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Influence of different storage temperatures and packing material in extending shelf life and quality attributes of Palmyrah (*Borassus flabellifer* L.) *Neera*

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Abstract
A study was conducted to determine the effect of packing material and storage conditions on the physiochemical changes that occurs during storage life of the palmyrah *neera*. The experiment was conducted in completely randomized factorial design with two factors at equal levels and replicated thrice. HDPE 50 micron pouch, PET bottle and glass bottle were the packing material and cold storage at 2 ºC, cold storage at 4 ºC, and refrigerated storage were the storage conditions used during the period of investigation. During the storage the physio-chemical properties *viz.*, total soluble solids, pH and reducing sugars showed an increasing trend upto 4th week. Whereas, phenols, titrable acidity and alcohol content were increased upto 6th week of storage. Among the packing material maximum total soluble solids (10.80ºBrix), reducing sugars (5.76%), total sugars (9.63%), minimum phenolic content (0.323 mg) and titrable acidity (1.116%) were recorded when palmyrah *neera* was packed in HDPE 50 micron pouch. Whereas, the maximum total soluble solids (10.83ºBrix), reducing sugars (5.75%), total sugars (9.57%), minimum phenolic content (0.322 mg) and titrable acidity (1.266%) were recorded when palmyrah *neera* was stored in cold storage at 2 ºC. However, interaction effect was found non significant. Superiority for sensory evaluation was reported for *neera* packed in LDPE 50 micron and stored in cold storage at 2 ºC upto the end of the shelf life *i.e.*, 6th week.

Keywords: *Neera*, packing material, palmyrah and shelf life

Introduction
In India, palmyrah adorns the dry landscape of the semi arid regions of Tamil Nadu, Andhra Pradesh, Gujarat, Odisha, West Bengal, Bihar, Karnataka and Maharashtra. Currently, palmyrah palm wealth of India is estimated as 102 million palms and half of them are in Tamil Nadu. Out of 51.90 million palms in Tamil Nadu, more than 50% of palms are concentrated in the Southern district of Thoothukudi (Anonymous, 2015) [3].

Palmyrah is referred as tree of life with nearly 800 uses including food, beverage, fiber, fodder, medicinal and timber. Among the various edible uses of the palm, the sweet sap (*neera*) from the inflorescence obtained by tapping the tip of the inflorescence either male or female, as is practiced with the other sugar palms. It is traditionally collected in hanging earthen pots and used to quench thirst. The sweet sap collected early in the morning is refreshing and light drink called *neera* in telugu and also in marathi and *pathaneer* in Tamil. *Neera* has sugary sweet in taste, oyster white in colour, translucent with high nutritive value but susceptible to natural fermentation at ambient temperature within a few hours of extraction (Vengaiah *et al.*, 2017) [14]. The neera collected in the evening or after fermentation becomes sour which is called *kallu* in telugu and *Tadi* in marathi. *Kallu* is mostly consumed by villagers as raw alcoholic beverage. Fermented toddy is in fact harmful because it is an alcoholic beverage with 5% alcohol hence not recommended as a health drink.

Fresh palmyrah sap (*Neera*) is highly prone to postharvest losses due to spoilage. Palmyrah sap is naturally prone to fermentation within few hours of extraction and becomes alcoholic beverage (Toddy). Selecting technological processes to preserve the natural wholesome properties of palmyrah *neera* still remains a challenge. Under these circumstances, the post-harvest management of sap with sufficient shelf life is most important. In this context, development of post harvest treatments like, packing material and storage conditions significantly increase shelf life, reduce post-harvest losses and maintain nutritional quality of *Neera*.

Material and Methods

Palmyrah palm *neera*, is the phloem sap extracted from the inflorescence of various species of toddy palms which is used as a nutritious health drink. Fresh palmyrah palm *neera* was collected from nearby palmyrah palms with the help of neera tappers. Initially the sap (*neera*) was collected in special ice box equipment and later neera was transferred from ice box to cold storage unit (PHTRS, Venkataramannagudem) of low temperature to minimize the fermentation and was used for experimental purpose.

Freshly extracted palmyrah palm *neera* was used for packing. Two hundred milliliters of sap was filled uniformly in each packing material *viz.*, HDPE 50 micron pouch (P_1), PET bottle (P_2) and glass bottle (P_3). Thirty number of units with each packing material was filled and stored in different storage conditions *viz*., cold storage at 2 ^oC (S_1), cold storage at 4^oC (S_2) and refrigerated storage (8-10 ^oC) (S_3). The samples were analyzed for physico-chemical parameters and sensory evaluation at weekly intervals. All the samples were discarded after 6th week due to the spoilage of neera during the period of storage.

Estimation of physico-chemical parameters of palmyrah *neera*

Total solubule solids (TSS) were determined with the help of digital refractometer by placing a drop of sample in the form of juice at room temperature. Reducing sugars and total sugars were determined by the method suggested by Lane and Eyon 1965. The method described by Ranganna, 2010 [10] was adopted for the determination of titrable acidity. The pH of the sample was tested by taking direct reading on pH meter model HI 9321 (periodically calibrated with buffer solution of pH 4.0 and 7.0) according to AOAC, 1992 [1]. Non enzymatic browning was estimated as per the method given by Ranganna, 2010 [10]. Total phenol content was estimated by using Folin-Ciocalteau reagent Sadasivam and Manickam, 2005. Alcohol content was estimated based on the formation of green colored chromate ions resulting from treatment of ethanol and sodium dichromate as limiting reactant in presence of sulfuric acid and acetate buffer pH 4.3. The absorbance maxima for the ethanol were found to be 578 nm by the method given by Sumbhate *et al.,* 2012. The standard calibration graph of known alcohol concentrations was graphically plotted (R2=0.99) and used for identification of the concentration of alcohol in the samples. All the samples were analyzed in triplicates.

$$\text{Titrable acidity (\%)} = \frac{\text{Titre value x Normality of alkali x Total volume made up x Equivalent weight of citric acid}}{\text{Aliquot taken for estimation x weight of sample x 1000}} \text{ X } 100$$

Percentage of ethanol in sample = (Cs/Cu) (Au/As) x 100

Where, Cs = Concentration of standard, Cu = Concentration of sample

Au = Absorbance of standard, As = Absorbance of sample.

Sensory parameters

The effect of packing material and storage conditions on taste, flavour and overall acceptability of palmyrah *neera* was evaluated by a panel consisted of ten panelists and points were given as per 9 point hedonic scale procedure, as described by Amerine *et al.*,1965 [2]. The panelists free from any addict related to taste bud damage like wine, tobacco *etc* were selected for evalution. Higher scoring was treated as more acceptable from the taste point of view.

Statistical analysis

The data obtained were analyzed statistically by following standard methods developed by Panse and Sukhatme 1985 for factorial with Complete Randomized Design (CRD). Statistical significance was tested, using 'F' value at 5 per cent level of significance. Critical difference at 5 per cent level was worked out for the effects which were found significant.

Results And Discussion

Quality parameters of neera

Neera samples packed in different packing material, stored under different storage conditions were analysed for quality parameters at weekly intervals and are presented in Table 1 and 2.

Physico-chemical characters of palmyrah neera

Total soluble solids (^{o}Brix)

The initial TSS of *neera* were found as 10.00^o Brix. The data revealed that, the TSS content of *neera* increased during storage period upto four weeks and ranged from 10.00 to 10.90^o Brix. Later, a decrease in TSS was noticed on 5th and 6th week of storage. The TSS content started to decline from the 5th week of storage. The decline in TSS can be attributed to the fact of complete hydrolysis of polysachrides and decline in TSS is predictable as they are the primary substrates of respiration. However, utilization of sugars in respiration and degradation of total soluble substance during storage might be the reason for the decrease in TSS (Wills *et al.,* 1980) [15]. Among the packing material, the maximum TSS content *i.e.,* 10.37 to 10.80^{o}Brix was recorded from 1st to 4th week of storage respectively when *neera* packed in HDPE 50 micron pouch (P_1). The minimum TSS content *i.e.,* 10.13 to 10.70 ^{o}Brix was recorded from 1st to 4th week of storage respectively when *neera* packed in glass bottles (P_3) *Neera* packed in HDPE 50 micron pouch (P_1) recorded the maximum TSS and minimum titrable acidity compared to other packing material which might be due to more permeability of gases and lower accumulation of CO_2 leading to low anaerobic respiration rate when compared to PET and glass bottles.

The maximum TSS content *i.e.,* 10.40 to 10.83^o Brix was recorded from 1st to 4th week of storage when *neera* stored at 2^{o}C (S_1). The minimum TSS content *i.e.,* 10.07 to 10.67^{o}Brix was recorded from 1st to 4th week of storage when *neera* stored in refrigerated condition (S_3) among the storage conditions. The palmyra neera stored in cold storage at 2^{o}C (S_1) recorded the maximum TSS. This might be due to slower respiration of substances at low temperature. Similar findings were reported by Santiago-Urbina *et al.,* 2013 [12] and Ramalakshmi *et al.,* 2018 [9] in coconut sap.

Potential hydrogen and titrable acidity

The initial value for pH of *neera* was found as 4.28. It was evident from the data that, the pH of *neera* decreased during storage period upto six weeks and ranged from 4.36 to 4.14. This may due to the production of acid during the fermentation in the medium. Among storage conditions, *neera* stored in refrigerated condition (S_3) recorded the minimum

pH *i.e.,* 4.26 to 4.15 from 1st to 6th week of storage whereas, the maximum pH *i.e.,* 4.34 to 4.20 was recorded from 1st to 6th week of storage when *neera* stored at 2ºC (S_1).

The initial value for titrable acidity of *neera* was observed as 0.575%. It was evident from the data that the titrable acidity of *neera* increased during storage period upto six weeks and ranged from 0.579 to 1.288%. The titrable acidity of a solution is an approximation of the solution's total acidity. The increase titrable acidity value in the palmyrah *Neera* sample shows the increase in acid production, this may be due to the microbial fermentation of carbohydrates present in the palmyrah *neera*. Among the packing material, the maximum titrable acidity *i.e.,* 0.751 to 1.223% was recorded from 1st to 6th week of storage when *neera* packed in glass bottles (P_3). The minimum titrable acidity *i.e.,* 0.665 to 1.116% was recorded from 1st to 6th week of storage when *neera* packed in HDPE 50 micron pouch (P_1).

The maximum titrable acidity *i.e.,* 0.773 to 1.266% was recorded from 1st to 6th week of storage respectively when *neera* stored in refrigerated condition (S_3). The minimum titrable acidity *i.e.,* 0.644 to 1.138% was recorded from 1st to 6th week when *neera* stored at 2ºC (S_1) among the storage conditions.

Neera packed in HDPE 50 micron pouch (P_1) recorded the maximum pH and minimum titrable acidity compared to other packing material which might be due to more permeability of gases and lower accumulation of CO_2 leading to low anaerobic respiration rate when compared to PET and glass bottles. The palmyra neera stored in cold storage at 2ºC (S_1) recorded the maximum pH and minimum titrable acidity. This might be due to slower respiration of substances at low temperature.

Reducing sugars (%)

The initial values for reducing sugars of *neera* were found as 5.16%. It was evident from the data that, the reducing sugars of *neera* increased during storage period upto five weeks and ranged from 5.18 to 5.80%. Later a decrease in reducing sugars was noticed during 6th week of storage. Fresh palmyrah neera from the cut inflorescence has sucrose, fructose and glucose as these are the components of reducing sugars. Concentration of sucrose decreased gradually whereas fructose and glucose increased after 5th week of storage this also supports the acid production in the medium and utilization of sucrose by different microorganisms including yeast. Among the packing material, the maximum increase in reducing sugars *i.e.,* 5.45 to 5.76% was recorded from 1st to 5th week of storage when *neera* packed in HDPE 50 micron pouch (P_1). The minimum increase in reducing sugars *i.e.,* 5.22 to 5.59% was recorded from 1st to 5th week of storage when *neera* packed in glass bottle (P_3).

The maximum reducing sugars *i.e.,* 5.36 to 5.75% was observed from 1st to 5th weeks of storage when *neera* stored at 2 ºC (S_1). On 2nd, 5th and 6th week of storage, both the treatments *i.e.,* cold storage at 4ºC (S_2) and refrigerated (S_3) recorded the same amount of reducing sugars among the storage conditions.

Phenolic content (mg)

The initial values for phenolic content of *neera* were found as 0.285 mg. It was evident from the data that, the phenolic content of *neera* increased during storage period upto six weeks and ranged from 0.297 to 0.339 mg. Increase in the phenolic content along storage period might be due to periodic fermentation of neera during storage. The minimum increase in phenolic content *i.e.,* 0.301 to 0.323 mg was recorded from 1st to 6th week of storage when *neera* packed in HDPE 50 micron pouch (P_1). The maximum increase in phenolic content *i.e.,* 0.310, 0.312 and 0.315 mg was recorded at 1st, 2nd and 3rd weeks of storage respectively when *neera* packed in glass bottles (P_3), whereas during 4th, 5th and 6th weeks of storage, *neera* packed in PET bottles (P_2) recorded maximum increase in phenolic content (0.321, 0.324 and 0.329 mg) among the packing material.

Among storage conditions, the minimum increase in phenolic content *i.e.,* 0.303 to 0.322mg was recorded upto 6thweek when *neera* stored at 2ºC (S_1) whereas, the maximum phenolic content *i.e.,* 0.311 to 0.331 mg was recorded upto 6th week respectively when *neera* stored in refrigerated condition (S_3).

Alcohol content (%)

The initial value of alcohol content of *neera* was found as 2.00%. It was evident from the data that the alcohol content of *neera* increased with the advancement in storage period upto six weeks and ranged from 2.08 to 4.07%. The alcohol had increasing trend during the storage period. The degree of fermentation of the palmyrah *neera* depends on the practice of *neera* collection and the environmental conditions of the region. Hygiene collection of the neera samples preserves it in fresh form for comparatively longer durations. Increase in alcohol might be due to accumulation of organic acids as respiratory substrates in palmyrah *neera*.

Among the packing material, the maximum increase in alcohol content *i.e.,* 2.14 to 4.01% was found from 1st to 6th week of storage when *neera* packed in glass bottles (P_3). The minimum increase in alcohol content *i.e.,* 2.10 to 3.87% was recorded from 1st to 6th week of storage when *neera* packed in HDPE 50 micron pouch (P_1).

The maximum increase in alcohol content *i.e.,* 2.15 to 4.05% was recorded from 1st to 6th week of storage when *neera* stored in refrigerated conditions (S_3). Whereas, the minimum increase in alcohol content *i.e.,* 2.10 to 3.85% was recorded from 1st to 6th week of storage when *neera* stored at 2 ºC (S_1).

The major physical and chemical changes occurring in the fermenting neera indicated that a natural fermentation of palmyrah neera consist of an initial lactic acid fermentation, a middle alcoholic fermentation and a final acetic acid fermentation. It also appeared that activities brought about by micro-organisms of early phase helped the activities of the micro-organisms in each of the later phases of storage (Atputharajah *et al.,* 1986) [5].

Sensory parameters

The data pertaining to evaluation of sensory parameters like taste, flavour and overall acceptability up to end of shelf life *i.e* six weeks were presented in table 3.

The maximum score for taste, flavour and overall acceptability was recorded when *neera* packed in HDPE 50 micron pouch and stored in cold storage at 2 ºC during the entire period of storage.

The sensory score for taste, flavour and overall acceptability of *neera* was declined from 8.80 to 3.00, 8.90 to 3.00 and 8.70 to 3.00 respectively during storage. On 1st, 2nd, 3rd, 4th, 5th and 6th week of storage, the highest score for taste, flavour and overall acceptability *i.e* 8.80, 7.90, 6.90, 5.90, 4.80, 3.90 and 8.90, 7.80, 6.90, 5.80, 4.80, 3.90 and 8.70, 7.80, 6.80, 5.80, 4.70, 3.80 respectively was recorded when *neera* packed in

HDPE 50 micron pouch and stored in cold storage at 2 ºC (P_1S_1).

The organoleptic score for taste, flavour and overall acceptability of neera had a decreasing trend during six weeks of storage. The highest organoleptic score for taste, flavour and overall acceptability was recorded for *neera* packed in HDPE 50 micron pouch and stored in cold storage at 2ºC (P_1S_1). It might be due to minimum change in acidity, maximum TSS of *neera* which produce less organic substance having bad taste. The minimum changes in pH, lower fermentation which produce less organic substance having bad flavour. The highest score of taste and flavour might be the reason for obtaining the highest organoleptic score for overall acceptability. These results are in accordance with (Gobin *et al*., 2009) [6] in coconut water and (Anon, 2013) [4] in palmyra *neera*.

Table 1: Effect of packing material and storage conditions on physico chemical properties of palmyrah neera during storage

Treatments	TSS (ºBrix)						pH						Titrable acidity (%)					
	1st week	2nd week	3rd week	4th week	5th week	6th week	1st week	2nd week	3rd week	4th week	5th week	6th week	1st week	2nd week	3rd week	4th week	5th week	6th week
Packing Material																		
(P_1) HDPE 50 MICRON	10.37	10.47	10.67	10.80	9.90	8.90	4.32	4.29	4.27	4.27	4.25	4.19	0.665	0.708	0.773	0.858	1.009	1.116
(P_2) PET Bottle	10.27	10.33	10.53	10.73	9.50	8.60	4.31	4.28	4.25	4.24	4.23	4.18	0.708	0.794	0.901	0.987	1.095	1.202
(P_3) Glass Bottle	10.13	10.20	10.50	10.70	9.73	8.60	4.29	4.24	4.22	4.22	4.20	4.16	0.751	0.816	0.901	1.052	1.159	1.223
LSD (P=0.05)	0.145	0.146	0.149	0.152	0.137	0.123	NS	NS	NS	NS	NS	NS	0.010	0.011	0.012	0.014	0.015	0.017
Storage Conditions																		
(S_1) Cold Storage @ 2 ºC	10.40	10.50	10.70	10.83	9.87	8.83	4.34	4.30	4.28	4.28	4.26	4.20	0.644	0.730	0.816	0.901	1.052	1.138
(S_2) Cold Storage @ 4 ºC	10.30	10.37	10.53	10.73	9.53	8.73	4.31	4.28	4.26	4.25	4.24	4.19	0.708	0.773	0.837	0.944	1.030	1.138
(S_3) Refrigerated Storage	10.07	10.13	10.47	10.67	9.73	8.53	4.26	4.23	4.20	4.20	4.18	4.15	0.773	0.816	0.923	1.052	1.180	1.266
LSD (P=0.05)	0.145	0.146	0.149	0.152	0.137	0.123	0.061	0.060	0.060	0.060	0.060	NS	0.010	0.011	0.012	0.014	0.015	0.017
Interaction Of Packing Material X Storag4.28e Conditions (P x S)																		
P_1S_1	10.60	10.70	10.80	10.90	10.10	9.00	4.36	4.33	4.30	4.31	4.29	4.23	0.579	0.644	0.773	0.837	0.966	1.095
P_1S_2	10.40	10.50	10.70	10.80	10.00	8.90	4.34	4.3	4.29	4.28	4.27	4.20	0.644	0.708	0.708	0.837	0.966	1.030
P_1S_3	10.10	10.20	10.50	10.70	9.60	8.80	4.26	4.23	4.21	4.21	4.19	4.15	0.773	0.773	0.830	0.901	1.095	1.223
P_2S_1	10.40	10.50	10.60	10.90	9.70	8.80	4.33	4.31	4.29	4.28	4.26	4.19	0.644	0.773	0.837	0.901	1.030	1.095
P_2S_2	10.30	10.40	10.60	10.50	9.10	8.60	4.31	4.28	4.25	4.25	4.24	4.19	0.708	0.773	0.901	0.966	1.030	1.223
P_2S_3	10.10	10.10	10.340	10.80	9.70	8.40	4.28	4.24	4.20	4.20	4.18	4.15	0.773	0.837	0.966	1.095	1.223	1.288
P_3S_1	10.20	10.30	10.70	10.70	9.80	8.70	4.33	4.27	4.24	4.25	4.23	4.17	0.708	0.773	0.837	0.966	1.159	1.223
P_3S_2	10.20	10.20	10.30	10.90	9.50	8.70	4.29	4.25	4.23	4.23	4.21	4.17	0.773	0.837	0.901	1.030	1.095	1.159
P_3S_3	10.00	10.10	10.50	10.50	9.90	8.40	4.25	4.21	4.20	4.19	4.16	4.14	0.773	0.837	0.966	1.159	1.223	1.288
LSD (P=0.05)	NS	NS	NS	NS	0.238	NS	NS	NS	NS	NS	NS	NS	0.017	0.019	0.021	0.024	0.027	0.029

Table 2: Effect of packing material and storage conditions on physico chemical properties of palmyrah neera during storage

Treatments	Reducing sugars (%)						Phenolic content (mg)						Alcohol content (%)					
	1st week	2nd week	3rd week	4th week	5th week	6th week	1st week	2nd week	3rd week	4th week	5th week	6th week	1st week	2nd week	3rd week	4th week	5th week	6th week
Packing Material																		
(P_1) LDPE 50 MICRON	5.45	5.48	5.57	5.72	5.76	5.69	0.301	0.305	0.312	0.316	0.319	0.323	2.10	2.26	2.59	2.81	3.52	3.87
(P_2) HDPE 50 MICRON	5.32	5.44	5.52	5.65	5.70	5.63	0.307	0.310	0.315	0.321	0.324	0.329	2.12	2.27	2.63	2.83	3.54	3.91
(P_3) Aluminium Foil Pouches	5.22	5.35	5.44	5.56	5.59	5.52	0.310	0.312	0.315	0.317	0.322	0.326	2.14	2.28	2.65	2.90	3.58	4.01
LSD (P=0.05)	0.075	0.077	0.078	0.080	0.080	0.079	0.004	0.004	NS	NS	NS	0.005	NS	NS	0.037	0.040	NS	0.056
Storage Conditions																		
(S_1) Cold Storage @ 2 ºC	5.36	5.48	5.55	5.70	5.75	5.68	0.303	0.304	0.310	0.314	0.318	0.322	2.10	2.25	2.59	2.76	3.51	3.85
(S_2) Cold Storage @ 4 ºC	5.27	5.40	5.50	5.62	5.65	5.58	0.304	0.307	0.314	0.317	0.321	0.324	2.11	2.26	2.60	2.81	3.53	3.89
(S_3) REFRIGERATED STORAGE	5.35	5.40	5.48	5.61	5.65	5.58	0.311	0.315	0.317	0.324	0.327	0.331	2.15	2.31	2.68	2.96	3.60	4.05
LSD (P=0.05)	0.075	NS	NS	NS	0.080	0.079	0.004	0.004	0.004	0.004	0.005	0.005	0.030	0.032	0.037	0.040	0.050	0.056
Interaction Of Packing Material X Storage Conditions (P X S)																		
P_1S_1	5.39	5.51	5.58	5.75	5.80	5.73	0.297	0.299	0.308	0.312	0.315	0.318	2.08	2.24	2.56	2.73	3.49	3.77
P_1S_2	5.33	5.45	5.56	5.69	5.74	5.67	0.299	0.302	0.310	0.315	0.318	0.321	2.10	2.25	2.57	2.75	3.50	3.81
P_1S_3	5.63	5.49	5.56	5.71	5.75	5.68	0.308	0.314	0.317	0.321	0.325	0.329	2.14	2.30	2.66	2.95	3.58	4.02
P_2S_1	5.42	5.53	5.59	5.71	5.77	5.70	0.304	0.305	0.309	0.314	0.318	0.322	2.11	2.26	2.59	2.75	3.50	3.83
P_2S_2	5.29	5.41	5.49	5.63	5.66	5.59	0.305	0.308	0.317	0.318	0.321	0.325	2.12	2.26	2.61	2.76	3.52	3.86
P_2S_3	5.25	5.38	5.47	5.61	5.66	5.59	0.312	0.316	0.319	0.331	0.334	0.339	2.14	2.30	2.68	2.96	3.60	4.05
P_3S_1	5.27	5.39	5.48	5.65	5.68	5.61	0.308	0.309	0.313	0.316	0.320	0.326	2.12	2.26	2.62	2.79	3.54	3.95
P_3S_2	5.20	5.34	5.44	5.53	5.55	5.48	0.309	0.312	0.315	0.317	0.323	0.326	2.12	2.27	2.63	2.92	3.56	4.00
P_3S_3	5.18	5.32	5.41	5.50	5.54	5.46	0.312	0.314	0.316	0.319	0.323	0.326	2.17	2.32	2.70	2.98	3.62	4.07
LSD (P=0.05)	0.130	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.008	NS	NS	NS	0.070	NS	NS

Table 3: Effect of packing material and storage conditions on sensory parameters of palmyrah neera during storage

Treatments	Taste						Flavour						Overall Acceptability					
	1st week	2nd week	3rd week	4th week	5th week	6th week	1st week	2nd week	3rd week	4th week	5th week	6th week	1st week	2nd week	3rd week	4th week	5th week	6th week
P_1S_1	8.80	7.90	6.90	5.90	4.80	3.90	8.90	7.80	6.90	5.80	4.80	3.90	8.70	7.80	6.80	5.80	4.70	3.80
P_1S_2	8.70	7.80	6.80	5.80	4.70	3.80	8.70	7.70	6.80	5.70	4.70	3.80	8.60	7.70	6.70	5.70	4.60	3.70
P_1S_3	8.20	7.30	6.20	5.30	4.20	3.20	8.00	7.00	6.00	5.00	4.00	3.20	8.20	7.20	6.20	5.20	4.20	3.30
P_2S_1	8.60	7.70	6.70	5.70	4.60	3.60	8.60	7.50	6.70	5.50	4.60	3.70	8.60	7.50	6.70	5.50	4.60	3.60
P_2S_2	8.50	7.60	6.50	5.60	4.50	3.50	8.40	7.40	6.60	5.40	4.50	3.60	8.50	7.60	6.50	5.60	4.50	3.50
P_2S_3	8.10	7.20	6.10	5.20	4.10	3.10	7.90	6.90	5.80	4.80	3.90	3.10	8.00	7.00	6.00	5.00	4.00	3.20
P_3S_1	8.40	7.50	6.40	5.50	4.40	3.40	8.30	7.30	6.40	5.30	4.40	3.40	8.40	7.40	6.60	5.40	4.50	3.60
P_3S_2	8.30	7.40	6.30	5.40	4.30	3.30	8.20	7.20	6.20	5.20	4.20	3.30	8.30	7.40	6.30	5.40	4.30	3.30
P_3S_3	8.00	7.10	6.00	5.10	4.00	3.00	7.80	6.80	5.70	4.70	3.80	3.00	7.80	6.80	5.70	4.70	3.80	3.00

Conclusion

Neera is highly nutritive and a good digestive agent, however it's highly fermentable nature is a constraint in large scale production and long term storage. The present experimental study was focused on investigating the effect of packing material and storage conditions on shelf life of palmyrah *neera*. Among different packing material and storage conditions *neera* packed in HDPE 50 micron pouch and stored in cold storage at 2°C (P_1S_1) found superior for long term storage of palmyrah *neera* and maximum retention of quality and sensory parameters.

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