like tiredness, scratching, pains, and reduction of burning sensations in soles and palms, reduce acidity and stomach heat, which prevents ulcers and intestines swelling as per National Institute of Ayurvedic Medicine of India. It acts as a tonic which decreases stress and strengthens the heart and central nervous system of human beings. It increases vision and decreases redness and swelling of the eyes. It treats ulcers in the mouth and makes teeth and gums powerful. It is a good rejuvenator that corrects skin problems like pimples and blemishes. It repairs sperm abnormalities in males, such as less number or weak sperm. Protects from sunstroke and prevents bleeding of the nose during the summer season. More over, this is a gentle laxative, it reinforces the body's 7 Dhatus (fundamental elements or tissues such as plasma, blood, muscles, fat, sperm, bone, and bone marrow), as par suggested by Rudrawar and Singar (2017). Gulkand contains a variety of biochemical substances, including alkaloids, flavonoids, glycosides, tannins, triterpenoids, and saponins which is a valuable source of therapeutic and preventative agents for diseases (Sindhura et al., 2013). The only disadvantage of gulkand is that diabetics should avoid it. It has a lot of sugar in it, which might cause your blood sugar to rise (Sao and Sharma, 2021)

Bourbon rose belongs to *R. bourboniana* group derived from a natural cross between *Rosa chinensis* and *Rosa damascena.* It is a vigorous shrub with erect shoots, flowers double, deep rosy red, scented, about 7.5 cm in diameter, borne singly or in small clusters. It originated from Bourbon Isle de of Reunion (then known as Bourbon) in 1817. At present, cultivated in Ajmer, Nagaur, Chittorgarh, Banswara and Udaipur districts of Rajasthan. Commercial rose products such as rose water, rose oil, gulkand, pankhuri and gulroghan are available both in international and national markets. Rose hips are an excellent source of vitamin C. Rose water is also one of the most important rose products due to its body-cooling properties, widely used as an ingredient in medicines, perfumes, eye lotions, eye drops and confectionery products. If the sugar and sugar candy levels are optimum set TSS (65°B) or above, will be helpful to draw the moisture or water through osmosis. When a higher concentration of sugar enters the petal cell, the water activity is stopped. Hence, micro-organisms do not grow and ultimately, colony-forming units of fungi, bacteria and actinomycetes decrease. Eventually, the shelf life of gulkand increases.

MATERIALS AND METHODS

The experiment was conducted at Post Harvest Lab, Department of Horticulture, Maharana Pratap University of Agriculture and Technology, Udaipur from October 2020 to March 2021, which is located at 24°35' Latitude, 73°42' Longitude and an elevation of 559.65 meters above the mean sea level. The daily high and minimum temperature in Udaipur during the experimental period of October 2020 to March 2021 was 22.5°C to 33.4°C and 3.8°C to 21.5°C, accordingly, while the high and minimum relative humidity varied from 54.4 per cent to 90.6 per cent and 18.3 per cent to 57.2 per cent, respectively. Sunlight hours vary from 3.4 to 9.6 hours per minute, and annual rainfall varies from 0.0 to 12.6 mm according to the Meteorological Observations, Deptt. of Agronomy, RCA, Udaipur. Bourbon rose flowers were procured from Mr. Parixit Singh a farmer's field at village Barodiya, District of Banswara, Rajasthan. Ingredients like sugar and sugar candy were purchased from the local market.

The experiment was laid out in a completely randomized design with 12 treatments combination replicated thrice, viz. C_1-Bourbon rose petals + Sugar (1.0:1.25 w w^{-1}- Check III), C_2- Bourbon rose petals + Sugar (1.0:1.50 w w^{-1}), C_3- Bourbon rose petals + Sugar (1.0:1.75 w w^{-1}), C_4-Bourbon rose petals + Sugar (1.0:2.00 w w^{-1}), C_5- Bourbon rose petals + Sugar (1.0:2.25 w w^{-1}), C_6-Bourbon rose petals + Sugar candy (1.0:1.25 w w^{-1}), C^7-Bourbon rose petals + Sugar candy (1.0:1.50 w w^{-1}), C8-Bourbon rose petals + Sugar candy (1.0:1.75 w w^{-1}), C_9-Bourbon rose petals + Sugar candy (1.0:2.00 w w^{-1}), C_{10}-Bourbon rose petals + Sugar candy (1.0:2.25 ww^{-1}), C_{11}-Check I market product from Rajsamund (Khamnore) and C_{12}-Check II market product from Chittorgarh (Ghodakheda).

Fresh rose flowers of Rosa bourboniana were chosen, washed and pre-cooled overnight. While next morning rotted, off-coloured rose petals, pollen, anther, stigma, epicalyx, and pedicel were separated and removed. For the preparation of gulkand, selected healthy rose petals were used. In a big mouth glass jar, weighed amounts of petals, i.e., 1 kg and varied levels of sugar or sugar candy, after weighing by electronic balance were mixed with the help of a blender as per treatment. The mouth of the gulkand fill-up jar was covered and bound with a white muslin cloth, and then kept in sunlight for one month to the impregnation process. The prepared gulkand was packed in food-grade plastic containers (500 g) and leaving 2-3 cm head space. The jars were then air-tightly sealed with lids. They were then labelled as per treatment details and kept at ambient temperature for 0, 30-, 60-, 90-, and 120-days storage for observations. The number of bacteria and fungus were counted using a medium of Potato Dextrose Agar (PDA) for fungus and Luria Bertani Agar (LBA) for bacteria. The non-enzymatic browning (NEB) in gulkand was calculated by measuring the optical density (OD) of methanol extracts of a sample at 440 nm by spectrophotometer. The Hedonic Rating Test of gulkand was assessed organoleptically by a jury of five people (Amerine et al., 1965). The data were analysed using a completely randomized design (Fisher, 1950).

RESULTS AND DISCUSSION

Fungal growth (cfu × 10^4 g^{-1})

The data in Table 1 regarding fungal growth shows an inclined trend in bourbon rose gulkand with the advancement of ambient storage duration and declined trends of the improved quantity of sugar and sugar candy. Initially, no colonies were observed up to 60 days of ambient storage in all treatment combinations. However, the maximum fungal growth was detected (2.00 cfu × 10^4 g^{-1}) in lower-level combinations of sugar and sugar candy at C_1, C_2, C_3, C_6, C_7 and C_8, while no fungal growth was detected at C_4-Bourbon rose petals + sugar (1.0:2.00 w w^{-1}), C_5-Bourbon rose petals + sugar (1.0:2.25 w w^{-1}), C_9-Bourbon rose petals + sugar candy (1.0:2.00 w w^{-1}) and C_{10}-Bourbon rose petals + sugar candy (1.0:2.25 w w^{-1}) as compared to best market product C_{11}-check I from Rajsamund (Khamnore) and C_{12}-check II from Chittorgarh (Ghodakheda) at 0 to 120 days ambient storage period. The decreasing number of fungal growths in the improved level of sugar and sugar candy might be due to the fact that when a higher concentration of sugar enters to bourbon rose petal cell, the free water comes out from the petal cell and hence not available to fungal and microorganism growth. Hence, micro-organisms do not grow and ultimately, the colony-forming units of fungi, bacteria and actinomycetes lower down at the higher level of sugar and sugar candy of bourbon rose gulkand.

Krishna et al. (2020) also observed a very negligible growth of fungal units upto 120 days of storage in mango jam and mentioned that the added sugar exerted an osmophillic load in the jam. Present findings are in conformity with the findings of Bafna and Manimehalai (2013) in kokum fruit jam, Jat (2018) and Jat et al. (2018) in rose petal jam.

Bacterial growth (cfu × 10^6 g^{-1})

It is apparent from the mean data in Table 1 that bacterial growth was increased significantly in bourbon rose gulkand with the advancement of ambient storage duration and reduced with the addition of a greater level of sugar and sugar candy. Initially, no bacterial colonies were observed up to 30 days of ambient storage in all treatment combinations. However, The highest bacterial growth was detected (5.00 cfu × 10^6 g^{-1}) with a lower level of sugar and sugar candy at C_6-Bourbon rose petals + sugar candy (1.0:1.25 w w^{-1}) and (4.00 cfu × 10^6 w w^{-1}) at C_1-Bourbon rose petals + sugar (1.0:1.25 w w^{-1}) at 120 days of ambient storage time, while no fungal growth was detected with a higher level combination under C_4-Bourbon rose petals + sugar (1.0:2.00 w w^{-1}), C_5-Bourbon rose petals + sugar (1.0:2.25 w w^{-1}), C_9-Bourbon rose petals + sugar candy (1.0:2.00 w w^{-1}) and C_{10}-Bourbon rose petals + sugar candy (1.0:2.25 w w^{-1}) as compared to best market product C_{11}-check I from Rajsamund (Khamnore) and C_{12}-check II from Chittorgarh (Ghodakheda) at 0 to 120 days ambient storage period.

The reduced bacterial growth seen at later stages of ambient storage might be attributed to an increase in the sugar content and titratable acidity of the gulkand, as sugar, sugar candy and increased acid have preservative action that inhibits microbial development (Jat et al., 2018). The present findings are less or more in agreement with the results of Bafna and Manimehalai (2013) in kokum fruit jam, Krishna et al. (2020) in mango jam and Rana et al. (2021) in mixed fruit jam.

Non-enzymatic browning (NEB)

The mean data about non-enzymatic browning of bourbon rose gulkand in Table 2 reveals that there was a gradually increasing trend observed upon advancement of storage duration from 0 to 120 days and improve quantity of sugar and sugar candy. The highest non-enzymatic browning (0.711) was found at C_5-Bourbon rose petals + sugar (1.0:2.25 w w^{-1}) and the lowest NEB (0.657) at C_6-Bourbon rose petals + sugar candy (1.0:1.25 w w^{-1}) at 120 days of ambient storage. While the best market products C_{11}-check I from Rajsamund (Khamnore) and C_{12}-check II from Chittorgarh (Ghodakheda) were statistically found to be equivalent to best desirable combination trends at C_9-Bourbon rose petals + sugar candy (1.0:2.00 w w^{-1}) and C_4-Bourbon rose petals + sugar (1.0:2.00 w w^{-1}) respectively. Present findings are consistent with those of Burdurlu and Karadeniz (2003) in apple juice and Kumar and Dean (2017) in wood apple jelly.

Table 1. Effect of sugar and sugar candy levels on fungal and bacterial growth of bourbon rose gulkand at ambient storage

Treatments (w w^{-1}) Ambient storage (days)	Fungal growth (cfu × 10^4 g^{-1})						Bacterial growth (cfu × 10^6 g^{-1})					
	0	30	60	90	120	Mean	0	30	60	90	120	Mean
C1- Bourbon rose petals + Sugar (1.0:1.25 Check III)	0.00	0.00	0.00	2.00	2.00	0.80	0.00	0.00	2.00	3.00	4.00	1.80
	(0.71)	(0.71)	(0.71)	(1.58)	(1.58)	(1.06)	(0.71)	(0.71)	(1.58)	(1.87)	(2.12)	(1.40)
C2- Bourbon rose petals + Sugar (1.0:1.50)	0.00	0.00	0.00	1.00	2.00	0.60	0.00	0.00	1.00)	2.00	3.00	1.20
	(0.71)	(0.71)	(0.71)	(1.22)	(1.58)	(0.99)	(0.71)	(0.71)	(1.22)	(1.58)	(1.87)	(1.22)
C3- Bourbon rose petals + Sugar (1.0:1.75)	0.00	0.00	0.00	1.00	2.00	0.60	0.00	0.00	0.00	1.00	1.00	0.40
	(0.71)	(0.71)	(0.71)	(1.22)	(1.58)	(0.99)	(0.71)	(0.71)	(0.71)	(1.22)	(1.22)	(0.91)
C4- Bourbon rose petals + Sugar (1.0:2.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
C5- Bourbon rose petals + Sugar (1.0:2.25)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
C6- Bourbon rose petals + Sugar candy (1.0:1.25)	0.00	0.00	0.00	2.00	2.00	0.80	0.00	0.00	2.00	2.00	5.00	1.80
	(0.71)	(0.71)	(0.71)	(1.58)	(1.58)	(1.06)	(0.71)	(0.71)	(1.58)	(1.58)	(2.35)	(1.39)
C7- Bourbon rose petals + Sugar candy (1.0:1.50)	0.00	0.00	0.00	1.00	2.00	0.60	0.00	0.00	1.00	1.00	3.00	1.00
	(0.71)	(0.71)	(0.71)	(1.22)	(1.58)	(0.99)	(0.71)	(0.71)	(1.22)	(1.22)	(1.87)	(1.15)
C8- Bourbon rose petals + Sugar candy (1.0:1.75)	0.00	0.00	0.00	1.00	1.00	0.40	0.00	0.00	0.00	0.00	1.00	0.20
	(0.71)	(0.71)	(0.71)	(1.22)	(1.22)	(0.91)	(0.71)	(0.71)	(0.71)	(0.71)	(1.22)	(0.81)
C9- Bourbon rose petals + Sugar candy (1.0:2.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
C10- Bourbon rose petals + Sugar candy (1.0:2.25)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
C11- Check I market product from Rajsamund (Khamnore)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
C12- Check II market product from Chittorgarh (Ghodakheda)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)	(0.71)
SEm±	0.001	0.001	0.001	0.003	0.003	-	0.001	0.001	0.003	0.003	0.003	-
C.D. (P=0.01)	NS	NS	NS	0.012	0.010	-	NS	NS	0.010	0.011	0.013	-

Note: values in parenthesis are transformed by √x+0.5

Table 2. Effect of sugar and sugar candy levels on NEB and colour L* value of Bourbon rose gulkand at ambient storage

Ambient storage (days) Treatments (w w^{-1})	Non-enzymatic browning						Colour L* value					
	0	30	60	90	120	Mean	0	30	60	90	120	Mean
C1- Bourbon rose petals + Sugar (1.0:1.25 Check III)	0.594	0.610	0.634	0.656	0.671	0.63	20.24	19.45	17.57	16.15	15.14	17.71
C2- Bourbon rose petals + Sugar (1.0:1.50)	0.599	0.619	0.641	0.663	0.675	0.64	21.01	20.18	19.20	18.16	17.09	19.13
C3- Bourbon rose petals + Sugar (1.0:1.75)	0.611	0.628	0.648	0.672	0.686	0.65	22.49	21.18	20.73	20.12	18.20	20.54
C4- Bourbon rose petals + Sugar (1.0:2.00)	0.623	0.644	0.661	0.686	0.698	0.66	23.20	22.60	21.73	20.61	19.10	21.45
C5- Bourbon rose petals + Sugar (1.0:2.25)	0.631	0.650	0.672	0.695	0.711	0.67	23.33	22.71	21.86	20.72	19.32	21.59
C6- Bourbon rose petals + Sugar candy (1.0:1.25)	0.580	0.598	0.616	0.641	0.657	0.62	20.66	19.85	18.03	16.77	15.43	18.15
C7- Bourbon rose petals + Sugar candy (1.0:1.50)	0.591	0.613	0.630	0.654	0.670	0.63	22.15	21.40	20.26	18.46	17.90	20.03
C8- Bourbon rose petals + Sugar candy (1.0:1.75)	0.604	0.626	0.643	0.665	0.682	0.64	22.75	21.78	21.14	20.34	19.29	21.06
C9- Bourbon rose petals + Sugar candy (1.0:2.00)	0.616	0.635	0.653	0.681	0.695	0.66	24.55	23.24	22.16	21.58	20.10	22.33
C10- Bourbon rose petals + Sugar candy (1.0:2.25)	0.625	0.640	0.670	0.686	0.692	0.66	24.65	23.27	22.21	21.71	20.21	22.41
C11- Check I market product from Rajsamund (Khamnore)	0.617	0.638	0.656	0.685	0.697	0.66	24.50	23.21	22.13	21.54	20.06	22.29
C12- Check II market product from Chittorgarh (Ghodakheda)	0.627	0.642	0.664	0.688	0.705	0.67	23.16	22.57	21.68	20.57	19.00	21.40
SEm±	0.007	0.007	0.001	0.006	0.008	-	0.23	0.26	0.23	0.21	0.20	-
C.D. (P=0.01)	0.028	0.029	0.007	0.027	0.033	-	0.92	1.02	0.90	0.83	0.80	-

A similar increasing trend was observed by Shafaly et al. (2019) in bael-mango jam during ambient storage and they stated that it might be owing to the effect of acidity, which accelerated the hydrolytic process, resulting in browning. Acids also accelerate the Maillard reaction and caramelization, resulting in more browning in the jam. The acceptability and freshness of the final product of papaya are jam reduced due to changing the colour by non-enzymatic browning (Pinandoyo and Siddiqui, 2020).

Hunter Colour *(L*)*

The data about the *L** value of bourbon rose gulkand in (Table 2) indicates that the colour coordinates for lightness *(L*)* of bourbon rose gulkand decreased gradually as the storage time increased from 0 to 120 days in all treatments. Present findings indicate that light colour decreased and dark colour increased at the advancement of the ambient storage period of bourbon rose gulkand. Colour changes might be caused by the Millard reaction, ascorbic acid breaking down, enzymatic browning and polymerization of colour pigments (carotenoids and anthocyanins) with some other phenolic compounds (Shah et al., 2015). Almost similar results were reported by Burdurlu and Karadeniz (2003) in apple juice and Jat (2018) in rose petal jam.

Organoleptic evaluation

The data in Table 3 & Table 4 revealed that the taste, flavour, and texture of bourbon rose gulkand were significantly affected by the different ratios of bourbon rose petals, sugar, and sugar candy levels. The taste, flavour and texture score decreased as the ambient storage time increased from 0 to 120 days. The highest mean score of 0 to 120 days for taste (8.25), flavor (7.92) and texture (7.88) were observed in the desirable treatment combination at C_9-Bourbon rose petals + sugar candy (1.0:2.00 w w^{-1}) and the

Table 3. Effect of sugar and sugar candy levels on taste and flavour of bourbon rose gulkand at ambient storage

Ambient storage (days)	Taste score						Flavour score					
Treatments (w w^{-1})	0	30	60	90	120	Mean	0	30	60	90	120	Mean
C1- Bourbon rose petals + Sugar (1.0:1.25 Check III)	6.50	6.41	6.26	6.10	5.81	6.22	7.51	7.34	6.13	5.89	5.65	6.50
C2- Bourbon rose petals + Sugar (1.0:1.50)	7.75	7.61	7.50	6.41	6.15	7.08	7.52	7.35	7.15	6.92	6.63	7.11
C3- Bourbon rose petals + Sugar (1.0:1.75)	8.05	7.91	7.79	7.65	7.48	7.78	8.61	8.44	8.23t	7.99	7.40	8.13
C4- Bourbon rose petals + Sugar (1.0:2.00)	8.63	8.48	8.35	8.21	8.06	8.35	8.86	8.58	8.37	8.18	7.82	8.36
C5- Bourbon rose petals + Sugar (1.0:2.25)	8.24	8.09	7.93	7.81	7.72	7.96	7.64	7.47	7.24	7.09	6.10	7.11
C6- Bourbon rose petals + Sugar candy (1.0:1.25)	6.20	6.05	5.70	5.35	5.10	5.68	6.38	6.21	6.00	5.76	5.47	5.96
C7- Bourbon rose petals + Sugar candy (1.0:1.50)	7.43	7.25	7.12	5.55	5.30	6.53	6.45	6.28	6.07	5.83	5.62	6.05
C8- Bourbon rose petals + Sugar candy (1.0:1.75)	7.91	7.85	7.74	7.56	7.13	7.64	7.73	7.56	7.35	7.12	5.90	7.13
C9- Bourbon rose petals + Sugar candy (1.0:2.00)	8.78	8.62	8.51	8.39	8.25	8.51	8.91	8.78	8.53	8.26	7.92	8.48
C10- Bourbon rose petals + Sugar candy (1.0:2.25)	8.16	8.05	7.91	7.77	7.50	7.88	7.62	7.45	7.25	7.01	6.72	7.21
C11- Check I market product from Rajsamund (Khamnore)	8.70	8.50	8.39	8.30	8.21	8.42	8.89	8.75	8.50	8.25	7.88	8.45
C12- Check II market product from Chittorgarh (Ghodakheda)	8.59	8.45	8.33	8.19	8.10	8.33	8.84	8.56	8.35	8.16	7.80	8.34
SEm±	0.12	0.08	0.09	0.09	0.10	-	0.10	0.09	0.08	0.09	0.09	-
C.D. (P=0.01)	0.48	0.31	0.34	0.37	0.39	-	0.39	0.36	0.31	0.35	0.34	-

lowest score were observed at T6–Bourbon rose petals + sugar candy (1.0:1.25 w w^{-1}) at 0 to 120 days of the storage period, which were better over C1, statistically at par with best market product C_{11}-Check I from Rajsamund (Khamnore) and C_{12}-Check II from Chittorgarh (Gohakheda) respectively. It can be concluded that the biochemical changes during storage i.e., fluctuations in acids, pH, sugar/acid ratio and the storage duration, had a significant impact on the organoleptic characteristics of the bourbon rose gulkand. Jat et al. (2018) indicates that the loss of flavour value is caused by the loss of highly volatile aromatic compounds, which are extremely susceptible to high temperature storage and some enzymatic degradation of phenols and oxidative changes in sugars, which cause flavour loss during storage. Similarly, a decreasing trend was reported by Patel et al. (2015) in banana and pineapple blended jam, Shah et al. (2015) in apple and olive fruit blended jam, Rahman et al. (2018) in guava jam and Khan et al. (2020) in fig fruit jam blended with apple.

Overall acceptability

It is apparent from the data in Table 4 that the overall acceptability of bourbon rose gulkand, which is a combined effect of taste, flavour and texture was significantly affected by the different ratios of ingredients. The overall acceptability score decreased as the storage time increased from 0 to 120 days at ambient storage period. The maximum score for overall acceptability (8.02) was found in C_9-Bourbon rose petals + sugar candy (1.0:2.00 w w^{-1}) and the lowest score (5.26) was observed in T_6 –Bourbon rose petals + sugar candy (1.0:1.25 w w^{-1}) at 120 days of ambient storage period. The C_9-Bourbon rose petals + sugar candy (1.0:2.00 w w^{-1}) and C_4-Bourbon rose petals + sugar (1.0:2.00 w w^{-1}) respectively were better

Table 4. Effect of sugar and sugar candy levels on texture and acceptability of bourbon rose gulkand at ambient storage

Ambient storage (days) Treatments (w w^{-1})	Texture score						Overall acceptability score					
	0	30	60	90	120	Mean	0	30	60	90	120	Mean
C1- Bourbon rose petals + Sugar (1.0:1.25 Check III)	7.62	7.50	7.36	7.13	6.87	7.30	7.21	7.08	6.58	6.37	6.11	6.67
C2- Bourbon rose petals + Sugar (1.0:1.50)	7.88	7.71	7.59	7.36	7.12	7.53	7.72	7.56	7.41	6.90	6.63	7.24
C3- Bourbon rose petals + Sugar (1.0:1.75)	8.25	8.14	8.00	7.74	7.48	7.92	8.34	8.18	8.02	7.82	7.47	7.96
C4- Bourbon rose petals + Sugar (1.0:2.00)	8.65	8.47	8.35	8.13	7.70	8.26	8.71	8.51	8.36	8.17	7.86	8.32
C5- Bourbon rose petals + Sugar (1.0:2.25)	8.19	8.03	7.86	7.63	7.37	7.82	8.02	7.86	7.68	7.51	7.06	7.63
C6- Bourbon rose petals + Sugar candy (1.0:1.25)	6.29	6.13	5.99	5.76	5.20	5.87	6.29	6.13	5.90	5.62	5.26	5.84
C7- Bourbon rose petals + Sugar candy (1.0:1.50)	6.55	6.34	6.23	6.00	5.26	6.08	6.81	6.62	6.47	5.79	5.39	6.22
C8- Bourbon rose petals + Sugar candy (1.0:1.75)	8.36	8.18	8.04	7.81	7.53	7.98	7.96	7.85	7.70	7.47	6.84	7.56
C9- Bourbon rose petals + Sugar candy (1.0:2.00)	8.79	8.55	8.41	8.20	7.88	8.37	8.83	8.64	8.48	8.28	8.02	8.45
C10- Bourbon rose petals + Sugar candy (1.0:2.25)	8.03	7.94	7.80	7.57	7.31	7.73	7.94	7.81	7.65	7.45	7.18	7.61
C11- Check I market product from Rajsamund (Khamnore)	8.74	8.53	8.40	8.18	7.86	8.34	8.78	8.59	8.43	8.24	7.98	8.41
C12- Check II market product from Chittorgarh (Ghodakheda)	8.61	8.45	8.32	8.10	7.68	8.23	8.68	8.49	8.33	8.15	7.86	8.30
SEm±	0.08	0.10	0.09	0.09	0.08	-	0.09	0.09	0.08	0.08	0.08	-
C.D. (P=0.01)	0.34	0.39	0.35	0.34	0.33	-	0.35	0.37	0.31	0.31	0.32	

over C1, statistically at par with best market product C_{11}- Check I from Rajsamund (Khamnore) and C_{12}-Check II from Chittorgarh (Gohakheda) for overall acceptability. A similar decline in overall acceptability was observed by Shah et al. (2015) in apple + olive fruit blended jam, Ullah et al. (2018) in carrot + apple blended jam, Jat et al. (2018) in rose petal jam, Rahman et al. (2018) in guava jam, Pinandoyo and Siddiqui (2020) in papaya jam and Khan et al. (2020) in fig fruit jam blended with apple.

CONCLUSION

It is concluded that C_9-Bourbon rose petals + sugar candy (1.0:2.00 w w^{-1}) was found to be statistically at par with regard to non-enzymatic browning (0.70) lightness *(L*)* value (20.10), *a** value (7.22), yellowness *(b*)* value (3.06) and no microbial and fungus growth, as well as attainment of the highest organoleptic score as compared to best market product C_{11}-Check I from Rajsamund (Khamnore), C_{12}-Check II from Chittorgarh (Ghodakheda) and C1-Check.

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