Original Research Article

Impact of sugar, sugar candy, jaggery and honey levels on physico-chemical changes of bourbon rose petal jam at ambient storage

ABSTRACT

An experiment was carried out at Post Harvest Laboratory, Department of Horticulture, Maharana Pratap University of Agriculture and Technology, Udaipur-313001, Rajasthan to analyze the physico-chemical changes during storage at ambient conditions. The bourbon rose petal jam ingredient combinations were studied at monthly interval up to 90 days at ambient storage for physico-chemical parameters. Quality changes exhibited increasing trends for total soluble solids, acidity, total sugars, reducing sugars, NEB and *a** value whereas declined trends were recorded for ascorbic acid, pH, non-reducing sugars, total anthocyanins, total phenolics content, *L** and *b** value throughout storage period. The bourbon rose petal jam treatment combination T3 - rose petal + sugar (1:1.25w/w) recorded higher level of total soluble solids (75 ^{0}B), pH (5.04), total sugars (63.34%), non-reducing sugars (55.10%) with minimum increase in percent titratable acidity (0.10% to 0.19%) and considerably retarded loss of total antocyanins and phenolics content throughout 90 days storage duration. However, reducing sugars (47.69%) was found higher in T_6 - rose petal + honey (1:1.25w/w) and ascorbic acid content (13.47 mg 100 g^{-1}) in treatment T_2 - rose petal + sugar (1:1w/w) at 90 days of ambient storage. Considering the chemical constituents mentioned above, treatment combination T3 - rose petal + sugar (1:1.25w/w) was found best over rest of the treatments during storage.

***Keywords**: Bourbon rose petals, sugar, honey, jaggery, sugar candy*

1. INTRODUCTION

In floriculture, rose is foremost commercially important as cut roses, loose flower and value added products, which have high demand throughout the world year round. Rose belongs to family Rosaceae. About 75 percent of this produce is exported to West-Asian countries in the form of petals, ascertaining the importance of rose for it's by products. In India rose is grown on an area of 30.87 million hectare with an annual production of 212.67 thousand MT [3]. The major rose growing states in our country are Karnataka, Gujarat, Andhra Pradesh, Odisha, Uttar Pradesh, Madhya Pradesh, Maharashtra,

Assam, Chhattisgarh and Haryana. In Rajasthan rose is grown in an area 1494 hectares with an annual production 2454 MT. The major rose producing districts are Ajmer, Nagaur, Chittorgarh, Jodhpur, Bundi, Ganganagar, Hanumangarh, Udaipur, Rajsamund and Bhilwara [4].

Among the various species of roses, damask rose (*Rosa damascena* Mill.) is the most important rose species used to produce rose oil, water, concrete and absolute which are valuable and important base materials for the perfume and cosmetic industry [5]. Rose petals are also preserved for direct consumption by making gulkand prepared by mixing equal parts of petals and white sugar. Preparation of Gulkand is a home industry in Jammu and Kashmir States. In the cities of Udaipur, Nathdwara, Ajmer in Rajasthan, fifteen units are making gulkand, rose water and syrup. Gulkand is one of the most delicious ayurvedic preparations which have been used from ancient times for good health. Gulkand is considered both as a tonic and laxative (16, 25]. Bourbon rose petal jam is mainly prepared from Bourbon rose belongs to *Rosa bourboniana* originated from natural cross between *Rosa chinensis* × *Rosa damascena.* It is a vigorous shrub with erect shoots, flowers double, deep rosy-red, scented, about 7.5cm in diameter, borne singly or in small clusters. It is originated from Bourbon Isle de of Reunion (then known as Bourbon) in 1817. At present cultivated in Ajmer, Nagaur, Chittorgarh and Udaipur district of Rajasthan [29]. Gulkand is a powerful antioxidant and a very good rejuvenator. Consuming 1-2 teaspoons of gulkand helps to reduce acidity and stomach heat.

At present scanty research work is available on the physico-chemical changes of bourbon rose petal jam at ambient storage condition and on standard parameters. Hence keeping this in view the present study was undertaken to analyze the impact of sugar, sugar candy, jaggery and honey levels on physico-chemical changes of bourbon rose petal jam at ambient storage.

2. MATERIALS AND METHODS

The experiment was carried out at Post Harvest Laboratory, Department of Horticulture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan during September, 2016 to January 2018. Bourbon rose flowers were procured from Sh. Devi Lal Jat farmer's field village Ghoda Kheda, District Chittorgarh, Rajasthan. Ingredients like sugar, honey, candy and jaggery were procured from local market. The experiment was laid out in completely randomized design with 12 treatments combination of bourbon rose petal jam replicated thrice, viz. T_1= rose petal + sugar(1:0.75w/w), T_2 = rose petal + sugar(1:1w/w), T_3 = rose petal + sugar(1:1.25w/w), T_4 = rose petal + honey(1:0.75w/w), T_5 = rose petal +

honey(1:1w/w), T_6 = rose petal + honey (1:1.25w/w), T_7 = rose petal + sugar candy(1:0.75w/w), T_8 = rose petal + sugar candy(1:1w/w), T_9 = rose petal + sugar candy(1:1.25w/w), T_{10} = rose petal + jaggery(1:0.75w/w), T_{11} = rose petal + jaggery(1:1w/w), T_{12} = rose petal + jaggery(1:1.25w/w). Fresh bourbon rose flower petals were used for the preparation of gulkand. The calculated quantities of bourbon rose petals either with sugar, jaggery, sugar candy and honey as per treatment were arranged in alternate layers in a wide mouth glass jar. The mouth of gulkand jar was covered and tied with muslin cloth, after that placed in sun light for impregnation of sugar, honey, sugar candy and jaggery into petals up to 30 days. They were then labeled and stored at ambient condition for physico-chemical estimation at 0, 30, 60 and 90 days storage duration.

The TSS content of bourbon rose petal jam was directly measured by the "Digital Refractometer" (Brix: 0.0 to 53.0, 58.0 to 95.0 %) at 20^0C temperature. Ascorbic acid content of bourbon rose petal jam determined by 2,6-dichlorophenol – indophenols dye method following the procedure of AOAC [1]. Acidity content was determined by diluting the known volume of jam with distilled water and titrating the same against standard N/10 sodium hydroxide solution, using phenolphthalein as an indicator given by AOAC [1]. The pH of the bourbon rose petal jam was directly measured by pH meter. Total sugars, reducing sugars and non-reducing sugars were determined by Lane and Eynon method as described by Ranganna [21].

Total anthocyanins content was determined by the pH-differential method given by Wrolstad *et al*. [28]. The extract was diluted both in buffer pH 1.0 (0.025 potassium chloride) and buffer pH 4.5 (0.4 M sodium acetate). After 30 min of incubation at room temperature, absorption was measured at 520 and 700 nm. Results were calculated using molar absorptivity of 26900 L/mol/cm and molecular weight of 449.2 (Da) and expressed as cyanidin 3-glucoside equivalents (CGE) in milligrams per 100 g fresh weight. Total phenols were estimated according to the Folin-Ciocalteu's reagent procedure described by Singleton and Rossi [27]. A 0.5g sample was extracted with 20ml 80% methanol. The aliquot (1ml) was taken in the test tubes and then added with 2.9 ml of Folin-Ciocalteu's phenol reagent (1N). To that, 0.5 ml of distilled water was added and all the tubes were shaken well. Then, 2 ml of sodium carbonate (20%) solution was added to all the tubes and kept for incubation at room temperature for 30 minutes. The colour developed was read in spectrophotometer at 750nm wavelength. The non-enzymatic browning (NEB) in the bourbon rose petal jam was determined by measuring optical density (OD) of methanol extracts of samples at 440 nm in UV-VIS spectrophotometer (Labomed Inc., USA). The colour parameters of bourbon rose petal jam was measured by using a Hunter Lab Colourimeter (model Hunter Colour Flex, Reston, USA), with reflectance mode (RSIN), CIE Lab

scale (L^*, a^* and b^*) according to Nielsen [15]**.** Colour was determined using a CIE L^*, a^* and b^* colour system, where L^* indicates lightness (L^* = 0, black and L^* = 100, white). a^* is the chromatic coordinate that represents the proportion of redness and varies from green (-) to red (+) and b^* is the chromatic coordinate that represents the proportion of yellowness and varies from blue (-) to yellow (+). The pooled data were analysed by using completely randomized design [10].

3. RESULTS AND DISCUSSION

3.1 Total soluble solids and ascorbic acid content

The pooled data indicates that total soluble solids (TSS) content of stored bourbon rose petal jam significantly increased with the higher quantity of ingredients and advancement of storage duration in all the treatments (Table 1). In treatment T_3 - rose petal + sugar (1:1.25w/w), total soluble solids increased from 71 to 75^{o}B from 0 to 90 days of storage while it was least increase in treatment T_4- rose petal + honey (1:0.75w/w). The increment in TSS content of bourbon rose petal jam during storage duration was probably due to conversion of free polysaccharides (starch) into monosaccharide (soluble sugars). Present findings are in conformity with the findings of Youssef and Mousa [30] in baladi rose petal jam. On the other hand, ascorbic acid content of bourbon rose petal jam decreased significantly on addition of increased quantity of sugar, honey, sugar candy and jaggery with the advancement of storage duration (Table 3). The maximum ascorbic acid content (13.47mg 100 g^{-1}) was recorded in treatment T_2 - rose petal + sugar (1:1w/w) followed by T_1 - rose petal + sugar (1:0.75w/w) while minimum ascorbic acid content (8.14 mg 100 g^{-1}) was recorded in treatment T_7- rose petal + sugar candy (1:0.75w/w) at 90 days storage duration. However, the least decline in ascorbic acid content (13.99-9.99 mg 100 g^{-1}) was observed in treatment T_9 –rose petal + sugar candy (1:1.25w/w) from 0 to 90 days of storage. The decrease in ascorbic acid content may also probably due to the process of oxidation of ascorbic acid resulted into formation of dehydroascorbic acid in presence of ascorbinase enzyme [17]. These findings are in line with Riaz et al. [24] who observed decrease in ascorbic acid content of strawberry jam from 18 mg/100g to 13 mg/100g during 90 days storage.

3.2 Titratable acidity and pH

The pH of bourbon rose petal jam decreased throughout storage period as a result of increase in the acidity of product due to the phenomenon of production of organic acid through initiation of fermentation process during impregnation of sugar, honey, sugar candy and jaggery into rose

petals (Table 1). The maximum pH (5.04) was recorded under T_3 -rose petal + sugar (1:1.25w/w) and the minimum pH (3.96) was recorded in the treatment T_{10} - rose petal + jaggery (1:0.75w/w) at 90 days of storage duration. However, the titratable acidity percent varied from 0.10 to 0.53 during 90 days storage. The minimum increase in percent titratable acidity (0.10% to 0.19%) was recorded in T_3 - rose petal + sugar (1:1.25w/w) while maximum increase in percent titratable acidity (0.43% to 0.53%) was observed in T_{10} - rose petal + jaggery (1:0.75w/w) from 0 to 90 days of storage. Kanwal et al. [11] reported that the increase in acidity may be due to acid formation, degradation of polysaccharides and oxidation of reducing sugars. Similar findings were also reported by Prasad and Mali [19] in ber jam, Chanbisana and Banik [8] in ripe banana jam and Patil *et al*. [18] in guava jam blended with sapota.

3.3 Total sugars, reducing sugars and non reducing sugars

Pooled data indicates (Table 2) that the total sugars and reducing sugars content of bourbon rose petal jam increased with higher level of ingredients like sugar, honey, sugar candy and jaggery during 90 days storage at ambient conditions. The maximum increase in total sugars content (61.13% to 63.34%) was recorded in treatment T_3-rose petal + sugar (1:1.25w/w) and the minimum increase in total sugars content (46.08% to 47.58%) was recorded in T_4- rose petal + honey (1:0.75w/w) at the initial level to 90 days of storage duration. The highest increase in reducing sugars content (39.49% to 47.69%) was observed in treatment T_6 -rose petal + honey (1:1.25w/w) whereas the lowest increase in reducing sugars (3.00% to 8.03%) was recorded in treatment T_1 - rose petal + sugar (1:0.75w/w) at initial to 90 days ambient storage duration. Increment in total sugars and reducing sugars might be due to hydrolysis of polysaccharides like starch and inversion of non reducing sugars to reducing sugars and partly due to loss of moisture. Total sugars and reducing sugars in guava -sapota blended jam [Patil et al., 18] and banana-pineapple blended jam [Patel et al., 17] showed increasing trend with the advancement of storage duration. Such identical increase in total sugars and reducing sugars has been also reported by Relekar et al. [22] in sapota jam and Kanwal et al. [11] in guava jam. The overall non reducing sugars content of bourbon rose petal jam showed decreasing trend with the advancement at ambient storage duration on the basis of pooled data. Among the various treatments, minimum decrease in non reducing sugars content (58.07% to 55.10%) were recorded under treatment T_3-rose petal + sugar (1:1.25w/w) whereas maximum decrease in non reducing sugars content (8.72% to 3.04%) were recorded under T_4 - rose petal + honey (1:0.75w/w) during 90 days storage duration (Table 2). This pattern of decreasing of non reducing sugars (%) during storage might be due to the hydrolysis of polysaccharides and

inversion of non- reducing sugars into glucose and fructose. These results were more or less similar to the study by Mulla [14] in mixed fruit jam and Shakir *et al*. [26] in apple and pear mixed fruit jam [26].

3.4 Total anthocyanins and phenolics

The total anthocyanins content of bourbon rose petal jam declined throughout the storage period in all the treatments as pooled data presented in Figure 1a. The minimum decline in anthocyanins content (380.53-260.44 mg 100 g^{-1}) was found in treatment T_9 –rose petal + sugar candy (1:1.25w/w) closely followed by T_3-rose petal + sugar (1:1.25w/w) and maximum decline (491.1-334.63 mg 100 g^{-1}) was recorded in treatment T_4 - rose petal + honey (1:0.75w/w) during 90 days storage period. The reduction of anthocyanins was reported by Cemeroglu et al. [7] in sour cherry juice and concentrates. Rhim [23] demonstrated that higher soluble solids content during jam processing increases the degradation of anthocyanins in red cabbage. Agrawal and Kaur [2] also reported that total anthocyanins content of various rose products were decreased slightly on storage might be due to interaction of ascorbic acid with anthocyanin's which resulted into degradation of both compounds through a condensation reaction. Likewise, total phenolics content also declined significantly throughout the storage period (Fig 1b). The decline was lesser (83.07-48.61 mg 100 g^{-1}) in treatment T_9 –rose petal + sugar candy (1:1.25w/w) closely followed by T_3-rose petal + sugar (1:1.25w/w) and greater decline (170.07-97.07 mg 100 g^{-1}) was recorded in treatment T_4 - rose petal + honey (1:0.75w/w) during 90 days storage period. The reduction of total phenolics might be due to disruption of cell structure during processing and sensitivity of the phenolic components to oxidation at ambient storage conditions. Present findings are in line with Agrawal and Kaur [2] in different rose products and Kanwal et al. [11] in guava jam.

3.5 Non enzymatic browning

Pooled data indicates that non enzymatic browning of bourbon rose petal jam increased with the advancement of ambient storage duration (Table 3). Minimum NEB (0.650) was recorded from treatment T_4 - rose petal + honey (1:0.75w/w), whereas maximum non enzymatic browning (0.850) was recorded in T_{12} -rose petal + jaggery (1:1.25w/w) at 90 days of storage period. This could be mainly due to the non-enzymatic reaction (Millard reaction) such as reaction of organic acids with sugars or oxidation of phenol which leads to the formation of brown pigments. The present findings of non-enzymatic browning are in agreement Burdurlu and Karadeniz [6] in apple juice concentrates, Deen and Singh [9] in karonda jelly, Kumar and Deen [12] in wood apple jelly.

3.6 *L*, a** and *b** value

Pooled data represented that CIE colour values *(L** and *b**) of bourbon rose petal jam decreased during 90 days ambient storage duration (figure 2a & 2c). The maximum luminosity *L** value (32.16) and *b** value (28.43) were recorded in treatment T_2 - rose petal + sugar (1:1w/w) and T_7- rose petal + sugar candy (1:0.75w/w) respectively while minimum luminosity *L** value (23.60) and *b** value (11.46) were recorded in treatment T_{11} – rose petal + jaggery (1:1w/w) and T_{12} -rose petal + jaggery (1:1.25w/w) respectively at 90 days ambient storage duration. However, CIE colour values (*a**) increased significantly on advancement of ambient storage duration (0 to 90th days of storage). The minimum CIE *a** colour coordinate (14.69) was recorded from treatment T_7- rose petal + sugar candy (1:0.75w/w) and maximum (16.08) was under T_3 - rose petal + sugar (1:1.25w/w) at 90 days ambient storage duration (figure 2b). Similar findings of *L*, a* and b** value were also observed by Burdurlu and Karadeniz [6] in apple juice concentrates and Mgaya-Kilima et al. [13] in roselle fruit juice blends.

CONCLUSION

On the basis of pooled results it is concluded that bourbon rose petal jam ingredient combination treatment T_3 - rose petal + sugar (1:1.25w/w) significantly retained total soluble solids (75 ^{0}B), total sugars (63.34%), non-reducing sugars (55.10%), *a** value (16.08) and significantly retarded loss of total anthocyanins and total phenolics content.

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Table 1. Effect of ingredient combination on TSS, titratable acidity and pH of bourbon rose petal jam at ambient storage (Pooled data)

Treatment (w/w)	Ambient storage duration (days)											
	TSS (°B)				Titratable acidity (%)				pH			
	0	30	60	90	0	30	60	90	0	30	60	90
T_1 : ROSE PETAL + SUGAR (1:0.75)	69.00	69.40	70.00	70.50	0.14	0.18	0.20	0.24	5.14	5.09	5.04	4.99
T_2: ROSE PETAL + SUGAR (1:1)	70.00	70.50	71.00	72.00	0.11	0.14	0.18	0.21	5.16	5.12	5.06	5.02
T_3 : ROSE PETAL + SUGAR (1:1.25)	71.00	71.80	73.00	75.00	0.10	0.13	0.16	0.19	5.19	5.14	5.09	5.04
T_4 :ROSE PETAL + HONEY (1:0.75)	44.80	46.00	47.40	49.00	0.24	0.27	0.30	0.34	5.05	4.96	4.91	4.85
T_5 :ROSE PETAL + HONEY (1:1)	46.00	47.21	48.60	50.40	0.22	0.24	0.27	0.31	5.08	5.01	4.95	4.91
T_6 :ROSE PETAL + HONEY (1:1.25)	48.00	49.20	50.80	52.60	0.20	0.23	0.26	0.29	5.10	5.04	4.97	4.92
T_7 :ROSE PETAL + SUGAR CANDY (1:0.75)	65.00	65.50	66.00	66.40	0.16	0.18	0.21	0.23	5.09	5.04	4.98	4.00
T_8:ROSE PETAL + SUGAR CANDY (1:1)	66.00	66.60	67.30	68.00	0.15	0.17	0.19	0.21	5.11	5.06	5.01	4.96
T_9 :ROSE PETAL + SUGAR CANDY (1:1.25)	68.00	69.00	69.50	70.00	0.14	0.16	0.19	0.20	5.13	5.07	5.02	4.98
T_{10} :ROSE PETAL + JAGGERY (1:0.75)	53.50	54.70	56.20	57.90	0.43	0.46	0.49	0.53	4.15	4.09	4.04	3.96
T_{11} :ROSE PETAL + JAGGERY (1:1)	56.00	57.20	58.60	60.20	0.41	0.45	0.48	0.52	4.18	4.13	4.09	4.04
T_{12} :ROSE PETAL + JAGGERY (1:1.25)	58.00	59.20	60.60	62.20	0.40	0.44	0.48	0.51	4.21	4.16	4.11	4.08
C.D. (P=0.05)	2.24	4.28	4.29	3.83	0.015	0.02	0.02	0.02	0.25	0.25	0.36	0.39

Table 2. Effect of ingredient combination on TS, RS and NR sugars content of bourbon rose petal jam at ambient storage (Pooled data)

Treatment (w/w)	Ambient storage duration (days)											
	Total sugar (%)				Reducing sugar (%)				Non- reducing sugar (%)			
	0	30	60	90	0	30	60	90	0	30	60	90
T_1 : ROSE PETAL + SUGAR (1:0.75)	60.02	60.62	61.32	61.84	3.00	4.84	6.13	8.03	56.98	55.77	55.18	53.80
T_2: ROSE PETAL + SUGAR (1:1)	60.72	61.12	61.82	62.36	3.03	4.88	6.18	8.11	57.68	56.23	55.63	54.25
T_3 : ROSE PETAL + SUGAR (1:1.25)	61.13	62.16	62.76	63.34	3.06	4.98	6.27	8.24	58.07	57.18	56.48	55.10
T_4 :ROSE PETAL + HONEY (1:0.75)	46.08	46.68	47.18	47.58	37.32	39.86	42.05	44.61	8.72	6.82	5.09	3.04
T_5 :ROSE PETAL + HONEY (1:1)	48.26	48.68	49.22	49.66	39.09	41.69	43.67	46.47	9.16	6.96	5.48	3.16
T_6 :ROSE PETAL + HONEY (1:1.25)	48.75	49.35	49.87	50.98	39.49	42.07	44.14	47.69	9.26	7.24	5.73	3.25
T_7 :ROSE PETAL + SUGAR CANDY (1:0.75)	58.52	58.92	59.42	59.84	4.08	5.90	7.12	9.58	54.42	53.02	52.28	50.26
T_8:ROSE PETAL + SUGAR CANDY (1:1)	59.40	59.94	60.52	61.12	4.14	5.98	7.26	9.76	55.24	53.94	53.25	51.34
T_9 :ROSE PETAL + SUGAR CANDY (1:1.25)	60.12	60.68	61.18	61.76	4.19	6.06	7.34	9.88	55.91	54.61	53.83	51.87
T_{10} :ROSE PETAL + JAGGERY (1:0.75)	49.22	49.64	50.16	50.92	18.21	22.33	25.58	28.06	29.53	27.30	24.57	22.91
T_{11} :ROSE PETAL + JAGGERY (1:1)	51.52	52.02	52.62	53.16	19.06	23.40	26.83	29.23	30.91	28.61	25.78	23.92
T_{12} :ROSE PETAL + JAGGERY (1:1.25)	52.37	52.81	53.33	53.94	19.90	23.76	27.18	29.67	31.42	29.02	26.13	24.26
C.D. (P=0.05)	2.62	3.18	5.40	3.14	0.99	2.23	1.54	1.37	2.13	3.52	2.90	2.04

Table 3. Effect of ingredient combination on Ascorbic acid and NEB of bourbon rose petal jam at ambient storage (Pooled data)

Treatment (w/w)	Ambient storage duration (days)							
	Ascorbic acid (mg/100g)				Non enzymatic browning (NEB)			
	0	30	60	90	0	30	60	90
T_1 : ROSE PETAL + SUGAR (1:0.75)	20.35	16.66	13.34	13.34	0.620	0.620	0.650	0.680
T_2: ROSE PETAL + SUGAR (1:1)	19.08	16.40	13.47	13.47	0.610	0.630	0.640	0.660
T_3 : ROSE PETAL + SUGAR (1:1.25)	18.23	14.46	12.78	12.78	0.600	0.620	0.630	0.650
T_4 :ROSE PETAL + HONEY (1:0.75)	17.80	14.75	12.64	12.64	0.590	0.620	0.620	0.650
T_5 :ROSE PETAL + HONEY (1:1)	16.53	14.54	11.66	11.66	0.600	0.620	0.640	0.670
T_6 :ROSE PETAL + HONEY (1:1.25)	15.26	15.74	9.84	9.84	0.610	0.630	0.650	0.650
T_7 :ROSE PETAL + SUGAR CANDY (1:0.75)	13.56	10.74	8.14	8.14	0.730	0.720	0.750	0.769
T_8:ROSE PETAL + SUGAR CANDY (1:1)	13.14	10.48	8.28	8.28	0.720	0.730	0.760	0.780
T_9 :ROSE PETAL + SUGAR CANDY (1:1.25)	13.99	10.96	9.20	9.20	0.740	0.760	0.761	0.800
T_{10} :ROSE PETAL + JAGGERY (1:0.75)	17.38	14.85	11.47	11.47	0.760	0.770	0.790	0.810
T_{11} :ROSE PETAL + JAGGERY (1:1)	16.96	13.56	10.85	10.85	0.760	0.780	0.800	0.820
T_{12} :ROSE PETAL + JAGGERY (1:1.25)	16.11	13.75	11.25	11.25	0.790	0.820	0.830	0.850
C.D. (P=0.05)	0.81	1.91	0.81	0.66	0.03	0.04	0.04	0.04

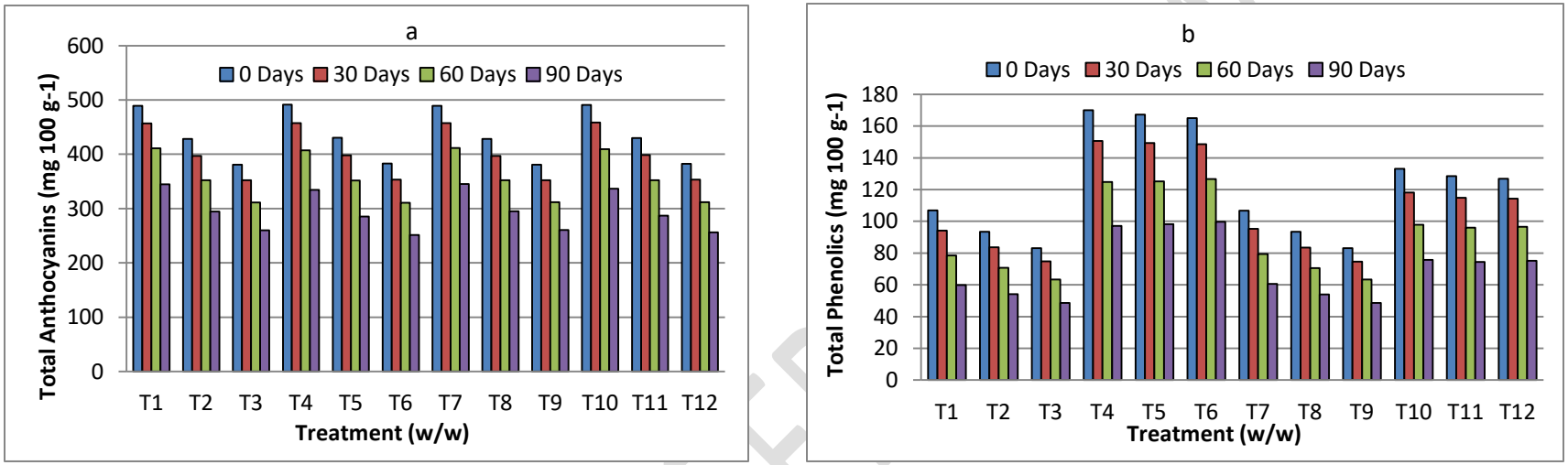
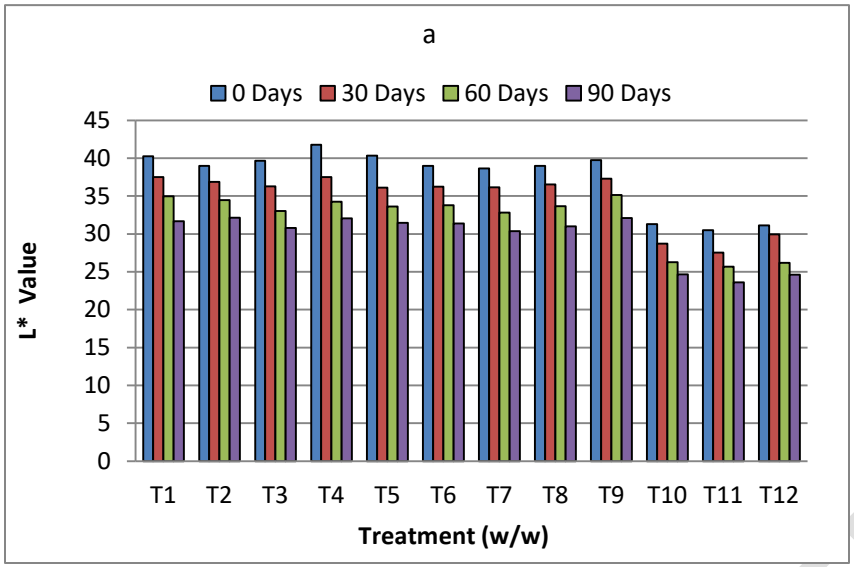
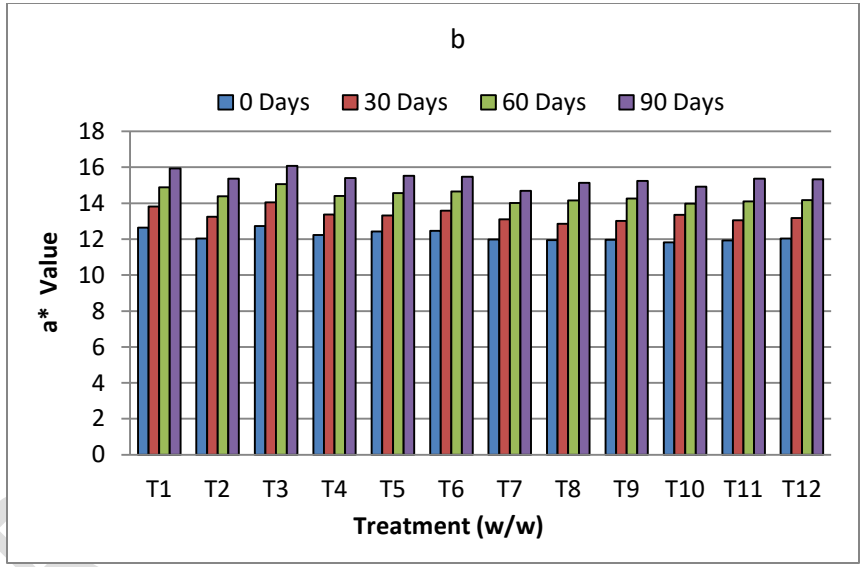


Fig 1. Effect of ingredient combination on (a) total anthocyanins and (b) total phenolics content of bourbon rose petal jam at ambient storage





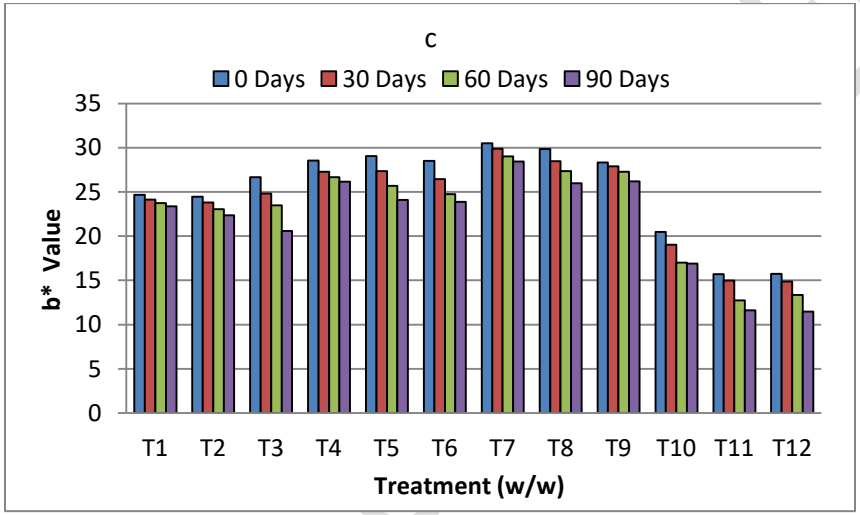


Fig 2. Effect of ingredient combination on (a) *L* *value (b) *a* *value (c) *b* *value of bourbon rose petal jam at ambient storage