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Qualitative Parameters and Relative Economics of Mango (Mallika) Pulp as Influenced by Preservatives and Temperature

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ABSTRACT: The present experiment was performed to evaluate the best method for preservation of mango pulp. For this the pulp of mango were preserved with thirteen different treatment combinations *viz.*, pulp preserved with KMS@0.05% (T_1), KMS@0.1% (T_2), sodium benzoate@0.05% (T_3), sodium benzoate@0.1% (T_4), sodium meta-bisulphite@0.05% (T_5), sodium meta bi-sulphite@0.1% (T_6), potassium sorbate@0.05 % (T_7), potassium sorbate@0.1 % (T_8), sodium benzoate + potassium sorbate@0.05 % each (T_9), KMS+ potassium sorbate@0.05 % each (T_{10}), sodium meta bi-sulphite + potassium sorbate@0.05 % (T_{11}), refrigeration at 4±2°C (T_{12}), frozen storage at -20°C (T_{13}), These treatment combinations were laid out in completely randomized design and replicated four times. Among all the various treatment combinations, pulp stored under low temperature *i.e.* at (-20°C) storage was found to be superior over rest of the treatments in terms of overall qualitative characteristics such as TSS, sugars (reducing and total), ascorbic acid and higher pH and lower acidity, performed better in terms of sensory parameters such as taste, flavour, aroma, also, it resulted in higher net returns and B:C ratio. All the parameters of samples were analyzed at fortnight interval during 90 days of storage and at end of storage. The overall acceptable pulp samples were used for economic analysis and for preparation of different value added products (RTS, Squash and jam) and analyzed for its quality.

Keywords: Mango pulp, Preservation, Ambient storage, Preservative, Economics.

INTRODUCTION

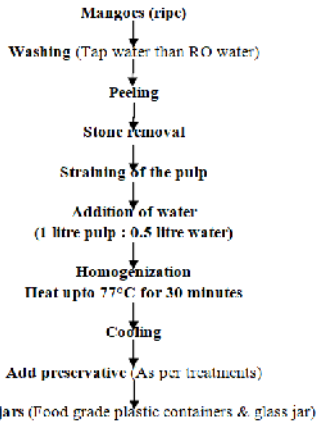
Mango (*Mangifera indica* L.) belongs to family Anacardiaceae and known for being the choicest fruit in India. It was originated from South-East Asia. The annual national production of mango is 20.44 million tons from an area of 2.29 million hectare with the productivity of 8.92 MT (NHB, 2019). Mango fruit is called "The King of fruits" throughout the world widely for its succulence, delicious sweet taste and exotic delicate flavor. The fruits are consumed fresh as table fruit and largely used in the food industry for making canned fruits, jam, squash and nectar (Tharanathan *et al.*, 2006). The mango fruit has popular demand in international market because of its delicate flavour, beautiful aroma, attractive bright colour, delicious taste and nutritional properties (Sivakumar *et al.*, 2011). apart from being a great fruit for table purpose, it is a good source of total soluble solids (18 to 22.8 %), acidity (0.12 %), total sugars (17.20 %), ascorbic acid between 6.8 to 38.8 mg 100 g^{-1}, carotenoids (16.83 µg 100 g^{-1} pulp), polyphenolic compounds and antioxidants (Yahia and Ornelas-Paz 2010) which makes mango a perfect fruit for providing a good amount of health protective bioactive compounds to the diet during summers.

Mango is a short seasoned fruit and does not withstand even in cold storage because of being highly perishable. Therefore, most of the fruit processing industries prefer to preserve mango pulp for the manufacture of mango products due to its high demand round the year. Mango pulp is not usually consumed directly rather used as an essential ingredient for fillings for pastries, sauces, crushes, jams, fruit juices and drinks (Hussain *et al.*, 2003). However, in India, mango fruits are used for the preparation of canned slices, canned pulp, squashes, nectar, juice, ready to serve beverage, jam and osmotically dehydrated pieces like mango leather etc. (Ramteke *et al.*, 1999). The mango pulp has a very high moisture content, thus does not have a good shelf life. Furthermore, the harmful impact of injudicious use of preservatives led to standardize the most effective way to preserve the pulp without losing the vital elements. Keeping this in mind the present experiment was conducted in order to find out the perfect method for preserving the mango pulp for round the year availability without losing its vital components and maintaining sensory attributes intact. Various types of

preservation methods have been tried under present investigation in order to improve the shelf life of mango pulp by using various safe preservatives with their optimum concentrations and temperature variations.

MATERIALS AND METHODS

The present experiment was performed in Post Harvest Lab, Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan) during May to October, 2016. Fully mature and ripe mango of Mallika mango fruits were procured from Agriculture Research Station, Banswara (Rajasthan) for experimentation. After fetching the fruits from the ARS, diseased, damaged and off type fruits were rejected. Fresh and physiologically mature mango fruits were washed with tap water to remove dirt and dust particles adhering to the surface of fruits and crushed for obtaining pulp. For the preparation of pulp samples, after washing thoroughly, peeling and removing the seed, the flesh was cut into small pieces with stainless steel knife and pulped by using electric blender. After diluting it with addition of water in 2:1, the pulp was homogenized and passed through fine sieve to get uniform textured pulp. Pulp was then pasteurized in a hot water bath at a temperature of 77°C for 30 minutes to reduce the initial microbial load.



Flow Chart For Extraction Of Mango Pulp

Obtained pulp was preserved with thirteen different treatments combination namely, pulp preserved with KMS@0.05% (T_1), KMS@0.1% (T_2), sodium benzoate@0.05% (T_3), sodium benzoate@0.1% (T_4), sodium meta-bisulphite@0.05% (T_5), sodium meta bi-sulphite@0.1% (T_6), potassium sorbate@0.05 % (T_7), potassium sorbate@0.1 % (T_8), sodium benzoate + potassium sorbate@0.05 % each (T_9), KMS+ potassium sorbate@0.05 % each (T_{10}), sodium meta bi-sulphite + potassium sorbate@0.05 % (T_{11}), refrigeration at 4±2°C (T_{12}), frozen storage at -20°C (T_{13}) and replicated four times. biochemical parameters of prepared samples were observed at 0, 15, 30, 45, 60, 75, 90 days of storage. The TSS content of pulp was directly measured by the "Digital Refractometer" (Brix: 0.0 to 53.0 %) at 20°C temperature. The pH of the sample was directly measured by the pH meter. Ascorbic acid was estimated by 2,6-DCIP (2,6-dichlorophenol – indophenol) dye method and the acidity of pulp was measured by diluting the known volume of pulp with distilled water and titrating against standard N/10 sodium hydroxide solution, using phenolphthalein as an indicator (A.O.A.C., 1995). Reducing sugars was determined by following "DNS Method" (Miller, 1959) while the total sugar was measured by using "Anthrone Method" (Dubois *et al.*, 1951).

Sensory evaluation of mango pulp: The pulp was assessed organoleptically on Hedonic Rating Test (Amerine *et al.*, 1965) by a panel of five judges. In following assessment, the colour, taste, texture, flavor and overall acceptability of the pulp was also evaluated. The score was given on 0-9 scale and then average from all the five values from different judges.

Hedonic rating test

Name of judge: ……Date: ……..

The judges were provided with prescribed questionnaires to record their marking. The denotations on the performa were

9 = Like extremely
8 = Like very much
7 = Like moderately
6 = Like slightly
5 = Neither like nor dislike
4 = Dislike slightly
3 = Dislike moderately
2 = Dislike very much
1 = Dislike extremely.

The data were analyzed under Completely Randomized Design (Fisher, 1950).

RESULTS AND DISCUSSION

TSS and total sugar. The data pertaining to TSS and total sugar content of stored mango pulp increased with the advancement of storage period in all the treatments (Table 1 and 2). Among various treatments, the maximum TSS and total sugar content were recorded under the treatment T_{13} (22.0°B and 15.69 %) *i.e.* frozen storage at -20°C whereas the minimum values for the same were observed under treatment T_7 (18.40°B and 14.98 %) during the storage. The increasing pattern in TSS content of mango pulp during storage was possibly due to change of free polysaccharides (starch) into monosaccharide (Jain and Nema 2007). Similar results were observed by Akhtar *et al.* (2010) in mango pulp, Chandra and Gehlot (2006) in bael pulp and Yadav *et al.* (2017) in guava pulp where TSS and total sugar content during storage were found to be following a positive proportional trend.

Acidity and pH. The data pertaining to acidity and pH revealed that the acidity of mango pulp increased and pH was found to be decreasing slightly over the period of time (Table 3 and 4). The maximum acidity (0.88%) was recorded in the treatment T_7 (PS@ 0.05%) whereas the minimum acidity (0.55%) was found under the treatment (T_{13}) *i.e.* at -20°C frozen storage. In pH *vice versa* pattern was observed from acidity *i.e.*, maximum in treatment T_{13} (3.85) whereas minimum in treatment T_7 (2.86). The increase in acidity of mango pulp during storage might have been due to formation of organic

acids by degradation of ascorbic acids (Bal *et al.*, 2014) and decrease in pH might be due to pectin hydrolysis and the formation of free acids (Ahmad *et al.*, 2000).

Ascorbic acid. As evident from the data, ascorbic acid content of mango pulp was observed decreasing as the storage period advanced (Table 5). Among various treatment combinations, the maximum ascorbic acid content was observed under treatment T_{13} (13.02 mg 100 g^{-1}) followed by T_{12} (12.88 mg 100 g^{-1}) whereas minimum was observed under treatment T_7 (9.89 mg 100 g^{-1}) at the end of 90 days of storage period. Decreasing values in ascorbic acid content might be due to the oxidation of ascorbic acid to de-hydro ascorbic acid that further degraded to 2, 3-diketo-gluconic acid by the action of ascorbic acid oxidase enzyme.

Reducing sugar. Table explicated the increase in reducing sugar content with the advancement of storage period in all the treatments (Table 6), where maximum value for reducing sugar was recorded under treatment T_{13} (12.04 per cent) followed by T_2 (11.94 per cent) whereas minimum reducing sugar was found under treatment T_7 (10.26 per cent) at the end of the storage. This increase might be due to breakdown of the hemicelluloses and other saccharides into simple soluble sugars. The results of present study are supported by Tandon *et al.* (1984) in guava pulp and Desai *et al.* (2012) in mango pulp.

Sensory evaluation. Organoleptic assessment of the mango pulp samples was performed for assessing the taste, flavor and aroma. It is obvious from the tables that that addition of chemical preservatives significantly positively influences sensory traits (Table 7-9). The data pertaining to the effect of chemical preservatives to mango pulp are presented in (Table 7-9) for assessing the taste, flavor and aroma respectively. The data revealed that maximum value for taste, flavor and aroma of mango pulp, maximum mean value was noted under mango pulp stored under refrigeration at -20°C and with minimum loss of flavor, aroma and taste of the pulp. However, slight loss in sensory qualities might be due to increased acidity and caramelization, and oxidation activities over a period of time during storage. Yadav *et al.* (2017) observed the similar findings where maximum value for flavor was observed under frozen storage at -20°C and the findings were in conformity with the findings of Khan *et al.* (2014) for strawberry jam. Results from the present investigation confirms that the loss of taste and flavour might possibly be due to the degradation of ascorbic acid and furfural production over the time (Shimoda and Osajima 1981; Perez and Sanz 2001).

Economics. From economic analysis the most economically feasible treatment combination with maximum incremental B:C ratio (2.24) and net returns (₹ 6850) was found to be under T_{13} (Frozen storage -20°C), however maximum B:C (2.87) was observed under treatment T_2(KMS@ 0.1%)) (Table 10).

Table 1: Effect of different preservatives and temperatures on TSS of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	17.50	17.80	17.80	18.00	18.20	18.40	18.80
T_2 (KMS@ 0.1%)	17.60	18.20	18.90	19.20	19.70	20.20	20.80
T_3 (SB@ 0.05%)	17.30	17.80	18.40	18.60	18.80	19.00	19.20
T_4 (SB@ 0.1%)	17.40	18.00	18.60	18.80	19.00	19.10	19.30
T_5 (SMS@ 0.05%)	17.30	17.50	17.60	17.80	18.10	18.40	18.80
T_6 (SMS@ 0.1%)	17.30	17.60	17.80	18.10	18.60	19.10	19.30
T_7 (PS@ 0.05%)	17.10	17.40	17.60	17.70	17.90	18.20	18.40
T_8 (PS@ 0.1%)	17.20	17.30	17.50	17.80	18.00	18.40	18.70
T_9 (SB+PS@ 0.05% each)	17.30	17.50	17.90	18.10	18.60	19.00	19.30
T_{10} (KMS+PS@ 0.05% each)	17.50	18.20	18.40	18.80	19.20	20.00	20.30
T_{11} (SMS+PS@ 0.05% each)	17.40	17.60	17.80	18.00	18.60	18.80	18.80
T_{12} (Refrigeration (4±2°C)	17.50	18.20	18.80	19.30	19.80	20.30	20.90
T_{13} (Frozen storage -20°C)	17.60	18.40	19.30	20.00	20.70	21.40	22.00
SEm±	0.37	0.39	0.60	0.42	0.42	0.34	0.43
C.D. (P=0.05)	NS	NS	NS	1.21	1.21	0.99	1.26

Table 2: Effect of different preservatives and temperatures on total sugar (%) content of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	13.05	13.39	13.90	14.28	14.29	15.01	15.09
T_2 (KMS@ 0.1%)	13.13	13.61	14.08	14.43	14.53	15.17	15.36
T_3 (SB@ 0.05%)	13.09	13.35	13.88	14.27	14.30	14.98	15.13
T_4 (SB@ 0.1%)	13.11	13.58	14.03	14.39	14.49	15.12	15.31
T_5 (SMS@ 0.05%)	13.13	13.35	13.83	14.23	14.31	14.95	15.14
T_6 (SMS@ 0.1%)	13.11	13.38	13.86	14.24	14.33	14.98	15.21
T_7 (PS@ 0.05%)	13.12	13.23	13.74	14.13	14.22	14.67	14.98
T_8 (PS@ 0.1%)	13.16	13.28	13.79	14.16	14.26	14.71	15.07
T_9 (SB+PS@ 0.05% each)	13.09	13.48	14.01	14.29	14.36	15.07	15.17
T_{10} (KMS+PS@ 0.05% each)	13.13	13.54	14.01	14.31	14.38	15.09	15.24
T_{11} (SMS+PS@ 0.05% each)	13.12	13.45	13.99	14.28	14.32	15.04	15.11
T_{12} (Refrigeration (4±2°C)	13.16	13.65	14.13	14.56	14.78	15.21	15.44
T_{13} (Frozen storage -20°C)	13.16	13.78	14.16	14.68	14.99	15.34	15.69
SEm±	0.20	0.20	0.18	0.10	0.15	0.12	0.12
C.D. (P=0.05)	NS	NS	NS	0.30	0.43	0.35	0.36

Table 3: Effect of different preservatives and temperatures on acidity (%) content of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	0.47	0.58	0.59	0.61	0.62	0.65	0.72
T_2 (KMS@ 0.1%)	0.45	0.50	0.50	0.52	0.53	0.54	0.60
T_3 (SB@ 0.05%)	0.46	0.54	0.56	0.61	0.62	0.72	0.80
T_4 (SB@ 0.1%)	0.42	0.54	0.55	0.56	0.58	0.59	0.66
T_5 (SMS@ 0.05%)	0.46	0.53	0.55	0.61	0.62	0.71	0.79
T_6 (SMS@ 0.1%)	0.46	0.52	0.54	0.59	0.61	0.70	0.78
T_7 (PS@ 0.05%)	0.45	0.59	0.62	0.64	0.69	0.79	0.88
T_8 (PS@0.1%)	0.43	0.55	0.57	0.62	0.64	0.74	0.82
T_9 (SB+PS@ 0.05% each)	0.46	0.54	0.56	0.59	0.62	0.67	0.73
T_{10} (KMS+PS@ 0.05% each)	0.47	0.56	0.58	0.60	0.61	0.62	0.68
T_{11} (SMS+PS@ 0.05% each)	0.47	0.57	0.59	0.60	0.60	0.63	0.70
T_{12} (Refrigeration (4±2°C)	0.44	0.48	0.49	0.50	0.50	0.53	0.56
T_{13} (Frozen storage -20°C)	0.45	0.47	0.48	0.49	0.50	0.50	0.55
SEm±	0.01	0.03	0.01	0.01	0.01	0.01	0.02
C.D. (P=0.05)	NS	NS	0.04	0.04	0.04	0.03	0.05

Table 4: Effect of different preservatives and temperatures on pH content of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	4.22	4.11	3.85	3.69	3.39	3.16	2.91
T_2 (KMS@ 0.1%)	4.23	4.17	3.86	3.71	3.46	3.17	2.99
T_3 (SB@ 0.05%)	4.24	4.12	3.85	3.69	3.41	3.17	2.96
T_4 (SB@ 0.1%)	4.21	4.16	3.87	3.72	3.45	3.18	2.97
T_5 (SMS@ 0.05%)	4.23	4.11	3.87	3.63	3.39	3.19	2.92
T_6 (SMS@ 0.1%)	4.24	4.15	3.89	3.64	3.41	3.22	2.94
T_7 (PS@ 0.05%)	4.23	3.93	3.79	3.49	3.29	3.11	2.86
T_8 (PS@ 0.1%)	4.22	3.94	3.81	3.51	3.32	3.23	2.89
T_9 (SB+PS@ 0.05% each)	4.24	3.98	3.84	3.57	3.39	3.19	2.98
T_{10} (KMS+PS@ 0.05% each)	4.25	4.10	3.87	3.63	3.46	3.25	2.96
T_{11} (SMS+PS@ 0.05% each)	4.22	4.04	3.84	3.59	3.42	3.21	2.91
T_{12} (Refrigeration (4±2°C)	4.23	4.18	3.96	3.95	3.87	3.80	3.72
T_{13} (Frozen storage -20°C)	4.21	4.18	4.11	4.05	4.01	3.91	3.85
SEm±	0.06	0.07	0.06	0.04	0.04	0.03	0.02
C.D. (P=0.05)	NS	NS	NS	0.12	0.11	0.09	0.06

Table 5: Effect of different preservatives and temperatures on ascorbic acid (mg $100g^{-1}$ of pulp) content of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	25.02	23.54	22.01	19.01	17.02	14.99	12.56
T_2 (KMS@ 0.1%)	25.03	23.67	22.17	19.12	17.34	15.12	12.76
T_3 (SB@ 0.05%)	24.98	21.97	19.73	18.23	16.65	14.61	11.14
T_4 (SB@ 0.1%)	25.04	22.21	20.11	18.67	16.02	14.02	11.88
T_5 (SMS@ 0.05%)	25.04	22.91	19.21	17.89	15.97	13.61	10.89
T_6 (SMS@ 0.1%)	24.99	22.31	20.17	18.91	16.03	15.04	10.98
T_7 (PS@ 0.05%)	24.94	21.92	18.92	17.92	15.54	13.77	9.89
T_8 (PS@ 0.1%)	25.04	23.17	20.71	18.83	16.02	14.78	10.87
T_9 (SB+PS@ 0.05% each)	24.93	23.26	20.81	18.33	15.93	13.91	10.91
T_{10} (KMS+PS@ 0.05% each)	24.89	23.59	20.69	19.05	17.03	15.00	12.57
T_{11} (SMS+PS@ 0.05% each)	24.87	23.23	19.89	18.62	15.91	13.78	11.03
T_{12} (Refrigeration (4±2°C)	25.05	23.89	21.67	19.24	17.16	15.02	12.88
T_{13} (Frozen storage -20°C)	25.15	23.91	21.87	19.84	17.43	16.23	13.02
SEm±	0.53	0.52	0.52	0.37	0.36	0.26	0.26
C.D. (P=0.05)	NS	NS	1.51	1.08	1.04	0.76	0.76

Table 6: Effect of different preservatives and temperatures on reducing sugar (%) content of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	9.79	9.86	9.99	10.08	10.11	10.24	10.32
T_2 (KMS@ 0.1%)	9.84	10.31	10.67	10.93	11.04	11.46	11.78
T_3 (SB@ 0.05%)	9.73	10.08	10.30	10.42	10.53	10.64	10.71
T_4 (SB@ 0.1%)	9.79	10.25	10.42	10.53	10.64	11.20	11.37
T_5 (SMS@ 0.05%)	9.81	9.89	9.97	10.18	10.26	10.34	10.41
T_6 (SMS@ 0.1%)	9.73	9.86	9.97	10.13	10.37	10.68	10.74
T_7 (PS@ 0.05%)	9.68	9.67	9.84	10.04	10.14	10.20	10.26
T_8 (PS@ 0.1%)	9.68	9.74	9.97	10.08	10.18	10.28	10.36
T_9 (SB+PS@ 0.05% each)	9.56	10.11	10.14	10.21	10.28	10.31	10.42
T_{10} (KMS+PS@ 0.05% each)	9.84	10.19	10.30	10.53	10.75	10.70	10.88
T_{11} (SMS+PS@ 0.05% each)	9.90	10.14	10.19	10.26	10.34	10.54	10.61
T_{12} (Refrigeration (4±2°C)	9.84	10.52	10.73	10.93	11.01	11.54	11.94
T_{13} (Frozen storage -20°C)	9.90	10.54	11.01	11.34	11.58	11.84	12.04
SEm±	0.15	0.23	0.28	0.11	0.12	0.10	0.07
C.D. (P=0.05)	NS	NS	NS	0.33	0.34	0.30	0.20

Table 7: Effect of different preservatives and temperatures on taste of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	8.84	8.76	8.65	8.00	7.10	6.62	6.00
T_2 (KMS@ 0.1%)	8.83	8.78	8.68	8.22	7.43	6.72	6.13
T_3 (SB@ 0.05%)	8.83	8.70	8.65	8.20	7.41	6.68	6.03
T_4 (SB@ 0.1%)	8.81	8.79	8.69	8.24	7.41	6.65	6.09
T_5 (SMS@ 0.05%)	8.82	8.75	8.64	8.21	7.39	6.63	6.09
T_6 (SMS@ 0.1%)	8.85	8.80	8.70	8.20	7.40	6.65	6.02
T_7 (PS@ 0.05%)	8.83	8.78	8.68	8.18	7.38	6.54	5.81
T_8 (PS@ 0.1%)	8.80	8.77	8.66	8.13	7.26	6.70	6.00
T_9 (SB+PS@ 0.05% each)	8.80	8.72	8.66	8.22	7.45	6.70	6.10
T_{10} (KMS+PS@ 0.05% each)	8.81	8.66	8.69	8.23	7.42	6.70	6.07
T_{11} (SMS+PS@ 0.05% each)	8.82	8.77	8.65	8.22	7.40	6.65	5.89
T_{12} (Refrigeration (4±2°C)	8.83	8.78	8.68	8.18	7.38	6.54	6.10
T_{13} (Frozen storage -20°C)	8.90	8.85	8.75	8.25	7.45	6.91	6.43
SEm±	0.19	0.20	0.22	0.18	0.12	0.06	0.10
C.D. (P=0.05)	NS	NS	NS	NS	NS	0.18	0.28

Table 8: Effect of different preservatives and temperatures on flavour of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	8.70	8.82	8.73	8.53	8.00	7.19	5.60
T_2 (KMS@ 0.1%)	8.93	8.84	8.74	8.55	8.04	7.24	6.24
T_3 (SB@ 0.05%)	8.83	8.75	8.69	8.35	7.50	7.19	6.00
T_4 (SB@ 0.1%)	8.85	8.77	8.71	8.50	8.01	7.21	6.21
T_5 (SMS@ 0.05%)	8.86	8.76	8.67	8.50	8.14	7.10	5.50
T_6 (SMS@ 0.1%)	8.90	8.80	8.69	8.53	8.20	7.28	6.19
T_7 (PS@ 0.05%)	8.75	8.74	8.64	8.44	7.95	6.18	5.14
T_8 (PS@ 0.1%)	8.80	8.74	8.67	8.45	7.94	6.20	5.30
T_9 (SB+PS@ 0.05% each)	8.81	8.76	8.67	8.47	7.80	7.20	6.00
T_{10} (KMS+PS@ 0.05% each)	8.87	8.80	8.68	8.52	8.02	7.22	6.22
T_{11} (SMS+PS@ 0.05% each)	8.81	8.76	8.69	8.49	7.99	7.30	5.60
T_{12} (Refrigeration (4±2°C)	8.97	8.91	8.80	8.54	8.00	7.10	6.10
T_{13} (Frozen storage -20°C)	8.98	8.93	8.81	8.61	8.10	7.30	6.30
SEm±	0.19	0.20	0.22	0.19	0.13	0.13	0.13
C.D. (P=0.05)	NS	NS	NS	NS	NS	0.37	0.39

Table 9: Effect of different preservatives and temperatures on aroma of mango pulp during storage.

Treatments	Storage duration (days)						
	0	15	30	45	60	75	90
T_1 (KMS@ 0.05%)	6.85	6.83	6.71	6.60	6.55	6.24	6.01
T_2 (KMS@ 0.1%)	6.85	6.84	6.73	6.63	6.53	6.28	6.08
T_3 (SB@ 0.05%)	6.83	6.80	6.70	6.60	6.45	6.20	6.00
T_4 (SB@ 0.1%)	6.82	6.81	6.71	6.60	6.50	6.24	6.04
T_5 (SMS@ 0.05%)	6.81	6.79	6.73	6.56	6.49	6.00	5.90
T_6 (SMS@ 0.1%)	6.82	6.80	6.75	6.58	6.50	6.10	6.00
T_7 (PS@ 0.05%)	6.81	6.80	6.70	6.59	6.50	6.20	6.00
T_8 (PS@ 0.1%)	6.83	6.81	6.72	6.61	6.51	6.25	6.05
T_9 (SB+PS@ 0.05% each)	6.79	6.78	6.66	6.56	6.46	6.21	6.00
T_{10} (KMS+PS@ 0.05% each)	6.80	6.79	6.69	6.59	6.49	6.23	6.00
T_{11} (SMS+PS@ 0.05% each)	6.79	6.79	6.68	6.57	6.50	6.21	6.00
T_{12} (Refrigeration (4±2°C)	6.90	6.88	6.77	6.70	6.60	6.30	6.10
T_{13} (Frozen storage -20°C)	6.90	6.89	6.78	6.70	6.60	6.32	6.12
SEm±	0.15	0.15	0.17	0.15	0.11	0.06	0.04
C.D. (P=0.05)	NS	NS	NS	NS	NS	0.16	0.11

Table 10: Economics of different treatments of preservatives and temperature in mango pulp preservation.

Preservation Methods	Cost (Rs.)	Gross return (Rs.)	Net return (Rs.)	B C ratio	Incremental B:C over T_7
T_1 (KMS@ 0.05%)	2313	7500	5187	2.24	1.70
T_2 (KMS@0.1%)	2326	9000	6674	2.87	2.18
T_3 (SB@0.05%)	2314	7200	4886	2.11	1.60
T_4 (SB@0.1%)	2328	8100	5772	2.48	1.89
T_5 (SMS@0.05%)	2314	5550	3236	1.40	1.06
T_6 (SMS@ 0.1%)	2328	6000	3672	1.58	1.20
T_7 (PS@0.05%)	2342	5400	3058	1.31	1.00
T_8 (PS@0.1%)	2384	5700	3316	1.39	1.08
T_9 (SB+PS@0.05% each)	2356	7350	4994	2.12	1.63
T_{10} (KMS+PS@0.05% each)	2355	8250	5895	2.50	1.93
T_{11} (SMS+PS@0.05% each)	2356	7500	5144	2.18	1.68
T_{12} (Refrigeration (4±2°C)	2750	9000	6250	2.27	2.04
T_{13} (Frozen storage -20°C)	2750	9600	6850	2.49	2.24

CONCLUSION

As per the results from the present investigation, the following conclusion can be derived that, mango pulp preserved under low temperature (-20°C) resulted in superior quality and physico-chemical stability upto 90 days of storage. However from economical analysis, preserving the pulp preserved with KMS was found to be the best but pulp storage at -20°C was found best from health point of view considering the chemical preservatives being harmful to the health and may be proposed for preservation of mango pulp. The present research work can be helpful for further development of a safer and viable storage of mango pulp at industrial scale.

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