Studies on physico chemical parameters of osmo dehydrated papaya slices

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ABSTRACT

A study was conducted to know the quality of osmo dehydrated papaya slices prepared from fruits of plants supplied with various organic sources and stored at different storage conditions. The minimum PLW of (0.83%) and maximum titrable acidity (0.169%) was recorded in osmo dehydrated papaya slices prepared from the fruits of plants fertilized half dose of FYM and Vermicompost stored at 4^0C on 15^{th} day of storage. The highest total soluble solids were observed in papaya slices taken for complete recommendation of farm yard manure on 90^{th} day of storage (15.32 ^{o}Brix) and in sheep manure 100 per cent RDN stored at ambient condition (14.66 ^{o}Brix). The minimum moisture content (12.65%) was observed in osmo dehydrated slices prepared from the fruits of plants fertilized with sheep manure 100 per cent RDN and stored at 4^0C (12.72%). The microbial spoilage (yeast and mould) was not observed up to 75 days of storage in all the treatments and in slices stored at 4^0C on 90^{th} day of storage. But the permissible limit of spoilage (1×10^2 to 2×10^4) was observed in osmo-dehydrated slices stored at ambient condition on 90^{th} day of storage.

Keywords: Osmo dehydration, papaya, Recommended dose of Nitrogen, TSS,

INTRODUCTION

Papaya (*Carica papaya* L.) is a versatile crop due to its nutritive and medicinal value (Ruth *et al*., 2020). Despite the fact that, the fruits are nutritionally rich, this crop could not be exploited at the large scale due to high perishability and poor post-harvest storage facilities. The perishability of papaya fruit was due to change in physic-chemical properties namely loss of weight due to respiration and transpiration, loss of moisture, softening of flesh, rapid microbial attack and change in sugar and acid content. Dehydration is an ancient and simple method of food preservation technique among which osmotic dehydration is a popular and cost effective method and can be used in a variety of fruits without loss in fruit quality (Revathi and Singh, 2020).

MATERIALS AND METHODS

The present work was conducted at the Post-Harvest Technology laboratory, College of Horticulture, Venkataramannagudem, Andhra Pradesh during the year 2016. Fruits were obtained from college farm for preparation of osmo dehydrated slices from fruits of papaya plants fertilized with different organic sources of nitrogen alone and in combinations and control. *Viz*., T_1- FYM (50kg/plant-full dose),, T_2- Vermicompost (8.5kg/plant-full dose), T_3- Neem cake (5kg/plant-full dose), T_4- Sheep manure (8.5kg/plant-full dose), T_5- FYM 50% + Vermicompost 50%, T_6- FYM 50% + Neem cake 50%, T_7- FYM 50% + Sheep manure 50% , T_8- Control (250:250:500 g NPK/plant) and were stored at ambient and refrigerator condition.

Method of preparation of osmo dehydrated slices: The matured, firm fruits were selected for preparation of osmo-dehydrated papaya slices. Then the selected fruits washed and peeled and were cut length wise for easy removal of seeds. The slices of equal size were cut with sharp knife. The sugar solution of 70 per cent concentration was prepared and preservatives citric acid (0.2%) and potassium meta bisulphite (0.2%) were added.

The papaya slices were weighed initially and were dipped in the sugar solution at the ratio of 1:3 and allowed for 24 hours at room temperature. The fruit slices were removed from the sugar solution and were weighed again to note the amount of water removed from the papaya slices through ex-osmosis.

The slices were spread thinly on stainless steel trays and kept in electrical dehydrator at 55^0C temperature till the slices reached the desired moisture content of 13-15 per cent of the product. For uniform dehydration, the trays were changed their places. After dehydration, the weight of the dried papaya slices was recorded and packed in plastic punnets and were subjected to storage studies at room temperature and refrigerated condition for a period of three months.

The loss of fruit weight was calculated by subtracting final weight with initial weight divided by initial weight and multiplied with 100 and expressed as percentage. The total soluble solids are recorded by using digital refractometer and expressed in degree Brix. Titrable acidity was measured by taking ten grams of papaya pulp well grinded and transferred to volumetric flask where the volume was made up to 100 ml with distilled water. The contents were filtered through whatman No.1 filter paper. An aliquot of 10 ml was taken into conical flask, added 2-3 drops of phenolphthalein indicator and titrated against 0.1 N NaOH solution untill a pink colour was obtained, which persists at least for 15 seconds and was considered as an end point as per the procedure laid out by (Ranganna, 1986) and calculated with the following formulae and expressed in percentage.

$$\text{Titrable acidity (\%)} = \frac{\text{Titre value} \times \text{Normality of NaOH} \times 0.0064 \times 100}{\text{Volume of aliquot taken (ml)}}$$

Moisture content of osmo dehydrated slice was estimated by using infrared moisture balance. The spoilage was estimated by using dilution plate method. (FAO, 1998) and expressed in colony forming units (cfu) per ml.

RESULT AND DISCUSSION

Effect on PLW (%)

As the storage period progressed the physiological loss in weight (Table 1) was also increased in all the treatments. Among the treatments, the minimum PLW of 4.27 per cent was recorded in osmo dehydrated slices prepared from fruits of plants applied with vermicompost followed by FYM (4.35%) and maximum of 5.27 per cent in osmo dehydrated slices prepared from fruits of plants applied 100 per cent RDF. At different storage conditions, the minimum PLW of 4.34 per cent was recorded in osmodehydrated slices stored at 4˚C compared to osmo dehydrated slices stored at ambient condition of 5.03 per cent. Among the different days of storage, the minimum PLW of 1.49 per cent was recorded on 15^{th} day of storage and maximum of 6.77 per cent was recorded on 90^{th} day of storage.

Among the interactions between nitrogen source and with days of storage, the minimum PLW of 1.12 per cent was recorded in the osmo dehydrated slices prepared from the fruits of plants applied with vermicompost alone which was on par with FYM alone (1.15%), sheep manure (1.15%) and FYM 50 per cent + vermicompost 50 per cent (1.19%) on 15^{th} day of storage and maximum of 7.19 per cent PLW in fruits applied with 100 per cent RDN on 90^{th} day of storage. The range of PLW of osmo dehydrated papaya slices was between 1.43 per cent in neem cake 100 per cent RDN at 15^{th} day of storage to 6.90 in FYM 50 per cent + neem cake 50 per cent at 90^{th} day of storage.

Among the first order interactions between storage condition and days of storage, the osmo dehydrated slices stored at 4˚C recorded minimum PLW of 1.05 per cent on 15th day of storage and maximum of 7.01 per cent at ambient condition on 90th day of storage. The range of PLW of osmo dehydrated papaya slices was between 1.93 per cent at ambient condition on 15th day of storage to 6.52 per cent at 4˚C on 90th day of storage.

Among the first order interactions between organic manures and storage condition, the minimum PLW of 3.80 per cent was observed in osmo dehydrated slices prepared from the fruits of plants fertilized with vermicompost and stored at 4˚C and maximum of 5.72 per cent in fruits of 100 per cent RDF stored at ambient condition. The range of PLW of osmo dehydrated papaya slices was between 4.07 per cent in FYM 100 per cent RDN stored at 4^0C to 5.34 per cent in FYM 50 per cent + neem cake 50 per cent stored at ambient condition.

Among the second order interactions, the minimum PLW of 0.83 per cent was observed in osmo dehydrated slices prepared from FYM 50 per cent + vermicompost 50 per cent stored at 4˚C on 15th day of storage which was on par with the osmo dehydrated slices prepared from fruits of plants fertilized with vermicompost stored at 4^0C on 15th day of storage (0.87%), sheep manure 100 per cent RDN stored at 4^0C on 15th day of storage (0.99%), FYM 100 per cent RDN stored at 4^0C on 15th day of storage (1.04%) and neem cake 100% RDN stored at 4˚C on 15th day of storage (1.07%) and maximum of 7.54 per cent was recorded in 100% RDF stored at ambient condition on 90th days of storage. The range of PLW of osmo dehydrated papaya slices was between 1.17 per cent in FYM 50 per cent RDN and neem cake50 per cent RDN stored at 4˚C on 15th day of storage to 7.20 per cent in FYM 50 per cent RDN + neem cake50 per cent RDN stored at ambient condition on 90th day of storage.

In the present study, minimum PLW was recorded in osmo-dehydrated slices prepared from organic manures and stored at 4˚C. The data revealed that, as storage period increased, the physiological loss in weight of osmo-dehydrated slices was also increased as sugar coating increased the rate of dehydration and hence the loss in weight was observed (Cristhiane *et al.,* 2013). These results were in harmony with the findings of Castello *et al*. (2009) in osmo dehydrated slices of apple.

Effect on TSS (^{o}Brix)

The osmo dehydrated papaya slices presented in Table 2 showed with the application of nitrogen with different sources, storage condition, days of storage and their interactions had significant difference and was increased in all the treatments.

Among the organic manures applied, maximum TSS of 14.52 ^{o}Brix was recorded in osmo dehydrated slices prepared from fruits of plants fertilized with sheep manure followed by farm yard manure (14.37 ^{o}Brix) and minimum of 12.69 ^{o}Brix in 100 per cent RDF. At different storage conditions, the osmo dehydrated slices stored at ambient condition recorded maximum TSS of 13.72 ^{o}Brix compared to slices stored at 4^0C of 13.35 ^{o}Brix. Among the different days of storage, the highest TSS of 14.51 ^{o}Brix was recorded on 90th day of storage (13.90 ^{o}Brix) and lowest of 12.96 ^{o}Brix on 15th day of storage.

Among the first order interactions between different sources of nitrogen and storage days, the highest TSS (15.32 ^{o}Brix) was observed in fruits of plants fertilized with FYM on 90th day of storage and lowest (12.02 ^{o}Brix) from fruits of plants fertilized with 100 per cent RDF on 15th day of storage. The range of TSS was between 15.02 ^{o}Brix in slices prepared from sheep manure 100 per cent RDN on 90th day of storage to 12.28 ^{o}Brix in control on 15th day of storage.

Among the first order interactions between organic manures and storage conditions, the maximum TSS of 14.66 ^{o}Brix was observed in the osmo dehydrated slices prepared from fruits of plants fertilized with sheep manure alone stored at ambient condition which was on par with FYM alone

and stored at ambient condition (14.61 ^{o}Brix) and minimum of 12.54 ^{o}Brix in 100 per cent RDF stored at 4˚C. The TSS was ranged between 14.48 ^{o}Brix in slices prepared from sheep manure 100 per cent RDN stored at 4˚C to 12.59 ^{o}Brix in FYM 50% RDN + neem cake 50 per cent RDN stored at 4˚C .

In the present investigation, total soluble solids increased during storage irrespective of treatments and the increase was more in slices stored at ambient condition. This increase was due to more exchange of water increased the concentration on dry weight basis. The findings were found similar with Manivasagan *et al*. (2006) in karonda candy, Sharma *et al*. (2006) in apricot and Priya and Khatkar (2013) in aonla.

Titrable acidity (%)

The highest titrable acidity of 0.169 per cent was recorded in osmo-dehydrated slices prepared from fruits of plants fertilized with FYM 50 per cent + vermicompost 50 per cent which was on par with vermicompost (0.167%) followed by sheep manure (0.156%) and lowest of 0.115 per cent in neem cake (Table 3). The osmo-dehydrated papaya slices stored at 4˚C recorded highest titrable acidity of 0.146 per cent compared to ambient condition of 0.141 per cent. Among the different days of storage, highest titrable acidity of 0.158 per cent was recorded on 15th day of storage followed by 30th day of storage (0.152%) and lowest of 0.130 per cent on 90th day of storage.

In the present study, highest titrable acid was observed in osmo-dehydrated slices of fruits of plants fertilized with organic manures stored at 4˚C (Sumitha, 2010) during the entire storage period in all the treatments may be due to conversion of complex molecules into their simple form. The titrable acidity decrease was less in slices stored at 4˚C due to less chemical reactions and thereby minimum utilization of acids. The decrease in the titrable acidity might be due to utilization of acids during the bio-chemical reactions occurring in the product during the storage as reported by Singh *et al*. (2011) in wild apricot.

Effect on moisture content (%)

The moisture content had significant differences between osmo dehydrated slices prepared from the fruits of plants fertilized with different sources of nitrogen, storage condition, days of storage and their interaction between organic manures and storage condition (Table 4). The highest moisture content of 13.12 per cent was recorded in the osmo dehydrated papaya slices prepared from the fruits of plants fertilized with neem cake followed by FYM 50 per cent + vermicompost 50 per cent (12.92%), vermicompost (12.90%) and lowest of 12.65 per cent in sheep manure. At different storage conditions, the osmo dehydrated papaya slices stored at ambient condition recorded maximum moisture content of 12.94% than at 4˚C of 12.72 per cent. During storage period, the more of 13.18% was recorded on 90th day of storage followed by 75th day of storage (13.06%) and less of 12.45 per cent on 15th day of storage.

Among the interactions between manure supplied and storage condition, the maximum moisture content was observed in slices prepared from fruits of plants supplied with neem cake and stored at ambient condition (13.21%) and minimum of 12.60% slices prepared from vermicompost 100 per cent RDN stored at 4˚C and sheep manure 100 per cent RDN stored at 4˚C. The similar change in moisture content during storage was in accordance with findings of Jesulin Aronika and Manimehalai (2014) in papaya, and Yadav and Singh 2014.

Spoilage (cfu)

The results on spoilage in terms of microbial count in dehydrated papaya slices were given in Table 5. The spoilage was not observed in osmo dehydrated slices stored at refrigerator condition in all the treatments of storage. The slices of different treatments stored at ambient conditions recorded microbial count ranged from 1×10^{2} to 1×10^{4} cfu. The highest of 2×10^{4} cfu was observed

in osmo dehydrated slices prepared from fruits of plants taken from control stored at ambient condition.

The osmotic dehydration of papaya slices decreased the spoilage by microorganisms by removing water from the product with increased osmotic pressure where the microorganisms cannot grow and multiply. Jorge and Favetto (1992) also reported lower microbial load after drying due to reduction in water activity. The similar results were also recorded in Kesar mango by Sakhale and Pawar (2011), Rahman *et al*. (2012) in jackfruit Vega *et al*. (2021) in papaya.

CONCLUSION

Osmotic dehydration is one of the most qualities improving food preservation technique. Papaya osmo dehydrated slices had maintained good quality in terms of both physical and chemical parameters during the storage period. There was no spoilage of osmo dehydrated papaya slices even at 90 days of storage and hence papaya fruits can be processed to osmodehydrated slices

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: Effect on physiological loss in weight (%) of osmo-dehydrated papaya slices during storage period

Manures (M)	Days after storage (D)						Mean
	15	30	45	60	75	90	
T_1- FYM	1.15	3.32	4.03	5.15	5.94	6.52	**4.35**
T_2 - Vermicompost	1.12	3.06	4.24	5.01	5.72	6.48	**4.27**
T_3 - Neem cake	1.43	4.19	4.99	5.58	6.19	6.83	**4.87**
T_4 - Sheep manure	1.15	3.11	4.66	5.61	6.07	6.72	**4.55**
T_5 - FYM 50% + Vermicompost 50%	1.19	3.37	3.85	5.51	6.07	6.73	**4.45**
T_6 - FYM 50% + Neem cake 50%	1.97	3.51	5.49	5.93	6.36	6.90	**5.03**
T_7 - FYM 50% + Sheep manure 50%	1.68	3.57	4.59	5.33	6.18	6.76	**4.68**
T_8 -Control 100% (RDF)	2.22	4.32	5.25	6.01	6.65	7.19	**5.27**
Storage condition (S)							
S_1- 4^0C refrigerator condition	1.05	3.22	4.26	5.18	5.82	6.52	**4.34**
S_2- Ambient condition	1.93	3.89	5.02	5.85	6.46	7.01	**5.03**
Mean	**1.49**	**3.55**	**4.64**	**5.51**	**6.15**	**6.77**	

Interaction effects (M x S):

Factor	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	Mean
S_1	4.07	3.80	4.60	4.27	4.14	4.72	4.32	4.81	**4.34**
S_2	4.64	4.74	5.14	4.83	4.76	5.34	5.05	5.72	**5.03**
Mean	**4.35**	**4.27**	**4.87**	**4.55**	**4.45**	**5.03**	**4.68**	**5.27**	

Interaction effects (M x S x D):

Treatments	Days after storage (D)											
	15		30		45		60		75		90	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	1.04	1.26	3.15	3.49	3.48	4.58	4.60	5.70	5.84	6.05	6.27	6.78
T_2	0.87	1.38	2.45	3.67	3.75	4.72	4.30	5.72	5.30	6.15	6.16	6.81
T_3	1.07	1.80	3.70	4.67	4.71	5.28	5.31	5.86	6.11	6.28	6.72	6.94
T_4	0.99	1.31	2.88	3.35	4.08	5.24	5.51	5.71	5.81	6.33	6.37	7.07
T_5	0.83	1.55	2.93	3.81	3.35	4.35	5.24	5.77	5.89	6.24	6.63	6.83
T_6	1.17	2.77	3.67	3.35	5.19	5.80	5.77	6.10	5.89	6.83	6.61	7.20
T_7	1.09	2.28	3.15	3.99	4.37	4.81	5.20	5.47	5.55	6.89	6.57	6.94
T_8	1.37	3.07	3.82	4.81	5.11	5.39	5.54	6.47	6.22	7.08	6.84	7.54

Factor	T	S	D	T*S	T*D	S*D	T*S*D
S.Em±	0.03	0.01	0.02	0.04	0.06	0.03	0.09
C.D (0.05)	0.07	0.04	0.06	0.11	0.18	0.09	0.26

Table 2: Effect on total soluble solids (^{o}Brix) of osmo-dehydrated papaya slices during storage period

Manures (M)	Days after storage (D)						Mean
	15	30	45	60	75	90	
T_1- FYM	13.50	13.89	14.12	14.52	14.88	15.32	**14.37**
T_2 - Vermicompost	13.01	13.23	13.42	13.61	13.86	14.09	**13.53**
T_3 - Neem cake	12.85	13.05	13.21	13.45	13.72	13.99	**13.38**
T_4 - Sheep manure	13.94	14.14	14.53	14.64	14.85	15.02	**14.52**
T_5 - FYM 50% + Vermicompost 50%	13.33	13.56	13.79	13.95	14.20	14.41	**13.87**
T_6 - FYM 50% + Neem cake 50%	12.29	12.45	12.68	12.88	13.13	13.34	**12.79**
T_7 - FYM 50% + Sheep manure 50%	12.76	12.77	12.98	13.24	13.46	13.70	**13.15**
M_8 -100% RDF	12.02	12.28	12.54	12.88	13.12	13.31	**12.69**
Storage condition (S)							
S_1- 4^0C	12.91	13.03	13.23	13.41	13.66	13.89	**13.35**
S_2- Ambient condition	13.01	13.31	13.59	13.88	14.14	14.40	**13.72**
Mean	**12.96**	**13.17**	**13.41**	**13.65**	**13.90**	**14.51**	

Interaction effects (M x S):

Factor	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	Mean
S_1	14.13	13.36	13.20	14.38	13.69	12.59	12.96	12.54	**13.35**
S_2	14.61	13.71	13.55	14.66	14.06	13.00	13.35	12.85	**13.72**
Mean	**14.37**	**13.53**	**13.38**	**14.52**	**13.87**	**12.79**	**13.15**	**12.69**	

Interaction effects (M x S x D):

Treatments	Days after storage (D)											
	15 Day		30 Day		45 Day		60 Day		75 Day		90 Day	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	13.38	13.62	13.72	14.05	13.96	14.30	14.10	14.94	14.58	15.17	15.05	15.59
T_2	12.90	13.07	13.04	13.42	13.18	13.66	13.41	13.81	13.63	14.08	13.94	14.24
T_3	12.80	12.90	12.91	13.19	13.08	13.34	13.24	13.67	13.49	13.96	13.71	14.27
T_4	13.92	13.97	14.06	14.22	14.40	14.67	14.52	14.76	14.62	15.08	14.76	15.29
T_5	13.24	13.42	13.42	13.69	13.57	14.00	13.72	14.18	13.99	14.42	14.20	14.63
T_6	12.20	12.39	12.34	12.57	12.43	12.93	12.62	13.14	12.89	13.37	13.05	13.63
T_7	12.87	12.66	12.60	12.93	12.83	13.13	12.97	13.52	13.14	13.78	13.33	14.07
T_8	11.94	12.10	12.15	12.42	12.38	12.71	12.74	13.03	12.94	13.31	13.08	13.54

Factor	T	S	D	T*S	T*D	S*D	T*S*D
S.Em±	0.03	0.01	0.03	0.04	0.07	0.04	0.11
C.D (0.05)	0.09	0.04	0.07	0.11	0.22	N.S	N.S

Table 3: Effect on titrable acidity (%) of osmo-dehydrated papaya slices during storage

Manures (M)	Days after storage (D)						Mean
	15	30	45	60	75	90	
T_1- FYM	0.148	0.142	0.137	0.133	0.127	0.123	**0.135**
T_2 - Vermicompost	0.182	0.175	0.171	0.164	0.159	0.153	**0.167**
T_3 - Neem cake	0.128	0.126	0.116	0.113	0.108	0.104	**0.115**
T_4 - Sheep manure	0.169	0.164	0.157	0.152	0.148	0.144	**0.156**
T_5 . FYM 50% + Vermicompost 50%	0.183	0.176	0.172	0.167	0.161	0.154	**0.169**
T_6 - FYM 50% + Neem cake 50%	0.150	0.141	0.134	0.129	0.124	0.118	**0.133**
T_7 - FYM 50% + Sheep manure 50%	0.171	0.165	0.158	0.151	0.145	0.139	**0.155**
T_8 -Control 100% (RDF)	0.135	0.123	0.122	0.116	0.112	0.106	**0.119**
Storage condition							
S_1- 4^0C	0.159	0.153	0.149	0.144	0.138	0.132	**0.146**
S_2- Ambient condition	0.157	0.150	0.143	0.137	0.133	0.127	**0.141**
Mean	**0.158**	**0.152**	**0.146**	**0.140**	**0.135**	**0.130**	

Interaction effects (M x S):

Factor	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	Mean
S_1	0.137	0.169	0.117	0.158	0.171	0.136	0.157	0.122	**0.146**
S_2	0.133	0.166	0.114	0.153	0.167	0.129	0.152	0.117	**0.141**
Mean	**0.135**	**0.167**	**0.115**	**0.156**	**0.169**	**0.133**	**0.155**	**0.119**	

Interaction effects (M x S x D):

Treatments	Days after storage (D)											
	15 Day		30 Day		45 Day		60 Day		75 Day		90 Day	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	0.151	0.145	0.143	0.141	0.140	0.135	0.135	0.131	0.130	0.125	0.126	0.120
T_2	0.183	0.181	0.177	0.174	0.172	0.170	0.167	0.161	0.163	0.156	0.156	0.151
T_3	0.129	0.127	0.130	0.126	0.119	0.114	0.116	0.111	0.109	0.106	0.105	0.103
T_4	0.171	0.167	0.166	0.164	0.160	0.154	0.155	0.148	0.152	0.145	0.146	0.142
T_5	0.185	0.181	0.179	0.176	0.175	0.170	0.169	0.165	0.163	0.160	0.155	0.152
T_6	0.151	0.150	0.145	0.141	0.140	0.129	0.134	0.124	0.127	0.121	0.122	0.114
T_7	0.172	0.170	0.166	0.165	0.161	0.156	0.155	0.147	0.149	0.141	0.143	0.135
T_8	0.135	0.135	0.124	0.123	0.125	0.119	0.120	0.113	0.114	0.110	0.108	0.104

Factor	T	S	D	T*S	T*D	S*D	T*S*D
S.Em±	0.001	0.000	0.001	0.001	0.002	0.001	0.003
C.D (0.05)	0.003	0.001	0.002	N.S	N.S	N.S	N.S

Table 4: Effect on moisture content (%) of osmo-dehydrated papaya slices during storage

Manures (M)	Days after storage (D)						Mean
	15	30	45	60	75	90	
T_1- FYM	12.33	12.48	12.63	12.72	12.82	12.99	**12.66**
T_2 - Vermicompost	12.51	12.65	12.77	13.00	13.18	13.26	**12.90**
T_3 - Neem cake	12.57	12.79	12.97	13.20	13.45	13.72	**13.12**
T_4 - Sheep manure	12.29	12.50	12.68	12.80	12.90	12.75	**12.65**
T_5 . FYM 50% + Vermicompost 50%	12.46	12.62	12.74	12.88	12.98	13.06	**12.79**
T_6 - FYM 50% + Neem cake 50%	12.59	12.76	12.87	12.96	13.09	13.23	**12.92**
T_7 - FYM 50% + Sheep manure 50%	12.38	12.55	12.65	12.81	12.99	13.24	**12.77**
T_8 -Control 100% (Recommended dose of fertilizer)	12.46	12.63	12.79	12.91	13.06	13.17	**12.84**
Storage condition (S)							
S_1- 4^0C	12.39	12.53	12.66	12.77	12.92	13.05	**12.72**
S_2- Ambient condition	12.51	12.71	12.87	13.05	13.20	13.31	**12.94**
Mean	**12.45**	**12.62**	**12.76**	**12.91**	**13.06**	**13.18**	

Interaction effects (M x S):

Factor	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	Mean
S_1	12.49	12.60	13.02	12.60	12.70	12.87	12.70	12.79	**12.72**
S_2	12.83	13.19	13.21	12.70	12.89	12.96	12.83	12.89	**12.94**
Mean	**12.66**	**12.90**	**13.12**	**12.65**	**12.79**	**12.92**	**12.77**	**12.84**	

Interaction effects (M x S x D):

Treatments	Days after storage (D)											
	15 Day		30 Day		45 Day		60 Day		75 Day		90 Day	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_1	12.26	12.40	12.34	12.62	12.44	12.82	12.50	12.94	12.60	13.00	12.82	13.17
T_2	12.32	12.71	12.44	12.86	12.54	13.00	12.68	13.32	12.79	13.57	12.84	13.66
T_3	12.53	12.61	12.72	12.87	12.89	13.00	13.06	13.33	13.34	13.56	13.57	13.88
T_4	12.25	12.33	12.41	12.59	12.61	12.76	12.69	12.92	12.81	12.99	12.87	12.63
T_5	12.43	12.49	12.53	12.72	12.63	12.88	12.79	12.97	12.87	13.10	12.92	13.19
T_6	12.55	12.64	12.69	12.82	12.83	12.90	12.93	13.00	13.06	13.12	13.16	13.31
T_7	12.37	12.40	12.54	12.56	12.60	12.70	12.69	12.94	12.91	13.07	13.14	13.35
T_8	12.44	12.48	12.60	12.66	12.77	12.82	12.86	12.97	12.98	13.13	13.08	13.26
	12.39	12.51	12.53	12.71	12.66	12.87	12.77	13.05	12.92	13.20	13.05	13.31

Factor	T	S	D	T*S	T*D	S*D	T*S*D
S.Em±	0.03	0.01	0.02	0.04	0.07	0.04	0.11
C.D (0.05)	0.08	0.04	0.07	0.12	N.S	N.S	N.S

Table 5: Spoilage (cfu) of osmo-dehydrated papaya slices during storage

Treatments	Days after storage (days)						
	1(Initial)	15	30	45	60	75	90
$T_1(T_1S_1)$	0	0	0	0	0	0	0
$T_2(T_1S_2)$	0	0	0	0	0	0	$1x10^2$
$T_3(T_2S_1)$	0	0	0	0	0	0	0
$T_4(T_2S_2)$	0	0	0	0	0	0	$1x10^4$
$T_5(T_3S_1)$	0	0	0	0	0	0	0
$T_6(T_3S_2)$	0	0	0	0	0	0	$1x10^2$
$T_7(T_4S_1)$	0	0	0	0	0	0	0
$T_8(T_4S_2)$	0	0	0	0	0	0	$1x10^4$
$T_9(T_5S_1)$	0	0	0	0	0	0	0
$T_{10}(T_5S_2)$	0	0	0	0	0	0	$1x10^4$
$T_{11}(T_6S_1)$	0	0	0	0	0	0	0
$T_{12}(T_6S_2)$	0	0	0	0	0	0	$1x10^4$
$T_{13}(T_7S_1)$	0	0	0	0	0	0	0
$T_{14}(T_7S_2)$	0	0	0	0	0	0	$1x10^4$
$T_{15}(T_8S_1)$	0	0	0	0	0	0	0
$T_{16}(T_8S_2)$	0	0	0	0	0	0	$2x10^4$