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Influence of Pretreatments and Prepackaging on Post Harvest Shelf Life of Underutilized Fruits (Star Fruit, Egg Fruit and Fig)

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Abstract

The effect of prepackaging (1 percent vented High Density Polyethylene (200 gauge) bag) and pretreatments (1.5 percent potassium metabisulphite (KMS) solution (T_1) and 2 percent sodium chloride (NaCl) and calcium chloride ($CaCl_2$) solution (T_2) on physiological loss in weight (PLW), total soluble solids (TSS), pH, titratable acidity, firmness and colour (L* a* b*) of star fruit, egg fruit and fig was studied during storage in ambient (R_1) and refrigeration (R_2) conditions (4±1 °C). The experimental results indicated that a decrease in titratable acidity, fruit firmness, increase in pH and total soluble solids (TSS) content under both pretreatments and storage conditions. The pretreatment (T_2) however extended star fruit and egg fruit marketable life with lowest PLW (8.04% and 4.52%) and physico-chemical constituents up till the 22th and 16th days at ambient temperature and more than 25th (7.47%) and 20th (3.40%) days under refrigeration condition. This might be due to the pretreatment with 2 percent NaCl and $CaCl_2$ solution which delayed fruits ripening periods during storage. Whereas the fig pretreated with T_1 had better shelf life (4 days) with respect to physical properties during storage at refrigeration temperature than control. The results of the study indicated that pretreatments T_2 and T_1 found to be better for improving the shelf life of star fruit (25 days), egg fruit (20 days) and fig (4 days) under room and refrigerated storage.

Keywords: Underutilized Fruits, Pretreatments, Prepackaging, Storage Temperatures, Shelf Life.

1. Introduction

Consumption of various types of fruit provides excellent health benefits because they are a good source of phytochemicals and prevent many diseases. A number of epidemiological studies have found that fruit and vegetable consumption is associated with health benefits, such as reducing the risk of cardiovascular diseases and cancer [1–2]. India is known for its diverse tropical and sub-tropical agro-climatic conditions, which are conducive to grow various types of fruits and vegetables. India stands second (27.8 million metric tones) in fruit production after China. It is also observed that in the country large numbers of minor fruits are being produced to the extent of 5.53 million metric tones. Some of the important fruits in this category are Fig (*Ficus carica*), Amla (*Emblica officinalis*), Star fruit (*Averrhoa carambola*), Beal (*Aegle marmalos*), Ber (*Zizyphus mauritiana*), Cashew (*Anacardium occidentale*), Egg fruit (*Pouteria campechiana*), Jackfruit (*Artocarpus heterophylus*) and Custard apple (*Anona sqomasa*) etc. Among these the star fruit, egg fruit and fig are the important minor fruits and have been attributed to possess several medicinal properties [3]. Star fruit (*Averrhoa carambola*) belongs to the family Oxalidaceae and is often called as "Carambola" or "Five

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finger fruit". The star fruit is a good source of reducing sugars, ascorbic acid, minerals (K, Ca, Mg and P) and amino acids (serine, glutamic acid and alanine) [4]. Egg fruit (*Pouteria campechiana*) belongs to the family Sapotaceae. The fruit flesh has the consistency of a hard-boiled egg yolk. So it is often referred to colloquially as "Egg fruit". It is high in carotene content (0.35mg / 100g of pulp) and good sources of vitamin A and niacin [5]. Fig (*Ficus carica*) the plant of genus *Ficus* belonging to the family Moraceae. In India the total area of fig cultivation is about 1500 hectares. In recent years, India exported about 663 metric tonnes figs of value Rs. 49.04 lakhs to many countries [6]. The fresh fig fruit contain energy (337.60–364.70 kcal/100g), potassium (3.82–6.11 g/kg), magnesium (0.11–0.20 g/kg), calcium (78.72–132.80 mg/kg) and 5.58–17.69 mg of sodium /kg [7]. These minor fruits were required to preserved as fresh and make available throughout the year to fulfill the human dietary requirements. As the fruits being living entities, their metabolic activities continue even after harvest. During storage, the produce deteriorates in their quality due to physiological activities such as respiration and loss of moisture. They are vulnerable to microbial spoilage leading to change in their texture, structure, colour and appearance and all these factors individually or in combination affect the shelf life. Therefore the present study was to investigate mainly to extend the shelf life of the produce using appropriate pretreatments and prepackaging and storage temperature.

2. Materials and Methods

2.1 Selection of Fruits

Star fruit, egg fruit and fig were collected from Horticulture Research Station, Tamil Nadu Agricultural University, Thadiyankudisai and Kodaikanal, Tamil Nadu, India. Well developed and matured fruits were harvested and brought to the laboratory. These fruits were subjected to different treatments on the day of harvest and used for further studies.

2.2 Preparation of 1 Percent Ventilation High Density Polyethylene (HDPE) Bag for Prepackaging

The 200 gauge thickness of HDPE bag were purchased from local market and used for prepackaging. The numbers of holes were made according to the length and breadth of the bag and the diameter of the glass tube using the formula

$$= \frac{Effective\ area\ of\ the\ bag}{Area\ of\ the\ hole}$$

These holes were made equidistance from one each other.

2.3 Preparation of Star Fruit, Egg Fruit and Fig for Storage Studies

2.3.1 Pretreatments

Uniformly matured fruits (Star fruit, Egg fruit and Fig) were selected for the experiments. These fruits were washed by running water, pretreated with 1.5 percent potassium metabisulphite (KMS) solution (T_1) and 2 percent sodium chloride (NaCl) and calcium chloride ($CaCl_2$) solution (T_2) for 30 minutes separately. Then the pretreated fruits were surface dried.

2.3.2 Prepackaging

The surface dried fruits were packed in 1 percent vented HDPE (200 gauge) bags and the bags were hot sealed using a heat sealing machine. The storage studies were conducted from the packed samples under ambient (R_1) in the laboratory on the floor of a well ventilated ambient and also in refrigeration (R_2) temperature (4±1°C).

2.3.3 Assessing Physico-chemical Analysis

The stored samples were subjected to analysis viz., physiological loss in weight (PLW), firmness (fruit pressure analyzer), and colour changes in terms of L^* a^* b^* (Lovibond tinto meter). The biochemical analysis like pH [4], TSS and titratable acidity [7], Total sugar, Reducing sugar, and beta-carotene [8], Fat and Fiber [9] were estimated in the pulp.

2.3.4 Statistical Analysis

The data obtained were subjected to statistical analysis to find out the impact of pretreatments (T_1 and T_2), prepackaging and storage temperatures on the shelf life of star fruit, egg fruit and fig. Factorial Completely Randomised Design (FCRD) was applied for the analysis of the study as described by Rangaswamy [10].

3. Results and Discussion

3.1 Proximate Composition

Table 1 shows the results obtained for the chemical analysis of the star fruit, egg fruit and fig. The proximate composition analysis of egg fruit showed higher beta-carotene (3250µg / 100g), total sugar (18.10 percent), reducing sugar (11.54 percent), fat (0.33 percent), TSS (18.4 obx) and pH (5.4) than star fruit and fig. The star fruit was rich in fiber content of 1.99 percent followed by fig (1.74 percent) and egg fruit (0.09 percent). The titratable acidity (0.18 percent), beta-carotene (77.16µg / 100g) and fat (0.05 percent) content of fig was found to be lower than that reported in star fruit and egg fruit.

3.2 Physiological Loss in Weight (PLW) in Percent

PLW is a strong indicator of storage deterioration of fresh produce. Generally the Physiological Loss in Weight (PLW) of star fruit, egg fruit and fig increases progressively during their storage due to respiration and transpiration and this kind of weight loss continues till the fruit attains fully ripened stage. However, the physiological loss in weight (PLW) of the currently tested fruits pretreated with the chemicals (KMS, NaCl and $CaCl_2$) is found to get decreased (Table 2) compared to control during storage at ambient (R_1) and refrigeration (R_2) condition. But the decreasing physiological loss in weight (PLW) was found to be minimum in T_2 pretreated star fruit and egg fruit than T_1. This might be due to surface disinfection, maintenance of cell wall integrity, firmness, reduced respiration rate and lack of substrate availability for respiration. At the same time the fig pretreated with 1.5 percent potassium metabisulphite (KMS) solution (T_1) had better shelf life (4 days) compared to T2 (3 days). This might be due to effective surface disinfection on fig by potassium metabisulphite (KMS) solution. The rate of weight loss was found to be minimum, when all the samples stored in refrigeration (R_2) temperature compared to ambient (R_1) temperature. A similar view was also shared by Ashok Rathod et al. [4] in star fruit pretreated with $CaCl_2$ and this is supported by the findings of Haydar [11] reported that the influence of calcium in maintaining cell wall integrity, firmness and reduced respiration rate during fruit ripening.

3.3 Firmness

The fruit firmness, in general followed a declining trend commensurate with advancement in storage period. The initial firmness of star fruit, egg fruit and fig (Figure 1) were 4.55 Lb force, 3.25 Lb force and 4.60 Lb force respectively. The fruits (star fruit and egg fruit) pretreated with sodium chloride (NaCl) and calcium chloride ($CaCl_2$) solution maintained higher firmness as compared to fruits pretreated with potassium metabisulphite (KMS) solution. Sodium chloride (NaCl) and calcium chloride ($CaCl_2$) pretreated star fruit and egg fruit demonstrated the best effect on maintaining fruit firmness and registered maximum firmness (3.25 Lb force and 1.87 Lb force) as compared to pretreatment T_1 (2.50 Lb force and 1.62 Lb force) and control (3.0 Lb force and 1.50 Lb force). On the other hand, the T_1 pretreated fig had minimum reduction of firmness (4.60

Table 1. Proximate Composition of star fruit, egg fruit and fig

Proximate Composition	Star fruit	Egg fruit	Fig
pH	2.08	5.4	5.27
TSSobrix (% fresh weight)	7.6	18.4	16.2
Titratable acidity (% fresh weight)	1.024	0.51	0.18
Total sugar (%)	7.40	18.1	16.0
Reducing sugar (%)	4.61	11.54	9.84
Fat (% fresh weight)	0.05	0.33	0.05
Fiber (% fresh weight)	1.999	0.09	1.743
Beta- Carotene (µg/ 100 g fresh weight)	184.37	3250.0	77.16

Table 2. Physiological loss in weight (PLW) of Star fruit, Egg fruit and Fig on prepackaging

Fruits	Pretreatments	Physiological loss of weight (%)			
		R_1	Storage life (days)	R_2	Storage life (days)
Star fruit	Control	13.56 ±1.35	13	8.77±1.28	15
	T1	9.14±0.82	17	7.90±0.64	20
	T2	8.04±0.22	22	7.47±0.17	25
Egg fruit	Control	8.13±1.17	10	7.85±1.09	15
	T1	5.26±0.76	15	4.64±0.52	17
	T2	4.52±0.24	16	3.40±0.13	20
Fig	Control	1.92±1.27	1	1.12±1.15	2
	T1	2.26±0.64	3	1.85±0.58	4
	T2	2.82±0.83	2	2.80±0.74	3

T_1 – 1.5 % KMS; T_2 – 2 % $CaCl_2$ + NaCl; R_1 – Room temperature; R_2 – Refrigeration temperature

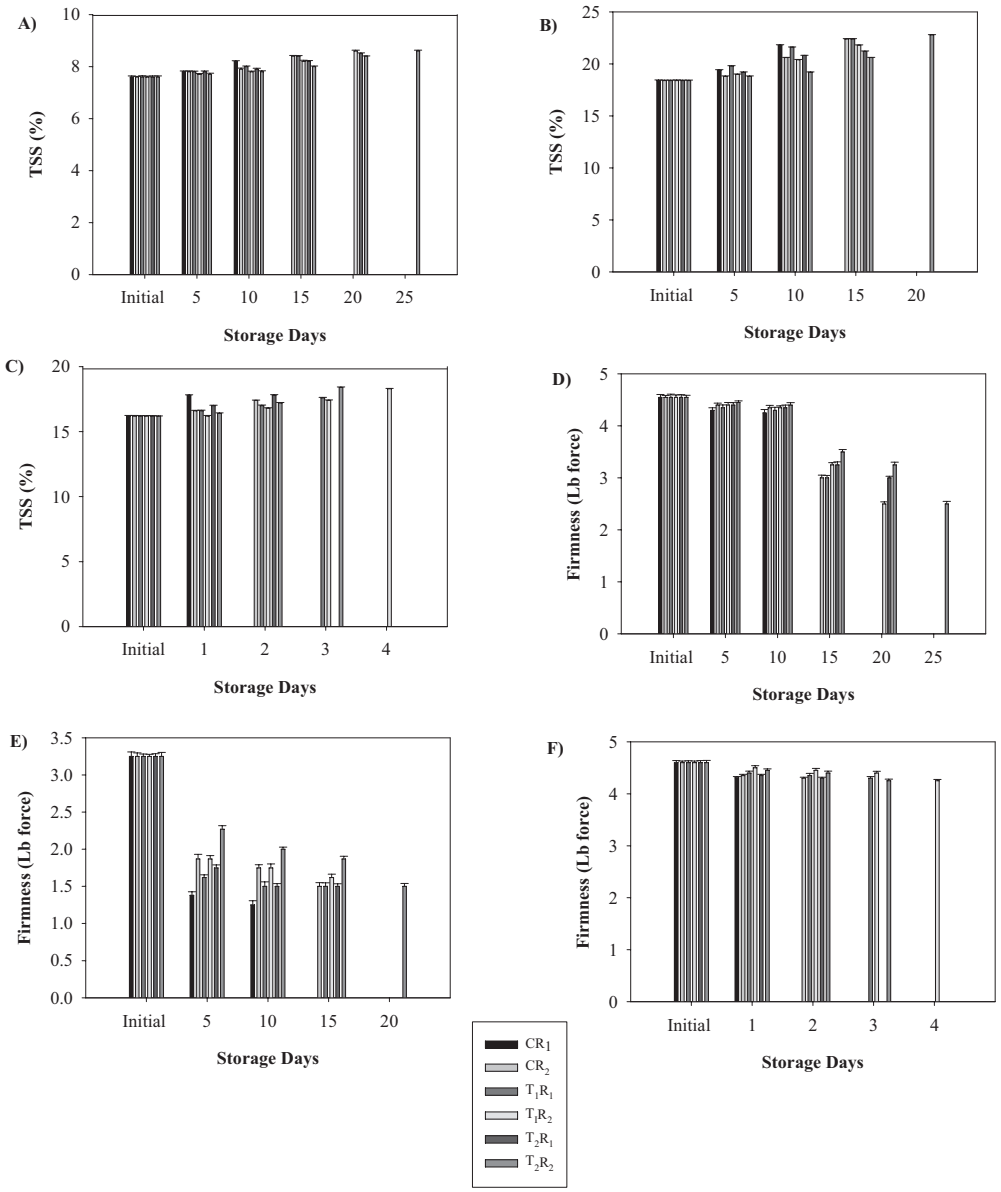

Figure 1. Changes in the TSS (%) and firmness (Lb force) of star fruit (A &D), egg fruit (B&E) and fig (C&F) on prepackaging.

Lb force to 4.25 Lb force) and it gives better shelflife (4 days) than pretreatment T_2 and control. This might be due to effective surface disinfection on fig by potassium metabisulphite (KMS) solution. Overall the pretreatments T_1 and T_2 found best for fig and star fruit and egg fruit during storage at refrigeration temperature than ambient temperature. This might be due to low storage temperature and modified atmosphere inside the package. Statistical analysis revealed that there was significant difference observed between storage condition and storage days and no significant difference was found with respect to their interaction between treatments, storage condition and storage days.

3.4 Colour Value (L^* a^* b^*)

Colour changes in skin is presented as (L^* a^* b^*) in Table 3. Colour of the fruits were measured in lovibond tinto meter where the L^* value represents the lightness of an object on a scale, a^* value represents the red versus green and b^* represents yellow versus blue. The initial L^* a^* b^* values of star

Table 3. Changes in the colour intensity (L^*a^* b^*) of Star fruit, egg fruit and fig on prepackaging

STAR FRUIT									
Treatments		Initial		5th day		15th day		25th day	
		R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
Control	L^*	91.86	91.86	85.30	86.39		84.15		
	a^*	-5.046	-5.046	3.17	2.34	–	3.85	–	–
	b^*	59.76	59.76	79.29	76.18		87.59		
T_1	L^*	91.86	91.86	85.43	87.47	80.96	85.06		
	a^*	-5.046	-5.046	-3.77	-3.27	2.54	1.47	–	–
	b^*	59.76	59.76	76.29	71.19	89.65	79.98		
T_2	L^*	91.86	91.86	90.62	91.75	85.14	87.45		80.92
	a^*	-5.046	-5.046	-4.35	-4.86	2.08	1.18	–	4.75
	b^*	59.76	59.76	65.82	62.95	76.54	74.65		89.56
EGG FRUIT									
Treatments		Initial		5th day		15th day		20th day	
		R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
Control	L^*	119.44	119.44	132.54	154.72		96.32		
	a^*	22.61	22.61	32.67	29.54	–	38.96	–	–
	b^*	75.09	75.09	129.34	112.65		138.57		
T_1	L^*	119.44	119.44	111.56	118.68	99.02	102.63		
	a^*	22.61	22.61	28.42	25.09	36.24	34.81	–	–
	b^*	75.09	75.09	136.15	124.76	136.98	132.76		
T_2	L^*	119.44	119.44	121.56	151.39	99.87	127.68		86.42
	a^*	22.61	22.61	26.31	24.02	30.92	29.47	–	37.63
	b^*	75.09	75.09	117.48	112.46	124.96	130.51		140.95
FIG									
Treatments		Initial		1st day		2nd day		4th day	
		R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
Control	L^*	118.61	118.61	82.17	87.36		80.64		
	a^*	5.68	5.68	7.96	6.53	–	7.82	–	–
	b^*	19.53	19.53	35.28	30.74		35.03		
T1	L^*	118.61	118.61	97.36	107.12	95.48	100.76		92.75
	a^*	5.68	5.68	5.94	5.82	6.08	6.24	–	6.53
	b^*	19.53	19.53	23.89	21.76	25.72	23.66		30.48
T2	L^*	118.61	118.61	94.57	96.47	87.56	91.36		
	a^*	5.68	5.68	5.84	5.78	5.92	6.18	–	–
	b^*	19.53	19.53	22.84	22.17	24.17	24.82		

L^* - lightness; a^* - red versus green; b^* - yellow versus blue

fruit was 91.86, -5.046, 59.75, 119.44, 22.61, 75.09 for egg fruit and 118.61, 5.68, 19.53 for fig. A gradual decrease in L^* values were observed during ripening of fruits in ambient and refrigeration temperature, whereas the a^* and b^* values were increased. The a^* and b^* values are the main indicator of fruit ripening during storage. The minimum increases of a^* and b^* values occurred in T_2, being 4.75 and 89.56 for star fruit, 37.63 and 140.95 for egg fruit at the end of the storage, whereas the least increases of a^* (from 5.68 to 6.53) and b^* (from 19.53 to 30.48) values were observed in T_1 pretreated fig compared to T_2. The experimental results indicated that the star fruit, egg fruit and fig pretreated with T_1 and T_2 delayed fruits ripening during storage in ambient and refrigeration temperature than control.

3.5 Titratable Acidity and pH

The total titratable acidity and pH were presented in Table 4. The pH of the pretreated fruits (star fruit, egg fruit and fig) pulp was found relatively in lesser range (2.08 to 2.24,

Table 4. Changes in the pH and titratable acidity of Star fruit, egg fruit and fig on prepackaging

STAR FRUIT

Storage days	pH						Titratable acidity (% fresh weight)					
	Control		T_1		T_2		Control		T_1		T_2	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
Initial	2.08±0.06	2.08±0.04	2.08±0.03	2.08±0.02	2.08±0.03	2.08±0.02	1.024±0.14	1.024±0.07	1.024±0.12	1.024±0.09	1.024±0.07	1.024±0.05
5	2.24±0.04	2.20±0.03	2.20±0.01	2.14±0.03	2.17±0.02	2.12±0.02	0.83±0.09	0.89±0.05	0.83±0.09	0.89±0.06	0.83±0.05	0.89±0.07
10	2.28±0.02	2.26±0.03	2.28±0.02	2.21±0.02	2.26±0.03	2.19±0.01	0.70±0.06	0.77±0.03	0.77±0.05	0.83±0.04	0.83±0.04	0.89±0.05
15	–	2.30±0.01	2.34±0.02	2.26±0.01	2.32±0.03	2.24±0.04	–	0.64±0.02	0.64±0.04	0.70±0.02	0.70±0.03	0.76±0.06
20	–	–	–	2.34±0.03	2.36±0.04	2.28±0.03	–	–	–	0.57±0.02	0.51±0.03	0.64±0.03
25	–	–	–	–	–	2.42±0.02	–	–	–	–	–	0.38±0.01
Mean	2.20±0.04d	2.21±0.03c	2.22±0.02b	2.22±0.02b	2.20±0.03d	2.23±0.02a	0.85±0.10a	0.83±0.04b	0.81±0.07c	0.80±0.05d	0.77±0.04e	0.76±0.04f
T*R*S = CD: 0.03; SED (p<0.05) 0.02							T*R*S = CD: 0.02; SED (p<0.05) 0.01					

EGG FRUIT

Storage days	pH						Titratable acidity (% fresh weight)					
	Control		T_1		T_2		Control		T_1		T_2	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
Initial	5.40±0.08	5.40±0.06	5.40±0.07	5.40±0.05	5.40±0.06	5.40±0.04	0.51±0.16	0.51±0.10	0.51±0.14	0.51±0.12	0.51±0.09	0.51±0.07
5	6.08±0.06	5.82±0.04	5.73±0.08	5.52±0.04	5.56±0.08	5.48±0.03	0.26±0.09	0.32±0.07	0.26±0.09	0.32±0.06	0.32±0.07	0.38±0.09
10	6.35±0.03	6.04±0.04	5.80±0.04	5.68±0.02	5.64±0.05	5.59±0.01	0.13±0.05	0.19±0.06	0.19±0.10	0.26±0.05	0.19±0.09	0.28±0.05
15	–	6.58±0.02	6.04±0.02	5.94±0.01	6.00±0.03	5.88±0.02	–	0.064±0.04	0.064±0.05	0.19±0.05	0.13±0.06	0.26±0.06
20	–	–	–	–	–	6.18±0.02	–	–	–	–	–	0.13±0.04
Mean	5.94±0.06b	5.96±0.04a	5.74±0.05c	5.63±0.03f	5.65±0.05e	5.70±0.02d	0.30±0.01c	0.27±0.06e	0.25±0.09f	0.32±0.07a	0.28±0.07d	0.31±0.06b
T*R*S = CD: 0.09; SED (p<0.05) 0.04							T*R*S = CD: 0.01; SED (p<0.05) 0.003					

FIG

Storage days	pH						Titratable acidity (% fresh weight)					
	Control		T_1		T_2		Control		T_1		T_2	
	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2	R_1	R_2
Initial	5.27±0.05	5.27±0.03	5.27±0.06	5.27±0.04	5.27±0.05	5.27±0.06	0.18±0.14	0.18±0.08	0.18±0.11	0.18±0.09	0.18±0.12	0.18±0.08
1	5.63±0.02	5.42±0.02	5.34±0.03	5.27±0.06	5.48±0.03	5.40±0.04	0.12±0.06	0.14±0.05	0.15±0.07	0.16±0.07	0.14±0.06	0.16±0.05
2	–	5.87±0.02	5.48±0.04	5.43±0.03	5.52±0.03	5.46±0.02	–	0.10±0.04	0.12±0.09	0.14±0.12	0.10±0.07	0.12±0.07
3	–	–	5.52±0.02	5.56±0.02	–	5.78±0.03	–	–	0.11±0.06	0.12±0.06	–	0.10±0.03
4	–	–	–	5.62±0.02	–	–	–	–	–	0.10±0.04	–	–
Mean	5.45±0.03c	5.52±0.02a	5.40±0.04f	5.43±0.03d	5.42±0.04e	5.47±0.04b	0.15±0.01a	0.14±0.05b	0.14±0.08b	0.14±0.07b	0.14±0.08b	0.14±0.06b
T*R*S = CD: 0.09; SED (p<0.05) 0.04							T*R*S = CD: 0.002; SED (p<0.05) 0.001					

T: Treatments; R: Storage temperature; S: Storage days

Values are mean of three replications. Values followed by different letters are significantly (p<0.05) different from each other.

5.40 to 5.88 and 5.27 to 5.56) as compared to the fruits of control having higher pH (2.30, 6.58 and 5.87) after 15 days storage of star fruit and egg fruit and 3 days storage of fig. The experimental results showed that the pH values of fruits increased with advance in maturity and increasing pH values were minimum in T_2 compared to T_1 and control. The total titratable acidity was expressed in terms of citric acid as percentage on fresh fruit weight basis. The titratable acidity reduced with advances in maturity. A gradual decrease in total titratable acidity was observed in T_2 pretreated star fruit and egg fruit, which decreased to 0.38 and 0.13 on 25th and 20th days of storage at ambient and refrigeration temperatures. Whereas minimum changes of pH (5.62) and titratable acidity (0.10) were observed in T_1 pretreated fig upto 4 days of storage at ambient and refrigeration temperature compared to T_2 and control. Overall the pretreatments (T_1 and T_2) shared better shelf life for star fruit, egg fruit and fig (25, 20 and 4 days) than control (15, 15 and 2 days) during storage. The decrease in the total titratable acidity might be due to increase in total sugar content of the fruits during ripening. Highly significant difference was observed between treatments, storage condition and storage days. Decreasing trend in total titratable acidity is in line with the findings of Avinash et al. [12] who reported that the decrease in total titratable acidity of star fruit during ripening. Narain et al. [13] reported that the pH of carambola fruit was increased from 2.71 to 3.44 with the advances in maturity, whereas the titratable acidity was decreased from 0.98 to 0.62.

3.6 Total Soluble Solids (TSS)

A gradual increase in total soluble solids (TSS) was observed (Fig.1) in star fruit, egg fruit and fig during storage at ambient and refrigeration temperatures. The initial TSS content of star fruit and egg fruit were found to be 7.6^{o}bx and 18.4^{o}bx, which increased slowly to 8.6^{o}bx and 22.8^{o}bx in T_2 compared to T_1 and control during storage. The gradual increasing total soluble solids (TSS) of sodium chloride (NaCl) and calcium chloride ($CaCl_2$) pretreated star fruit and egg fruits were probably due to slowing down of the respiration and metabolic activity. Similar pattern of total soluble solids (TSS) was observed (16.2^{o}bx to 18.3^{o}bx) in T_1 pretreated fig. The increase in TSS might be due to the increase in soluble solids content and total sugars caused by hydrolysis of polysaccharides into simple sugars during storage. Statistical analysis revealed that there was highly significant difference observed between treatments, storage condition and storage days and no significant difference was found with respect to their interaction between treatments and storage condition. Ashok Rathod et al. [4] observed an increase in the total soluble solids (TSS) content from 7.1^{o}bx to 7.8^{o}bx in star fruit during storage at room and refrigeration temperature. Nilda Ersoy et al. [14] reported that the initial soluble solid content (SSC) of fig was 10.47, which was increased to 18.60 during at maturity. The same trend was observed in the present investigation.

4. Conclusion

The study results indicated that 2 percent sodium chloride (NaCl) and calcium chloride ($CaCl_2$) plays a very effective role in controlling physiological loss in weight (PLW) and other compositional changes such as pH, titratable acidity, total soluble solids (TSS), fruit firmness and colour values of star fruit and egg fruit stored at ambient and refrigeration temperatures. The shelf life for star fruit was 25 days and 20 days for egg fruit. This may be due to the combined effect of pretreatment (T_2), low storage temperature and packaging material (200 gauge 1 percent vented HDPE bag) whereas 1.5 percent potassium metabisulphite (KMS) solution pretreated fig had a shelf life of 4 days during storage at ambient and refrigeration temperatures. The pretreatments have delayed the ripening process more effectively and with a minimum quality loss, as compared to the control sample. Finally the experimental results indicated that the shelf life of star fruit, egg fruit and fig can be extended upto 25, 20 and 4 days without excessive deterioration in quality by using appropriate pretreatments (KMS, NaCl and $CaCl_2$), prepackaging (200 gauge HDPE bag with 1 percent ventilation) and storage temperature.

5. References

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