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Research Article

EFFECT OF BIOCHEMICAL PARAMETERS DURING STORAGE OF FIG (*Ficus carica L.*)

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Abstract- Fig is highly perishable subtropical fruit, hence it succumbs to high spoilage due to Bio- chemical changes takes place during the storage. The shelf life of fruit is these reduced at a faster rate. Post harvest treatment of fig with different gauges of polyethylene cover with or without ventilation resulted in extending shelf life of fig and biochemical changes like physiological loss in weight, total sugars, reducing sugars and no reducing sugars found Significant increase in all the treatments during the advancement of storage.

Keywords- Fig, Physiological loss in weight, Total sugars, Reducing sugars, Non reducing sugars.

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Introduction

The ascorbic acid content decreased with increase in processing time, osmotic concentration and temperature for osmodehydrated apples were observed by [5] and might be due to diffusion from the fruit tissue into the osmotic solution during dehydration and losses due to chemical degradation during processing. [6] evaluated OD of sliced fruit of two cultivars of pineapple, Pearl and Smooth Cayenne in invert sugar syrup and found that an increase of about three times TSS of the pineapple slices and no significant differences due to cultivar and temperature of dehydration was noticed. Being highly perishable fruit, fig succumbs to high spoilage due to physicochemical changes taking place in the fruit. The shelf life of fruit is these reduced at a faster rate. Post harvest treatment of fig with different gauges of polyethylene cover with or without ventilation resulted in extending shelf life of fig. [7] studied osmotic concentration kinetics on aonla preserve and reported that total sugar and TSS increased with the increase in sugar syrup concentration and temperature, while moisture and ascorbic acid decreased. In general, dried fruits pre-treated with sucrose, inverted sugar or de-acidified fruit juice had a predominantly sweet taste, while those treated with concentrated apple juice had high acidity [14]. A change of temperature of the sucrose solution from 20 to 60°C had impact on ascorbic acid content and was lost due to heat sensitive reactions, mainly oxidation [20]. Total titratable acidity decreased independently of the pre-treatment time, in apricot cubes pre-treated in sucrose [27]. [28] reported that reducing sugar and total sugar were found higher in osmosed mango slices than in unosmosed slices. According to [4] fruit with high amount of reducing sugar and polypheol oxidase substrates should apply low temperature drying technique. Product saltiness or sweetness increased during osmotic process and the acidity decreased which is not desirable in some cases and this could be avoided by controlling the solute diffusion and optimising the process to improve the sensory properties of the product [29].

Materials and Methods

Physiological loss in weight (%): Each package was weighed regularly using electronic balance until it was judged not suitable for marketing. The cumulative loss in weight was calculated and expressed in percentage. The PLW recorded at the end of shelf life was divided by storage life (days) at 2, 4, 8, and 10 days to get mean PLW per day.

$$PLW(\%) = Initial\ weight - \frac{Final\ weight}{Initial\ weight} * 100$$

Total soluble solids: The total soluble solids (TSS) were determined with the help of hand refractometer and expressed as ºBrix at 20 ºC using reference table for temperature. The TSS of fruit pulp was determined by soaking 10g of pulp in distilled water in 1:2 (product: water) ratio for 4 h and followed by crushing. Filtrate was extracted though cheese cloth and then put on prism of refractometer to record observations. These values were multiplied by dilution factor to represent TSS percentage in fig pulp [26].

Titrable Acidity: The method described by [26] was adopted for estimation of titratable acidity. A weighed amount of fig pulp (crushed to fine particles in mortle and pestel) was transferred to a volumetric flask and the volume was made upto 100 ml with distilled water. After 30 minutes, the suspension was filtered through Whatman No. 1 filter paper and the filtrate was used subsequently. An aliquot [10 ml) was taken from the filtrate and titrated against standard 0.1 N sodium hydroxide using phenolphthalein as an indicator. The titratable acidity was expressed as per cent citric acid by adopting the following formula.

$$\text{Titrable acidity}(\%) = \frac{\text{Titre value X N of NaOH X Volume made up X equivalent weight of citric acid}}{\text{Volume of sample X Weight of sample taken for titration}}$$

Sugars: Sugars were determined by Lane and Eynon Method as detailed by [26]. Invert sugar reduces the copper in Fehling's solution to red, insoluble cuprous oxide. The sugar contents in samples were estimated by determining the volume of the unknown sugar solution required to completely reduce a measured volume of Fehling's solution. Before using, the mixture (1:1) of Fehling's solution A and B (5 ml of each) was standardized against standard glucose for obtaining glucose equivalent and to arrive at a conversion factor.

Reducing Sugars: A weighed amount of the sample was taken in a volumetric flask and two millilitres of 45 % basic lead acetate solution was added for clarification. After 10 minutes, the solution was deleaded by adding potassium oxalate crystals in excess and the volume was made upto a known amount with distilled water and filtered through Whatman No. 1 filter paper. The filtrate was taken in a burette and titrated against boiling Fehling's mixture (5 ml of Fehling's solution A + Fehling's solution 5 ml of B) till the blue colour faded. Then, one ml of methylene blue indicator (1 %) was added and the titration was continued till the contents attained a brick red colour and titre value was noted. The per cent of reducing sugars were calculated according to the following formula:

Total Sugars: For estimation of total sugars, the filtrate obtained during reducing sugars estimation was used. An aliquot from the filtrate was taken and to the one fifth of its volume, hydrochloric acid (1:1) was added and the inversion was carried out at room temperature for 24 hours. Subsequently, the contents were cooled and neutralized with 40 per cent sodium hydroxide using phenolphthalein as indicator and the final volume was made upto 100 ml. The solution was filtered and titrated using filtrate as detailed for reducing sugars. The total sugars were expressed as per cent in terms of invert sugars according to the following formula

$$\text{Reducing sugars (\%)} = \frac{0.05 \text{ X Volume made up}}{\text{Titre value X Weight of sample}}$$

:

$$\text{Total sugars (\%)} = \frac{0.05 \text{ X Volume made up}}{\text{Titre value X 25 X weight of sample}}$$

Non-reducing sugars: The non-reducing sugars in per cent were calculated by multiplying the differences of total and reducing sugars by factor of 0.95. The results were expressed as per cent.

$$\text{Non} - \text{reducing sugars, \%} = (\text{Total sugars, \%} - \text{Reducing sugars, \%}) \times 0.95$$

Results

Physiological Loss in Weight (%)

Significant difference was found in PLW of fig fruits stored in different gauge of polyethylene cover with or without ventilation on 2, 4 and 6 DAS of fruits [Table-1]. After 2 DAS lower PLW of 0.50% was recorded when the fruits were stored in polyethylene cover of 200 gauges with 1% ventilation. This result is on par with the three other treatments *viz.,* storing of fruits in 100 gauge polyethylene cover with 1% ventilation (0.75%), 50 gauge polyethylene cover with 1% ventilation (0.93%) and 100 gauge polyethylene cover without ventilation (0.93%)

The PLW was maximum (1.39%) when fig fruits were stored openly under room condition (control). On 4 DAS of fig fruits minimum PLW was noticed when the fruits were stored in 50 gauge polyethylene cover with 1% ventilation (0.44%). This result is on par with treatments consisting of 200 gauge polythene cover with 1% ventilation (0.57%) and 100 gauge polyethylene cover with 1% ventilation (0.80%). The PLW was maximum (1.72%) when fruits were stored under room condition (control). On 6 DAS of fig fruits, minimum PLW (0.58%) when fruits were stored in 200 gauge polyethylene cover with 1% ventilation. The treatments which are on par with this treatments *viz.* storing fruits in 100 (0.85%) and 50 (1.00%) gauge polyethylene with 1 per cent ventilation. The PLW was maximum (1.77%) when fruits were stored in 200 gauge polyethylene covers without ventilation. On 8 DAS of fruits the observation with respect to PLW was not recorded in both non ventilated covers of all the gauge and 50 gauge polyethylene covers with 1% ventilation. This is due to the fact that the fruits lost their keeping quality. However minimum and maximum PLW of 0.61 and 0.98% were recovered when fruits were stored in 200 gauge polyethylene cover with one per cent ventilation and control treatment.

Table -1 *Effect of different gauge of polyethylene cover (with or without ventilation) on physiological loss in weight (%) of fig fruits during storage*

Treatments		Number of days after storage			
		2	4	6	8
T_1	50 gauge polyethylene cover without ventilation	1.09 (5.86)	1.31 (6.55)	1.67 (7.12)	-
T_2	100 gauge polyethylene cover without ventilation	0.93 (5.46)	1.29 (6.48)	1.37 (6.56)	-
T_3	200 gauge polyethylene cover without ventilation	1.24 (6.36)	1.50 (6.05)	1.77 (7.00)	-
T_4	50 gauge polyethylene cover with 1% ventilation	0.93 (5.48)	0.44 (5.54)	1.00 (5.64)	-
T_5	100 gauge polyethylene cover with 1% ventilation	0.75 (5.26)	0.80 (4.94)	0.85 (5.23)	0.92
T_6	200 gauge polyethylene cover with 1% ventilation	0.50 (4.07)	0.57 (4.53)	0.58 (4.88)	0.61
T_7	Storing of fig fruits in room condition (control)	1.39 (6.75)	1.72 (7.00)	1.69 (7.23)	0.98
	Mean	0.99 (3.75)	1.16 (4.86)	1.26 (5.16)	-
	F test	*	*	*	-
	SEm±	0.19 (0.56)	0.16 (0.39)	0.16 (0.37)	-
	C.D. at 5%	0.58 (1.65)	0. 49 (1.57)	0.48 (1.56)	-
	C.V.(%)	33.22 (16.15)	24.02 (14.16)	21.47 (12.16)	-

*Significant at 5 %

\- Observations were not recorded as the fruits lost their keeping quality

Values in parenthesis are transformed values

Total soluble solids (%)

There was a non significant difference in the total soluble solids content of fig fruits when stored in 2, 4 and 6 DAS in all the three gauges of polyethylene covers studied either with or without ventilation. However, on 2 DAS maximum and minimum TSS of 14.59 per cent and 14.01 per cent was noticed in control and 200 gauge polyethylene cover with 1 per cent ventilation treatments respectively. On 4 DAS maximum (14.73%) and minimum (14.29%) TSS of fruit was noticed when fruits were stored in 200 gauge polyethylene cover without and with 1 per cent ventilation respectively. Similarly on 6 DAS maximum (15.03%) and minimum (14.46%) of TSS was noticed when fruits were stored in 200 gauge polyethylene cover with 1 per cent ventilation and 100 gauge polyethylene cover without ventilation respectively. On 8 DAS the observation with respect to TSS of fruits in 50, 100 and 200 gauge polyethylene covers without ventilation and control was not recorded as fruits lost their keeping quality. On this day maximum and minimum TSS of 15.25 per cent and 15.11 per cent was noticed when fruits were stored in 200 and 50 gauge polyethylene covers with one per cent ventilation respectively [Table-2].

Titratable acidity (%)

There was a significant difference in the titratable acidity content of fig fruits when stored in different gauge of polyethylene covers with or without ventilation on 2, 4 and 6 DAS [Table-3]. On 2 DAS the minimum titratable acidity (0.19%) was recorded when fruits were stored under room condition (control). This result is on par with two other treatments namely storing of fruits in 50 and 100 gauge polyethylene covers without ventilation (0.21%). Maximum titratable acidity of 0.27 per cent was found when fruits were stored in 200 gauge polyethylene cover with 1 per cent ventilation. Similarly on 4 DAS minimum titratable acidity (0.18%) was recorded when fruits were stored in 50 and 100 gauge polyethylene covers without ventilation as well as control treatments. Maximum titratable acidity of 0.24 per cent was noticed in the treatment T_6 i. e. when stored in 200 gauge polyethylene covers with 1 per cent ventilation.

Similarly on 6 DAS the minimum titratable acidity (0.14%) was recorded when fruits were stored under room condition (control). This result is on par with three

other treatments namely, storing of fruits in 50, 100 and 200 gauge polyethylene covers without ventilation (0.15%, 0.15% and 0.17% respectively). On 8 DAS the observation with respect to titratable acidity of fruits in 50, 100 and 200 gauge polyethylene covers without ventilation and control was not recorded as fruits lost their keeping quality. On this day minimum titratable acidity of 0.18 per cent was noticed when fruits were stored in 50 and 100 gauge polyethylene covers with one per cent ventilation and maximum (0.20%) where in fruits were stored in 200 gauge polyethylene covers with 1 per cent ventilation.

Table-2 *Variations in total soluble solids (%) content of fig fruits during storage due to storage in different gauge of polyethylene covers (with or without ventilation)*

Treatments		Number of days after storage			
		2	4	6	8
		Initial value – 14.02			
T_1	50 gauge polyethylene cover without ventilation	14.10	14.61	14.69	-
T_2	100 gauge polyethylene cover without ventilation	14.20	14.33	14.46	-
T_3	200 gauge polyethylene cover without ventilation	14.56	14.73	14.95	-
T_4	50 gauge polyethylene cover with 1 % ventilation	14.38	14.57	14.89	15.11
T_5	100 gauge polyethylene cover with 1 % ventilation	14.12	14.58	15.01	15.20
T_6	200 gauge polyethylene cover with 1 % ventilation	14.01	14.29	15.03	15.25
T_7	Storing of fig fruits in room condition (control)	14.59	14.68	14.80	-
	Mean	14.28	14.54	14.40	-
	F test	NS	NS	NS	-
	SEm±	0.26	0.29	0.29	-
	C.D. at 5%	0.79	0.87	0.87	--
	C.V.(%)	3.15	3.40	3.35	-

NS : Non - Significant

-Observations were not recorded as the fruits lost their keeping quality

Table-3 *Changes in titratable acidity (%) content of fig fruits during storage as influenced by different gauge of polyethylene covers (with or without ventilation)*

Treatments		Number of days after storage			
		2	4	6	8
		Initial value – 0.29			
T_1	50 gauge polyethylene cover without ventilation	0.21	0.18	0.15	-
T_2	100 gauge polyethylene without ventilation	0.21	0.18	0.15	-
T_3	200 gauge polyethylene cover without ventilation	0.23	0.21	0.17	-
T_4	50 gauge polyethylene cover with 1% ventilation	0.24	0.22	0.19	0.18
T_5	100 gauge polyethylene cover with 1% ventilation	0.26	0.23	0.20	0.18
T_6	200 gauge polyethylene cover with 1% ventilation	0.27	0.24	0.23	0.20
T_7	Storing of fig fruits in room condition (control)	0.19	0.18	0.14	-
	Mean	0.23	0.21	0.17	-
	F test	*	*	*	-
	SEm±	0.01	0.01	0.01	-
	C.D. at 5%	0.02	0.02	0.24	-
	C.V. (%)	4.08	5.38	7.53	-

* Significant at 5 %; - Observations were not recorded as the fruits lost their keeping quality

Total sugars (%)

There was a significant difference in the total sugars content of fig fruits when stored in polyethylene covers of different gauge on 2nd, 4th as well as 6th day after storage [Table-4]. On 2 DAS maximum total sugar content of 14.78 per cent was recorded wherein the fruits were stored under room conditions (control). This result is on par with T_2 treatment (storing fruits in 100 gauge of polyethylene cover without ventilation) which recorded total sugar content of 14.41 per cent. The total sugar content was lowest (13.46%) when fig fruits were stored in 200 gauge polyethylene cover with 1 percent ventilation. On 4 DAS of fig fruits maximum total sugar content (16.5%) was noticed when fruits were stored under room conditions (control). This result is on par with the three other treatments namely storing of fruits in 100 (T_2), 200 (T_3) and 50 (T_1) gauge of polyethylene covers without ventilation (16.18%, 16.17% and 15.99% respectively). The total sugar content was minimum (14.00%) when fruits were stored in 200 gauge polyethylene cover with 1 per cent ventilation.

On 6 DAS of fig fruits maximum total sugars content (18.40%) was noticed wherein fruits were stored in 100 gauge polyethylene cover without ventilation. The other treatments which are on par with this treatment (T_2) are T_1 T_3 and T_4 treatments i.e. storing fruits in 50 and 200 gauge polyethylene cover without ventilation and 50 gauge polyethylene cover with 1 per cent ventilation (8.06, 18.05 and 17.62% respectively). The total sugar content was minimum (15.93%) when fruits were stored in 1 per cent ventilated polyethylene covers of 200 gauge. On 8 DAS observation with respect to estimation of total sugars content was carried out in the fruits stored in 1 per cent ventilated covers whereas in the control as well as without ventilated cover, the observations were not recorded as the fruits lost their keeping quality. On 8 DAS of fruits maximum (17.2%) and minimum (16.22%) total sugar content were noticed in 50 and 200 gauge polyethylene covers having ventilation.

Table-4 *Effect of different gauge of polyethylene cover (with or without ventilation) on total sugars (%) content of fig fruits during storage*

Treatments		Number of days after storage			
		2	4	6	8
		Initial value 13.50			
T_1	50 gauge polyethylene cover without ventilation	14.19	15.99	18.06	-
T_2	100 gauge polyethylene cover without ventilation	14.41	16.18	18.40	-
T_3	200 gauge polyethylene cover without ventilation	13.93	16.17	18.05	-
T_4	50 gauge polyethylene cover with 1 % ventilation	13.95	15.23	17.62	17.20
T_5	100 gauge polyethylene cover with 1 % ventilation	14.14	15.21	16.84	16.41
T_6	200 gauge polyethylene cover with 1 % ventilation	13.46	14.00	15.93	16.22
T_7	Storing of fig fruits in room condition (control)	14.78	16.50	18.17	-
	Mean	14.12	15.61	17.58	-
	F test	*	*	*	-
	SEm±	0.18	0.32	0.42	-
	C.D. at 5%	0.54	0.97	1.33	-
	C.V. (%)	2.15	3.54	4.30	-

* Significant at 5 %

- Observations were not recorded as the fruits lost their keeping quality

Reducing sugar (%)

There was a non significant difference in the reducing sugar content of fig fruits when stored in different gauge of polyethylene covers with or without ventilation on 2, 4 as well as 6 DAS [Table-5]. On 2 DAS the maximum reducing sugar content (12.39%) was found when fruits were stored in 100 gauge polyethylene cover without ventilation and minimum reducing sugar content (11.84%) was found in two treatments T_4 (50 gauge polyethylene cover with 1% ventilation) and T_6 (200 gauge polyethylene cover with 1% ventilation) on both 4 and 6 DAS of fig fruits in 200 gauge polyethylene covers with 1 per cent ventilation recorded maximum (11.79% and 12.98% respectively) reducing sugar content while it was minimum when fruits were stored in 100 gauge polyethylene covers without ventilation (13.58% and 15.12% respectively). On 8 DAS only the fruits stored in ventilated polyethylene covers were in good condition and recorded maximum and minimum of 13.23 per cent and 12.72 per cent reducing sugars content in 50 and 200 gauge polyethylene covers with 1 per cent ventilation.

Table-5 *Variations in reducing sugar (%) content of fig fruits during storage as influenced by different gauge of polyethylene covers (with or without ventilation)*

Treatments		Number of days after storage			
		2	4	6	8
		Initial value – 11.35			
T_1	50 gauge polyethylene cover without ventilation	12.09	13.28	14.58	-
T_2	100 gauge polyethylene cover without ventilation	12.39	13.58	15.12	-
T_3	200 gauge polyethylene cover without ventilation	11.88	13.48	14.67	-
T_4	50 gauge polyethylene cover with 1% ventilation	11.84	12.51	14.15	13.23
T_5	100 gauge polyethylene cover with 1 % ventilation	12.25	12.78	13.92	12.90
T_6	200 gauge polyethylene cover with 1 % ventilation	11.84	11.79	12.98	12.72
T_7	Storing of fig fruits in room condition (control)	12.35	13.52	14.51	-
	Mean	12.09	12.99	14.27	-
	F test	NS	NS	NS	-
	SEm±	0.23	0.40	0.52	-
	C.D. at 5%	0.70	1.20	1.56	-
	C.V.(%)	3.30	5.26	6.21	-

NS: Non – Significant; - Observations were not recorded as the fruits lost their keeping quality

Non-reducing sugar (%)

The data pertaining to non- reducing sugar content of fig fruits when stored in different gauge of polyethylene covers with or without ventilation is tabulated in [Table-6]. It is clear from this table that only 2 DAS there was a significant difference in the non reducing sugar content of fig fruits. On this day maximum non-reducing sugar content (2.43%) was noticed in control treatment and it was on par with four other treatments *viz.* when fruits stored in 50 and 100 gauge polyethylene covers without ventilation along with 50 gauge polyethylene covers with 1per cent ventilation (2.10% each) and fruits stored in 200 gauge polyethylene cover without ventilation (2.04%). On both 4 and 6 DAS of fig fruits there is a non significant result with respect to non reducing sugar content of fig fruits when fruits were stored in different gauges of polyethylene cover either with or without ventilation.

Table-6 *Variations in non-reducing sugar (%) content of fig fruits during storage as influenced by different gauge of polyethylene cover (with or without ventilation)*

Treatments		Number of days after storage			
		2	4	6	8
		Initial value – 1.40			
T_1	50 gauge polyethylene cover without ventilation	2.10	2.70	3.47	-
T_2	100 gauge polyethylene cover without ventilation	2.10	2.59	3.28	-
T_3	200 gauge polyethylene cover without ventilation	2.04	2.69	3.38	-
T_4	50 gauge polyethylene cover with 1 % ventilation	2.10	2.71	3.47	3.96
T_5	100 gauge polyethylene cover with 1 % ventilation	1.89	2.42	2.92	3.51
T_6	200 gauge polyethylene cover with 1 % ventilation	1.62	2.21	2.95	3.52
T_7	Storing of fig fruits in room condition (control)	2.43	2.98	3.65	-
	Mean	2.03	2.61	3.35	-
	F test	*	NS	NS	-
	SEm±	0.13	0.18	0.18	-
	C.D. at 5%	0.40	0.54	0.55	-
	C.V. (%)	11.29	11.71	9.42	-

* Significant at 5 %
NS: Non - Significant
- Observations were not recorded as the fruits lost their keeping quality

On 4 and 6 DAS maximum (2.98% and 3.65% respectively) and minimum (2.21% and 2.95% respectively) reducing sugar content was recorded in control treatment and fruits stored in 200 gauge polyethylene covers with 1 per cent ventilation respectively. On 8 DAS only the fruits stored in ventilated polyethylene covers were in good condition and recorded maximum of 3.96 per cent and minimum of 3.51 per cent non reducing sugar in 50 and 100 gauge polyethylene stored fruits [Table-6].

Discussion

Physiological loss in weight (%)

Physiological loss in weight refers to loss in weight of fruit after harvesting of a fruit. The reduction in weight of fruit when recorded at regular interval after harvesting is known to occur in all fruits and fig is not an exception to this. In both the experiments when fig fruits were stored either in polyethylene cover alone or storing of fruits in polyethylene cover along with $KMnO_4$ or $CaCl_2$ treatment has helped in reducing PLW of fruit. The polyethylene cover may act as barrier in preventing the moisture loss from the fruit and it is clear from the present study that, when fig fruits were stored in 200 gauge polyethylene cover with 1per cent ventilation the PLW was as low as 0.50, 0.57 and 0.58 per cent after 2, 4 and 6 DAS. Whereas, in the control treatment PLW was as high as 1.39, 1.72 and 1.69 per cent respectively for the same DAS. Similarly the minimum PLW of 0.65, 0.96, 0.81 and 0.98 per cent was noticed when fig fruits were stored in 200 gauge polyethylene cover along with 2 per cent $KMnO_4$ placed in tea bags. The corresponding result for the control treatment was 1.45, 1.91, 2.10 and 1.98 per cent respectively. The results from these two experiments differ significantly from other treatments. It is clear from these two experiments that the fig fruits stored in polyethylene cover had lesser PLW when compared to control [Fig-1]. Similarly, when fig fruits were either treated with $CaCl_2$ or stored along with $KMnO_4$ in polyethylene cover had lesser PLW of fruits when compared to control. In the first experiment when the fruits were stored in polyethylene cover the lesser PLW may be due to presence of polyethylene cover between the fruits and atmosphere. It acts as a barrier in hastening the process of ripening. Similarly, in the second experiment $CaCl_2$ chemical coating on the fruit surface might have prevented respiration and thereby reduced PLW. Similarly, $KMnO_4$ helped in absorbing the synthesized ethylene and thereby delayed the process of ripening. Various workers who studied on PLW of fruits also were of the opinion that by storing the fruits in polyethylene cover the processes of ripening can be delayed and the PLW of fruits was lower. [9] observed reduction in weight loss of custard apple fruit and maintenance of turgidity of fruits by arresting the process of ripening in polyethylene stored fruits. [16] was of the opinion that when sapota fruits were stored in polyethylene cover there was reduction in loss of moisture from the fruits. [21] observed reduction in transpiration rate of ber fruits when stored in polyethylene cover due to restricting diffusion of gasses and feedback mechanism.

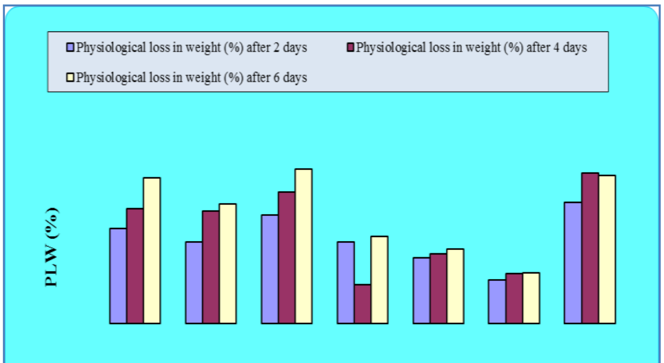

Fig 1. Effect of different gauge of polythene cover (with or without ventilation) on physiological loss in weight (%) of fig fruits during storage

Titratable acidity (%)

In both the experiments when fig fruits were stored in polyethylene cover (with or without ventilation) alone are storing of fruits in polyethylene cover along with $CaCl_2$ or $KMnO_4$ there was a reduction in titratable acidity content. There was a significant reduction in the titratable acidity content in all the treatments when fig fruits were stored in polyethylene cover (with or without ventilation). Fruits stored in 50, 100 and 200 gauge polyethylene covers with 1 per cent ventilation recorded gradual decrease in organic acids whereas when fruits stored in 50, 100 and 200 gauge polyethylene covers without ventilation and control recorded increase in organic acid content and suddenly declined within 6 days after storage [Fig-2].

There was a maximum reduction in organic acids of fig fruits during storage period as a result of wrapping the fruits with polyethylene cover with ventilation. It is attributed to the fact that it reduces the rate of respiration of the fruits thereby oxidative breakdown of acids proceeds at a slower rate as compared to the fruits in unventilated polyethylene covers and unwrapped fruits of control. The results obtained in the present investigation can be compared to those obtained by [11,12] in ber fruits.

There was a non-significant difference in titratable acidity on 2 and 4 DAS when fig fruits were treated with $CaCl_2$ and $KMnO_4$. On 6 and 8 DAS significant difference were found. In general all treatments recorded increasingly in acidity content. Fruits treated with 2% $KMnO_4$ and packed in polyethylene cover and control recorded gradual decrease in acidity content. Decrease in acid content may be due to conversion of acid into sugars by enzyme invertase during storage period. Similar findings were also reported by [5,9] in guava fruits; [10] in custard apple, [12] in ber and [15] in ber fruits, [17,25]. [30] reported that guava fruits in control recorded maximum acidity, minimum acidity was recorded when chalk impregnated with $KMnO_4$.

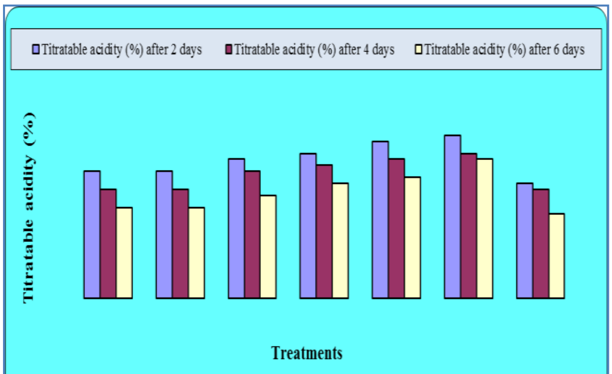

Fig. 2. Changes in titratable acidity (%) content of fig fruits during storage as influenced by different gauge of polyethylene covers (with or without ventilation)

Total soluble solids (%)

Total soluble solids content of fruits will determine the taste or the edible quality of the fruit. The main factors which influence the TSS content of fig fruits at the stage of harvesting is mainly the variety, the stage of maturity of the fruit and the climatic condition prevailing at the harvesting stage. Fig being a climateric fruit [2] there will not be much variation in TSS of fruit at different periods of storage. In the present study also there is no variation in TSS content of fig fruits when stored in polyethylene covers of different thickness either with or without ventilation. As a result non significant observations were recorded between treatments when fruits were stored in polyethylene covers of different gauge. However, when calcium chloride treated fruits or $KMnO_4$ treated fruits were stored in the polyethylene cover there is a significant difference in the TSS content of fruits at 2, 4, 6 and 8 DAS. However, the variation between the treatments is rather very narrow. The slight variation in the TSS content may be attributed to the better environmental conditions provided by calcium chloride and $KMnO_4$ chemicals. Calcium chloride treated fruits have enhanced the calcium content of fig fruits cells, thereby altering the permeability of the cell membrane, enhanced the shelf life of fruit and there by fruit remains healthy and attractive even upto 8 DAS and correspondingly there is a slight improvement in the TSS content from 14.11, 14.29 per cent to 15.06 and 15.22 per cent on 2 and 8 DAS in 1 and 2 per cent $CaCl_2$ treated fruits respectively. In case of fig fruits stored along with $KMnO_4$ also there was a very slight improvement in TSS content of fruits between 2 and 8 DAS and this is due to $KMnO_4$ act as absorbent of ethylene which is synthesized during ripening of fruits and as a result there was improvement in TSS content. Fig is a typical example for climateric fruit as such at the harvesting stage of fruit itself maximum accumulation of TSS will be there. Various workers who worked with a large number of fruits crops were also of the opinion that by storing the fruits either in polyethylene cover or storing the fruits along with $KMnO_4$ or $CaCl_2$ treatment there was a slight improvement in the TSS content of fruits. [8,13,17,18] worked on guava crop for improving the shelf life in various parts of India and are of the opinion that storing fruits in polyethylene cover or storing fruits along with $KMnO_4$ have helped in slight accumulation of TSS content in guava fruit. Guava being a climateric fruit the accumulation of TSS is very narrow. Similarly, [22] have worked with another climacteric fruit *viz.,* apple and found that there is a slight accumulation in the TSS of fruit with the advance in storage period.

Sugars (%)

The changes in the total sugars, reducing sugar and non reducing sugar content of fig fruits during storage as influenced by different gauge of polyethylene cover (with or without ventilation) and calcium chloride and potassium permanganate followed a trend similar to that of TSS. There was a significant increase in total sugars, reducing sugar and non reducing sugar content in all treatments as the storage period advanced [Fig-3]. The general increase in the sugar content of fig fruits irrespective of the treatment has been recorded by [11,12,15]. This increase in sugar content of fig fruits during storage could be due to normal ripening process leading to senescence. In both the experiments where fruits are packed in different gauge of polyethylene covers (with or without ventilation) and treating with $CaCl_2$ and $KMnO_4$ treatments registered relatively lower total sugars, reducing sugar and non reducing sugars as compared to control on all the days of storage. Fruits stored in 50, 100 and 200 gauge polyethylene cover with 1 per cent ventilation recorded consistently higher total sugars, reducing sugar and non reducing sugar content even after 6 DAS. Whereas control fruits recorded sudden increase in sugar content and fruits lost their keeping quality after 6 DAS. When fruits are treated with $CaCl_2$ and $KMnO_4$ the sugar content increased over a period of time. Fruits stored in 200 gauge polyethylene cover with 2 per cent $KMnO_4$ recorded consistently higher sugar content and fruits remained in good marketable condition. Whereas, in control, even though fruits recorded increase in sugar content upto 8 DAS but declined further as the fruits lost keeping quality. This can be attributed mainly due to reduced rate of respiration and delayed ripening due to treatments imposed in the form of $CaCl_2$ and $KMnO_4$ with 200 gauge polyethylene cover (1% ventilation). Similar findings were reported by [11,12,15]. Various other workers reported similar results in other fruits. [23] reported sugar content increasing from harvesting till ripening, as senescence approaches sugars will decline. Similar results are reported by [31,32] in ber fruits. Similar findings are also reported by Gopi krishna and Hari babu (2002) in guava fruits and also by Chavan *et al* (2010); Amin and Hossain (2012); Patil *et al*. (2013).

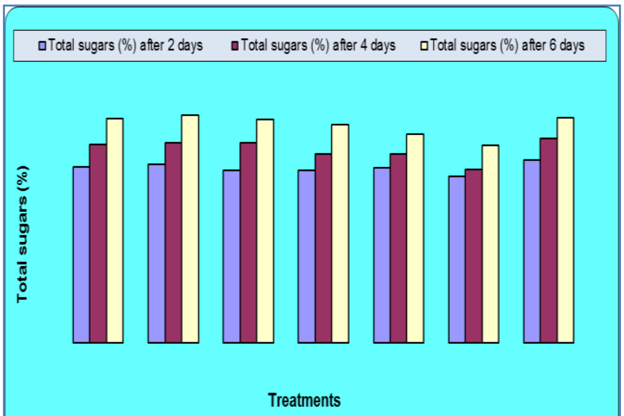

Fig. 3. Effect of different gauge of polythene cover (with or without ventilation) on total sugars (%) content of fig fruits during storage

Conclusion

Studies on shelf life of fig has been taken for the experimental research from that a part of the experiment that's the effect of biochemical parameters during storage of fig has been taken and its results are expressed. Totally 7 treatments have been taken for the experimental research with different polyethylene thickness which may includes with or without ventilation. The significant differences between treatments were interpreted.

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Author Contributions

Paramesha D- Conception and design of the work, data collection, data analysis and interpretation, drafting the article, Critical revision of the article, final approval of the version to be published and acted as corresponding author

Keerthishree M- Reviews collection, Critical revision of the article, final approval of the version to be published.

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Abbreviations

PLW- Physiological loss in weight; TSS- Total soluble solids; %- Percentage; DAS- Days after storage.

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