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Effect of some chemical preservatives and storage condition on phytochemical components and antioxidant activity of some fruit pulp

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Abstract

The aim of this study was to evaluate the effect of some chemical preservatives such as sodium benzoate (SB), potassium sorbate (PS) and citric acid (CA) on phytochemical components and antioxidant activity for mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃). The phytochemical constituents such as total phenolic content, total Flavonoids, vitamin C, β-carotene were assessed the level of their concentrations for examine their antioxidant activity. In general, chemical preservatives (sodium benzoate, potassium sorbate, and citric acid) noticed that extend the storage period of fruit pulp products. All fruit pulp samples under study were capable of scavenging activity DPPH. They showed a wide range 6.98-91.68% scavenging effects. The wide range and difference in antioxidant activity could be due to the different extractability of the antioxidant compounds were found in fruit pulp samples. It is important to note that the antioxidant activities were relatively correlated with the total phenolic contents and ascorbic acid. Phytochemical components and antioxidant activity were showed that significantly ($p<0.05$) decreased in all treatments during storage period. Guava pulp showed the highest antioxidant activity, total phenolic and ascorbic acid contents. On the other side, mango pulp showed the highest total flavonoids and β-carotene, while apricot pulp showed the lowest in phytochemical components and antioxidant activity. Thus, chemical preservatives (sodium benzoate, potassium sorbate, and citric acid) were used to extend the storage period and maintain the quality of the products.

Keywords: fruit pulp, chemical preservatives, sodium benzoate, potassium sorbate, citric acid.

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1. Introduction

Fruits are among the most important foods of mankind as they are not only nutritive but are also indispensable for the maintenance of health. Fruits both in fresh as well as in processed form not only improve the quality of our diet but also provide essential ingredients like vitamins, minerals, carbohydrates etc. (Marak, 2018). Also, Fruits and vegetables are rich sources of several bioactive compounds which have many health promoting effects, in addition to vitamins and minerals (Singh *et al*., 2016). A large number of studies showed that the intake of fruits and vegetables is helpful to reduce the incidence of cardiovascular, cerebrovascular diseases and tumors, which are closely related to the antioxidant function of active substances in fruits (Kaul *et al*., 2007; Pandey and Rizvi, 2009; Silalahi, 2002). Antioxidants have been confirmed to include phenolic metabolites, carotenoids and vitamin C (Vc) (Kaul *et al*., 2007). Post-harvest losses occur around 22 % (Bons and Dhawan, 2006). Fruit and vegetables can be preserved through processing and the use of preservatives. There are many pathways that lead to the deterioration of fruit juices. However, many effective preservation methods can combat spoilage and waste (Olurankinse, 2014). Prevention of the food spoilage due to microbial attack is done by using the chemical preservatives. Chemicals show better effect when use in different combinations and concentrations for the control of microbial growth however no preservative on its own is absolutely efficient against the entire microorganisms (Marak, 2018). Chemical preservation is the most economical method among the other preservation techniques (Islam, 1986; Younis *et al*., 2011). As a food additive, Potassium sorbate is found in many products (soft drinks and juices, apple cider, baked goods, canned fruits and vegetables, cheeses, dried meats and fruits, ice cream, pickles, wine, yogurt, etc. (Ahmed *et al*., 2021). Citric acid is used as a flavoring, a preservative, an acidulant, and to provide pH control in foods and beverages (Sweis and Cressey, 2018). It is applied in foods such as cookies, cake, ready sauces, cheese, baby foods, chewing gum, fizzy lemonade, margarine, juice and drinks (Türkoğlu, 2007). Food and Drug Administration (FDA) and The European Food Safety Authority (EFSA) have established that sodium benzoate, potassium sorbate, and citric acid are “Generally Recognized as Safe” (GRAS). Usually, potassium sorbate ingests as a food additive, it passes through our digestive system harmlessly as water and carbon dioxide (Dehghan *et al*., 2018). It does not accumulate in our bodies (Deshpande, 2002). Considering the effectiveness of sodium benzoate, potassium sorbate, and citric acid have been used in this study to preserve the mango, guava, apricot pulp. Mango (*Mangifera indica* L.) from Anacardiaceae family is one of the most widely used fruits due to its unique taste, attractive color, flavor, affordability and nutritional qualities. It is a rich source of vitamins, organic acids, carbohydrates, amino acids, phenolic acids (such as gallic acid, caffeic acid, tannic acid) and certain Volatile compounds (Pino *et al*., 2005). Due to the presence of phenolic acids in mango, so many pharmacological properties are attributed to it, because this compound has a strong antioxidant activity that plays an important role in human nutrition (Chiou *et al*., 2007). In general, mango pulp is used in the manufacture of beverages, sweets and dairy products, and partially processed mango is used as an industrial raw material applicable throughout the year as a basis to produce nectar and other beverages (Sakhale *et al.*, 2012). Guava (*Psidium guajava*) is one of the most glorious fruits and the most valuable in terms of nutritional value. It is famous for its low price, nutritional importance, pleasant aroma and taste (Rehman and Muhammad, 2020). Guava fruit is a vital source of vitamins, minerals, antioxidants and dietary fibres (Adrees *et al*., 2010; Hassimotto *et al*., 2005). Guavas are mainly used in fresh fruit as dessert because of their pleasant aroma, good nutritional profile, and availability in cheap excess quantities during the high season reflects a high potential for processing into products with nutritional and health benefits. It is the best way for further use to prepare a number of products such as guava drinks, dried products, jams and products mixed with other fruits (Rehman and Muhammad, 2020). The best way to reduce post-harvest losses is to process surplus guava fruits into different products (Bons and Dhawan, 2013). Apricot known botanically as *Prunus armeniaca* is an important member of the *Rosaceae* family. Apricots are considered to be one of the most delicious temperate fruits (Bhat *et al*., 2002). Apricot has an important place in human nutrition, as It is a rich source of sugars, fiber, minerals, bioactive phytochemicals, vitamins A and C, thiamine, riboflavin, niacin and pantothenic acid (Leccese *et al*., 2007). Regardless of its nutritional properties. The apricot fruit also has some medicinal importance due to its high amount of antioxidants (Wani *et al*., 2015). Apricots can be used as fresh, dried or processed fruits such as frozen apricots, jams, jellies, jams, pulp, juice, nectar, extrusion products, etc. Moreover. Apricot kernels are used in the production of oils, cosmetics, activated carbon, and aroma perfume (Janatizadeh *et al*., 2008). The aim of this study was to evaluate the effect of some chemical preservatives such as sodium benzoate (SB), potassium sorbate (PS) and citric acid (CA) on phytochemical components and antioxidant activity for mango, guava and apricot pulp during storage period (210 days) at ambient temperature (25±4 ^{o}C).

2. Materials and methods

2.1 Materials

2.1.1 Collecting of fruits

This study was carried out on fruits of three fruit varieties; mango (*Mangifera indica* L.), guava (*Psidium guajava*) and apricot (*Prunus armeniaca*). Fruit samples were obtained from Assiut local market, Egypt. All studied fruit samples were collected during the 2020 season.

2.1.2 Chemical and reagents

All the chemicals and reagents used in analytical methods were obtained from El-Gomhouria Trading Chemicals and Drugs, Assiut city, Egypt. The distilled water was used for the preparation of all solutions.

2.2 Methods

2.2.1 Preparation of pulp

The fruit was cleaned with tap water, and pulp was produced using a mixing machine. Pulp was stored at ambient temperature (27±4 ℃).

2.2.1.1 Extraction of pulps

Fully ripe mango, guava and apricot fruits were selected and washed properly with running tap water to remove any adhering foreign matter. The peel and stone were removed and cut into pieces using a stainless knife. The pulp was blended properly in mixer and strained out to get fine pulp.

2.2.1.2 Treatments

Then different preservatives (sodium benzoate, potassium sorbate, and citric acid) were added to pulps (per kg). Following are the treatments combinations:

Treatments	Additives
Control	Pulp fruit without additives
Treatment1	Sodium benzoate 1g
Treatment 2	3g citric acid + 2 g potassium sorbate
Treatment 3	3g citric acid + 3 g potassium sorbate
Treatment 4	4g citric acid + 3 g potassium sorbate
Treatment 5	4g citric acid + 4 g potassium sorbate

2.2.1.3 Pasteurization

The prepared pulps were pasteurized using a water bath at a temperature of 82 ±2 for 30 minutes.

2.2.1.4 Storage

The pasteurized pulp was filled in pre-sterilized 250ml glass bottles. The bottles were cooled and stored at ambient temperature (25±4 ℃) for analysis and evaluation.

2.2.2 Analytical methods

2.2.2.1 Determination of ascorbic acid using the iodine method

An amount of 400 mg of iodine powder was dissolved in 100 ml of H_2O and then 25 ml of dilute H2SO4 were carefully added to make 0.1 N I2. One ml of 0.1 N I2 equals 8.81mg vitamin C/100ml of pulp and juice fruits. One gram of wheat flour was dissolved in 100 ml of distilled H2O and then boiled and cooled. One ml of pulp fruit was taken and diluted with 25 ml of distilled water, 10 drops of starch solution were added, and the mixture was titrated against 0.1 N I2. The number of ml of 0.1 N I2 was determined, and vitamin C was calculated as follows: Vitamin C (mg/100 g) = number of ml of 0.1 N I2 × 8.81 × 25 (dilution factor) (Elkashif *et al*., 2016).

2.2.2.2 Estimation of total phenol content

The total phenol content of pulp fruit extract was determined by using a UV/VIS spectrophotometer (Shimadzu, Kyoto, Japan) according to Ting *et al*. (1986).

2.2.2.3 Determination of total flavonoid content

The total flavonoids content of pulp fruit extract was determined use a colorimetric method described by Zhishen *et al*. (1999).

2.2.2.4 Determination of free radical scavenging activity using DPPH

Total antioxidant activity of pulp fruit extract was determined following the method of Su *et al*. (2006).

2.2.2.5 Determination of β-carotene content

The β-carotene (µg/100 gm) of pulp fruit extract was determined use a spectrophotometer method described by Srivastava and Kumar (2002).
Was measured as follows:

$$\text{B-carotene } (\mu g/100g) = \frac{\text{Optical density x } 13.9 \text{ x} 10^4 \text{ x } 100}{560 \text{ x Weight of the sample x } 1000} \times 100$$

2.2.2.6 Statistical analysis

The experiment was conducted in triplicate for each of the samples. All of the results were presented means. A three-way variance analysis (ANOVA) was conducted to analyze the statistics (Statistix for Windows version 8.1). LSD multiple range tests were also performed at $p \leq 0.05$.

3. Results and Discussion

3.1 Effect of chemical preservatives on ascorbic acid content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 °C)

Data of ascorbic acid content of different pulp samples during storage time at room temperature at (25±4 °C) are shown in Table (1). The results explained that there were significant differences at ($p<0.05$) in the content of vitamin C between the different treatments and the studied fruit varieties during the storage period. Generally, it could be noticed that there were differences between varieties in the conservation of storage periods. The negative control (C) was spoilage after 30 days. Moreover, the ascorbic acid content decreased gradually throughout the storage period. Guava pulp had the highest value for vitamin C content (117.90 mg/100 g) compared to all other varieties. Also, T1 (Control positive) had the highest value for vitamin C, followed by T2 (55.22 and 53.42 mg/100 g, respectively) compared to all other treatments. While, T5 had the lowest content (50.40 mg/100 g). The decrease in ascorbic acid content was due to the oxidation of ascorbic acid to de hydro ascorbic acid and then further degraded to 2, 3-diketo-gluconic acid by the action of ascorbic acid oxidase enzyme. The present study is in agreement with the finding of Bons *et al*. (2011). Kinh *et al*. (2001) who recorded a decrease in ascorbic acid content in apple pulp. Brunini *et al*. (2003) also reported that ascorbic acid content of guava pulp decreased during storage.

Table (1): Effect of chemical preservatives on ascorbic acid content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃).

Variety	Treatment	Storage periods (days)							
		0	30	60	90	120	150	180	210
Mango	C	30.84	26.72	-	-	-	-	-	-
	T1	36.34	26.96	22.76	21.29	19.91	17.99	16.15	13.58
	T2	35.24	26.20	22.76	20.97	19.73	17.99	15.97	13.40
	T3	33.36	25.70	22.23	20.92	19.09	17.80	15.90	12.48
	T4	34.96	25.79	22.30	20.92	19.13	17.99	15.97	13.22
	T5	31.75	25.33	22.21	20.64	19.09	17.48	15.78	11.38
Guava	C	264.30	236.24	-	-	-	-	-	-
	T1	267.60	220.25	192.35	157.30	122.60	70.76	45.52	-
	T2	267.60	214.38	186.39	156.38	105.20	65.34	45.15	-
	T3	265.40	212.45	184.09	155.28	102.00	50.11	43.32	-
	T4	266.50	213.92	184.64	156.38	102.80	52.86	44.05	-
	T5	264.30	211.35	182.72	154.54	101.70	49.19	42.58	-
Apricot	C	12.11	7.89	-	-	-	-	-	-
	T1	14.32	13.40	12.77	11.89	11.23	10.35	-	-
	T2	13.22	12.60	11.89	11.23	10.57	9.91	-	-
	T3	11.01	9.91	8.81	7.71	6.61	5.51	-	-
	T4	12.11	11.00	9.91	8.81	7.71	6.61	-	-
	T5	8.81	7.93	7.05	6.17	5.29	4.41	-	-
F.A	Mango			Guava			Apricot		
	18.88			117.86			6.43		
F.B	C		T_1	T_2	T_3	T_4		T_5	
	24.09		55.22	53.42	51.24	51.98		50.40	
F.C	0		30	60	90	120	150	180	210
	103.88		84.89	60.72	51.69	37.37	23.02	16.69	3.56
LSD (0.05)	A = 0.1441, B= 0.2038, C= 0.2353, AB= 0.3529, AC= 0.4075, BC= 0.5763, ABC= 0.9983								

C: (control) pulp fruit and orange juice without addition. T_1: (treatment 1) Sodium benzoate 1g. T_2: (treatment 2) 3g citric acid + 2g potassium sorbate. T_3: (treatment 3) 3g citric acid + 3g potassium sorbate. T_4: (treatment 4) 4g citric acid + 3g potassium sorbate. T_5: (treatment 5) 4g citric acid + 4g potassium sorbate.

3.2 Effect of chemical preservatives on Total phenolic content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃)

Data in Table (2) showed that total phenolic content of all stored mango, guava and apricot pulp decreased during storage period at ambient temperature (25±4 ℃). The results cleared that, total phenolic compounds of preserved pulp were significantly affected ($p<0.05$) by the storage period and treatments for all varieties. Guava pulp had the highest mean value of total phenol content (100.53 mg/100 g) compared to all other fruit cultivars. Also, T1 (Control positive) recorded the highest mean value of total phenol content, flawed by T2 (67.35 mg/100 g, respectively) compared to other treatments. While T5 recorded the lowest mean value (61.75 mg/100 g) of total phenol content. The results are similar to the study of Walkowiak-Tomczak (2007) who found a decrease of phenolic contents in fruit pulp juices with six months of storage. He discussed in his report that a decline in total phenolic content might be due to an increment in temperature and oxygen during the storage period of six months. Mgaya-Kilima *et al*. (2014) concluded a decrease in total phenolic compounds of Roselle fruit juice blends stored at 28°C for 6 months.

Table (2): Effect of chemical preservatives on total phenolic content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃).

Variety	Treatment	Storage periods(days)							
		0	30	60	90	120	150	180	210
Mango	C	86.30	57.35	-	-	-	-	-	-
	T1	113.59	87.42	72.38	66.26	60.69	57.91	47.88	32.85
	T2	101.89	88.53	73.5	67.37	61.25	57.91	47.88	36.19
	T3	98.55	82.41	71.83	65.15	60.69	57.35	46.21	26.73
	T4	100.22	86.30	73.50	67.37	61.8	57.91	46.21	30.07
	T5	97.44	81.29	71.83	65.15	60.69	56.79	42.87	26.17
Guava	C	275.06	165.33	-	-	-	-	-	-
	T1	205.46	169.82	149.22	130.85	109.13	83.52	64.03	-
	T2	193.21	165.09	143.65	133.08	108.02	90.2	68.35	-
	T3	182.63	162.59	138.36	127.51	103.01	83.52	59.02	-
	T4	183.19	163.14	142.54	129.18	108.02	87.97	64.03	-
	T5	181.52	162.03	137.53	122.77	102.73	82.68	47.33	-
Apricot	C	35.91	33.18	-	-	-	-	-	-
	T1	47.88	35.08	28.95	23.94	17.82	11.69	-	-
	T2	45.10	34.24	30.07	23.39	18.37	11.14	-	-
	T3	40.65	33.96	27.28	21.16	15.59	9.47	-	-
	T4	43.43	34.24	28.40	22.27	17.82	10.02	-	-
	T5	40.09	32.85	26.73	21.16	15.59	6.68	-	-
F.A	Mango			Guava			Apricot		
	57.33			100.53			17.59		
F.B	C		T₁	T₂		T₃	T₄		T₅
	27.21		67.35	66.60		63.07	64.90		61.75
F.C	0	30	60	90	120	150	180	210	
	115.12	93.05	67.54	60.37	51.18	42.49	29.66	8.44	
LSD (0.05)	A = 0.3841, B= 0.5433, C= 0.6273, AB= 0.9410, AC= 1.0865, BC= 1.5366, ABC= 2.6615								

C: (control) pulp fruit and orange juice without addition. T_1: (treatment 1) Sodium benzoate 1g. T_2: (treatment 2) 3g citric acid + 2g potassium sorbate. T_3: (treatment 3) 3g citric acid + 3g potassium sorbate. T_4: (treatment 4) 4g citric acid + 3g potassium sorbate. T_5: (treatment 5) 4g citric acid + 4g potassium sorbate.

3.3 Effect of chemical preservatives on Total flavonoid content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃)

Data in Table (3) showed that the total flavonoid count of all mango, guava and apricot pulp samples decreased during storage time at room temperature (25±4 ℃). The results indicated that, there were a significant differences ($p<0.05$) in the total flavonoid count of preserved pulp. Mango pulp had the highest mean value of flavonoid content (2.60 mg/100 g) compared to all other studied varieties. It was also observed that T_1 (Control positive**)** were the highest mean value, followed by T2 (2.05 and 2.04 mg/100 g, respectively) compared to all other treatment. While T5 the lowest mean value (1.92 mg/100 g) of flavonoids content. These results are consistent with Oszmiański and Wojdyło (2009) who found a loss from 37.28 to 50.50% of flavanols in apple juice after 6 months storage at 30°C. Flavonoid content of all samples diminished throughout the storage period. The reduction of flavonoid content could be due to the oxidative cleavage of phenolic compounds and their protein polymerization may also result in the reduction of flavonoid content during storage (Huang *et al*., 2015).

Table (3): Effect of chemical preservatives on total flavonoid content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 °C).

Variety	Treatment	Storage periods(days)							
		0	30	60	90	120	150	180	210
Mango	C	4.67	4.46	-	-	-	-	-	-
	T1	4.77	3.96	3.27	2.86	2.51	2.3	2.12	1.88
	T2	4.73	3.85	3.33	2.86	2.58	2.36	2.15	1.91
	T3	4.56	3.73	3.14	2.77	2.49	2.24	2.09	1.85
	T4	4.58	3.74	3.20	2.77	2.50	2.30	2.10	1.85
	T5	4.40	3.69	3.06	2.77	2.47	2.24	2.08	1.78
Guava	C	3.44	2.56	-	-	-	-	-	-
	T1	3.43	2.58	2.07	1.88	1.78	1.68	1.56	-
	T2	3.25	2.66	2.06	1.88	1.79	1.68	1.56	-
	T3	3.08	2.48	2.02	1.88	1.78	1.66	1.39	-
	T4	3.12	2.56	2.04	1.88	1.79	1.68	1.5	-
	T5	3.02	2.27	2.02	1.88	1.76	1.65	1.37	-
Apricot	C	1.84	1.45	-	-	-	-	-	-
	T1	2.77	2.10	1.65	1.42	1.36	1.20	-	-
	T2	2.61	2.08	1.61	1.41	1.37	1.23	-	-
	T3	2.51	2.01	1.58	1.41	1.32	1.13	-	-
	T4	2.55	2.08	1.61	1.41	1.34	1.13	-	-
	T5	2.43	1.93	1.57	1.4	1.32	1.05	-	-

F.A= A varieties	Mango	Guava	Apricot
	2.60	1.64	1.12

F.B = Treatments	C	T_1	T_2	T_3	T_4	T_5
	0.77	2.05	2.04	1.96	1.99	1.92

F.C= Storage periods	0	30	60	90	120	150	180	210
	3.43	2.79	1.90	1.69	1.57	1.42	1.00	0.51

LSD 0.05	A = 0.0143, B= 0.0203, C= 0.0234, AB= 0.0351, AC= 0.0405, BC= 0.0573, ABC= 0.0993

C: (control) pulp fruit and orange juice without addition. T_1: (treatment 1) Sodium benzoate 1g. T_2: (treatment 2) 3g citric acid + 2g potassium sorbate. T_3: (treatment 3) 3g citric acid + 3g potassium sorbate. T_4: (treatment 4) 4g citric acid + 3g potassium sorbate. T_5: (treatment 5) 4g citric acid + 4g potassium sorbate.

3.4 Effect of chemical preservatives on Antioxidant activity of mango, guava and apricot pulp during storage period at ambient temperature (25±4 °C)

Data in Table (4) revealed that the antioxidant activity of all stored mango, guava and apricot pulp gradually decreased during the storage period at room temperature (25±4 °C). The results showed that there are significant differences at ($p<0.05$) between treatments and varieties during storage. Guava pulp had the highest value of antioxidant activity (44.53%) compared to all other cultivars. It is important to note that the antioxidant activities were relatively correlated with the total phenolic contents and Ascorbic acid (Table 2 and 3).

Table (4): Effect of chemical preservatives on antioxidant activity of mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃).

Variety	Treatment	Storage periods (days)							
		0	30	60	90	120	150	180	210
Mango	C	52.51	40.15	-	-	-	-	-	-
	T1	50.87	44.31	38.45	32.68	26.82	20.69	14.74	8.749
	T2	50.09	39.05	32.15	28.38	26.17	25.35	21.3	10.46
	T3	49.38	35.91	31.49	27.28	26.06	24.72	18.77	4.422
	T4	49.49	36.42	31.65	27.42	26.14	24.82	20.49	5.995
	T5	47.13	35.47	30.6	27.08	26.05	24.29	18.59	3.274
Guava	C	91.68	78.62	-	-	-	-	-	-
	T1	88.99	78.97	68.69	53.39	48.68	39.26	23.65	-
	T2	86.44	77.64	69.47	53.76	48.34	39.54	28.29	-
	T3	84.72	76.73	66.26	52.98	46.42	38.64	22.47	-
	T4	85.73	77.64	68.12	53.27	46.79	38.7	23.48	-
	T5	83.90	76.71	61.23	52.71	44.9	38.59	21.97	-
Apricot	C	9.2١	7.293	-	-	-	-	-	-
	T1	9.27	6.78	5.69	4.66	3.89	2.84	-	-
	T2	8.57	6.86	5.09	4.53	4.04	2.89	-	-
	T3	7.38	5.61	4.86	4.35	3.68	2.69	-	-
	T4	8.34	5.88	4.92	4.38	4٠٠.	2.82	-	-
	T5	6.98	5.48	4.74	4.23	3.63	2.19	-	-
F.A= A varieties	Mango			Guava			Apricot		
	25.33			44.53			3.50		
F.B = Treatments	C		T_1	T_2	T_3	T_4	T_5		
	11.64		28.00	27.85	26.45	26.94	25.82		
F.C=Storage periods		0	30	60	90	120	150	180	210
		48.37	40.86	29.08	23.95	21.42	18.22	11.88	1.83
LSD 0.05	A = 0.1529, B= 0.2162, C= 0.2497, AB= 0.3745, AC= 0.4325, BC= 0.6116, ABC= 1.0593								

C: (control) pulp fruit and orange juice without addition. T_1: (treatment 1) Sodium benzoate 1g. T_2: (treatment 2) 3g citric acid + 2g potassium sorbate. T_3: (treatment 3) 3g citric acid + 3g potassium sorbate. T_4: (treatment 4) 4g citric acid + 3g potassium sorbate. T_5: (treatment 5) 4g citric acid + 4g potassium sorbate.

In addition, treatment T1 (Control positive) had the highest value of antioxidant activity, flawed by T2 (28.00 and 27.85%, respectively) compared to all other treatments. While, T5 had the lowest value (25.82 %) of antioxidant activity. These results are in line with the outcomes of Ali and Muhammad (2021) who observed a decline in antioxidant activity of mango loquat blended pulp at ambient conditions (25±2ºC) for six months with twenty days interval. The decrease in antioxidant activity is related to oxygen and free radicals which protect the juice from oxidation and these compounds get oxidized by reacting themselves with oxygen (Ismail *et al.*, 2004). Prabal *et al.* (2018) observed a decline in antioxidant activity of fruit pulp during three months of the storage period.

3.5 Effect of chemical preservatives on β-carotene content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃)

Data pertaining to the effect of chemical preservatives at various treatments on the content of β-carotene as presented in Table (5) showed that there was decrease in β-carotene content of the samples during storage period at room temperature (25±4 ℃) in all the treatments for all varieties. The results revealed that there are significant differences at ($p<0.05$) between all treatments for all studied fruit cultivars during the storage period. Mango pulp achieved the highest mean value for β-carotene content (194.19 µg/100 g) compared to all other varieties.

Table (5): Effect of chemical preservatives on β-carotene content of mango, guava and apricot pulp during storage period at ambient temperature (25±4 ℃).

Variety	Treatment	Storage periods(days)							
		0	30	60	90	120	150	180	210
Mango	C	668.94	384.73	-	-	-	-	-	-
	T1	515.79	359.91	273.04	203.54	126.59	71.32	56.59	43.02
	T2	580.82	382.75	286.69	208.5	134.04	76.12	57.42	46.00
	T3	488.98	350.48	260.63	193.61	121.63	71.32	55.60	40.38
	T4	544.42	359.91	285.78	208.5	131.55	74.30	57.09	44.35
	T5	488.98	345.02	253.18	191.13	117.65	67.35	54.11	39.55
Guava	C	225.88	193.32	-	-	-	-	-	-
	T1	378.53	181.82	55.48	34.50	20.52	10.30	3.23	-
	T2	495.19	205.19	74.71	39.71	21.84	11.91	5.96	-
	T3	302.20	162.17	54.61	33.10	19.36	9.93	0.50	-
	T4	394.66	183.68	70.66	36.65	20.52	11.58	5.46	-
	T5	266.83	151.41	54.61	32.93	18.99	9.929	0.50	-
Apricot	C	96.97	63.53	-	-	-	-	-	-
	T1	70.49	57.75	50.14	42.86	35.08	26.48	-	-
	T2	72.81	61.72	52.46	43.69	35.58	27.63	-	-
	T3	68.34	57.59	49.31	40.71	33.76	25.65	-	-
	T4	71.32	61.23	50.47	43.52	35.25	27.14	-	-
	T5	67.85	56.76	48.82	40.05	33.76	24.66	-	-
F.A	Mango			Guava			Apricot		
	194.19			79.13			32.78		
F.B	C		T_1	T_2	T_3	T_4		T_5	
	68.06		109.04	121.70	101.66	113.25		98.50	
F.C	0	30	60	90	120	150	180		210
	322.17	201.05	106.70	77.39	50.34	30.31	16.47		11.85
LSD (0.05)	A = 0.8827, B= 1.2483, C= 1.4414, AB= 2.1621, AC= 2.4966, BC= 3.5307, ABC= 6.1154								

C: (control) pulp fruit and orange juice without addition. T_1: (treatment 1) Sodium benzoate 1g. T_2: (treatment 2) 3g citric acid + 2g potassium sorbate. T_3: (treatment 3) 3g citric acid + 3g potassium sorbate. T_4: (treatment 4) 4g citric acid + 3g potassium sorbate. T_5: (treatment 5) 4g citric acid + 4g potassium sorbate.

T2 treatment had the highest mean value, flawed by T1 (121.70 and 109.04 µg/100 g, respectively) for carotene content. While, T5 had the lowest mean value (98.50 µg/100 g) of β-carotene content. The loss in the retention of β-carotene might be due to oxidation. These results agree with the findings of Sethi and Anand (1983) in carrot preserve. Saini and Pal (1997) reported that total carotenoids content of stored kinnow juice decreased in all the treatments.

4. Conclusion

The pulp of mango, guava and apricot treated with preservatives (SB, PS and CA) retained more bioactive compounds (total phenols, vitamin C, flavonoids, antioxidant activity and beta-carotene) than the unprocessed. It is recommended to use lower concentrations of preservatives (T1, T2 and T3). The treated pulp did not prevent a decrease in the content of bioactive compounds during storage than the untreated at the end of the storage period. The shelf life of processed pulp (SB, PS and CA) can be increased by preserving the bioactive compounds. Possibility to combine preservatives (PS and CA) when processing pulp.

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