Studies the Shelf life of litchi (*Litchi chinensis* Sonn.) juice as a function of preservation methods

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Abstract

The present investigation entitled, **"Studies the Shelf life of litchi (*Litchi chinensis* Sonn.) juice as a function of preservation methods"** was conducted in the SGGS Khalsa College, Department of Agriculture, Mahilpur, Hoshiarpur during year 2017-18. The salts of various organic acids like citric acid, tartaric acid, ascorbic acid have been tested for preservation of fruit juice due to their greater solubility in water. The primary inhibitory action of these acids is against yeasts and moulds. While the activity against bacteria is not comprehensive and appears to be selective. Overall citric acid appears to be the safest food preservative for litchi juice preservation which can be effectively used to inhibit chemical, enzymatic or microbiological deterioration at concentration as low as 0.1- 0.25 %. Potassium meta-bisulphite is highly soluble in water so is preferred as an effective preservative and its 0.05% concentration can satisfactorily control the microbiological, physical and chemical quality of litchi juices during ambient temperature or controlled atmosphere storage.

Key words: Litchi, juice, acidity and preservation

Introduction

The litchi (*Litchi chinensis* Sonn.) is one of the cheapest fruit of region and belongs to family *Sapindaceae.* Skin which is green in early phase of development but becomes red, rose or pink at full maturity depending on seeds only after formation of seeds below the skin and having cultivars specific flavors. The litchi fruit is also rich source of vitamins 'C' (Wall, 2006) and phenolic compounds that have antioxidant activities (Hu *et al*. 2010) but it may decrease after harvest (Taylor, 1993). Litchi is preferred for its characteristic sweet-acidic taste, excellent aroma and high nutritive value. Litchi fruit consists of 60 percent juice, 8 percent rag, 19 percent skin and 16% seeds varied depending upon the varieties and the climate under which it is grown. Litchi pulp is rich in sugar which varies from 6.74 to 18.00 percent with the average of 11.85 percent and contains 78.2% moisture, 17-18% TSS, 0.69% ash, 4.92 pH, 0.327% acidity and 1.2 mg/100g Vitamin-C. It also contains protein (0.3%), minerals, calcium and phosphorus (0.7%) and Vitamin- A, B_1 and B_2. Litchi is delicate and highly perishable so long duration storage results in pericarp browning. Low temperature storage, sulphur dioxide, fumigation, dipping in wax emulsions are commercially used to extend the shelf life and reducing browning (Chand and Polo, 2006, Sharma and Pongene 2010, Marbon *et al.* 2012). Litchi is mostly consumed as a table fruit, however it can be utilized for processing in to different products such as canned litchi, squash, cordial, syrups, ready to serve (RTS) canned litchi , soft drink, wine, jam, jelly and concentrates (Vijayanand *et al*. 2010). One litre of fresh litchi juice contains 161.4g total sugar and 2.2 g total acids (Zeng *et al.* 2008). The content of vitamin-C was reported as 354.12 mg/l which is 8 times that of apple juice (40 mg/l) as suggested by Yang *et al.*, (2002). Fruit juices can be suitably preserved by pasteurization at low temperature (63◦C) for longer period (30min) where the leached components will remain also in the product. Pasteurization has also been reported to prevent vitamin-C degradation. Li *et al.* (2012) had also suggested the thermal processing at 70-121◦C for 30-120 seconds as the most effective technique to inactivate the microorganism and enzymes in fruit juice. Among different preservatives, sodium benzoate and benzoic acid are effective to inhibit yeast and moulds (Banwort, 1981); sodium and potassium metabisulphites can reduce browning (Costa *et al.* 2003), citric and tartaric acids are well known to bring down activity of polyphenol oxidase (Quelroz *et al.*, 2011). Sodium benzoate, sodium sorbate and

sodium bisulphate have protential to keep equally and colome of fruit juice acceptable even at ambient temperate and can waste against microbial activity in juice (Rusul ad aug, 1994).

Preservation of fruit juice for consumption exposes it for changes in chemical composition, colour, antioxidant property and sensory value to a lower level which leads to reduce the health related quality of fruit juice. To maintain the quality for health benefit, it is necessary to standardize the suitable preservatives and preservation methods for litchi juice preservation.

Material and methods

Litchi cv Calcuttia was used for present study. The Litchi fruits of uniform size, disease free were picked at full maturity randomly from all the four directions of the plants with the help of secateurs. Extracted juice was divided into containers as per the treatments and five bottles for each treatments were packed and pasteurized. The experiment was carried out in Completely Randomized design with 11 treatments and 3 replications. The treatments consisted of T_1: Pasteurized juice or Control, T_2: Pasteurized juice + 0.05% Potassium meta- bi- sulphite, T_3: Pasteurized juice +0.1% Citric acid, T_4: Pasteurized juice + 0.15% Citric acid, T_5: Pasteurized juice + 0.20% Citric acid, T_6: Pasteurized juice + 0.25% Citric acid, T_7: Pasteurized juice + 0.1% Tartaric acid, T_8: Pasteurized juice + 0.15% Tartaric acid, T_9: Pasteurized juice + 0.20% Tartaric acid, T_{10}: Pasteurized juice + 0.25% Tartaric acid, T_{11}: Non-pasteurized juice under cold storage. Observations were recorded on all randomly selected fruit juices *i.e.* TSS (Total soluble solids), ascorbic acid, total acidity, active acidity, total sugar, reducing sugar, non-reducing sugar, sensory analysis, browning and microbial count. The data was analyzed as per design of the experiment.

Result and Discussion

Total soluble solid (TSS)

It is evident from the observations that TSS was significantly affected by preservatives added in juice at all the days of observations. Highest value of TSS (16.10%, 16.30%, 16.53%,16.60% and 16.73%) at 0 days, 15 days, 30 days, 45 days and 60 days of storage respectively, was reported in T_6 (Pasteurized juice + 0.25% Citric acid). Increase in TSS during storage of litchi fruit juice might be due to increased hydrolysis of polysaccharides with gradual passage of time as reported by Bhardwaj (2013). The increase in TSS was higher in juices stored at ambient temperature in comparison to low temperature storage (T_{11}) which could be attributed to high rate of solubilisation as proposed by Bhardwaj and Nandlal (2014) in blended Kinnow juice at ambient temperature and by Prasad and Mali (2000) who had reported reduced hydrolysis of polysaccharides and acids under refrigerator storage accounts for least increase in TSS in Kinnow Juice.

Ascorbic acid

At 15 and 30 days of storage, highest (132.67 and 101.46 mg/l, respectively) ascorbic acid content was reported in T_{11} (Non-pasteurized juice under cold storage). Whereas lowest (39.97, 54.09, 70.31 and 84.40%) decrease in ascorbic acid was observed in T_{11}. The expected decrease in ascorbic acid content of litchi fruit juice during passage of storage duration might be due to the interaction effect of light, metallic ions and prevailing high temperature which had resulted in oxidation of ascorbic acid to dehydroascorbic acid and is in conformity with findings of Bhargawa *et al.* (2014) in blanched and unblanched aloe juice supplemented with Kinnow nectar and Ahmed *et al.* (2008) in citrus juice.

Titratable Acidity

It is evident from the observations that acidity was significantly varied between treatments with highest value as 0.336% in T_{11} (Non-pasteurized juice under cold storage) at 0 day of storage, 0.366% in T_{10} (Pasteurized juice + 0.25% Tartaric acid) at 15 days of storage, 0.397%, 0.410% and 0.431% in T_1 (Pasteurized juice or Control) at 30, 45 and 60 days of storage. T_2 (Pasteurized juice + 0.05% Potassium meta- bi- sulphite) was reported to contain lowest (0.287, 0.317, 0.349, 0.362 and 0.383%) value of titratable acidity at 0 day, 15 days, 30 days, 45 days and 60 days of storage, respectively. Acidity of litchi

juice was also significantly affected with storage duration and showed increasing trend during storage in both refrigerator storage with non-pasteurized juice or ambient temperature storage of pasteurized juice and with or without preservatives. The increase in acidity during storage could be possible associated with fermentation of sugar present in litchi juice and is the unique character of litchi fruit juice.

pH Value

It is evident from data presented for litchi juice at 0, 15, 30, 45 and 60 days of storage that pH was significantly influenced by preservatives and storage duration. Throughout the storage period highest (4.33, 4.33, 4.36, 4.45 and 5.27) and acceptable pH was reported in T_2 (Pasteurized juice + 0.05% Potassium meta-bi- sulphite). The possible reason for increase in pH with prolonged storage of Kinnow juice may be the acid hydrolysis of the poly-saccharides into mono-saccharides and di-saccharides which are responsible for increase in sweetness and decrease in sourness. The results of present investigation are in line with the findings of Alaka *et al.* (2003). The increase in pH during storage is also in conformity with the findings of Rahman *et al.* (2014) who had reported significant and high pH value of mango and peach juice concentrates at 30 days of storage.

Sugar content

Highest total sugar was reported in T1 (17.47% and 17.57%) at 0 days and 15 days of storage, respectively, whereas at 30 days, 45 days and 60 days of storage it was highest in T1 (20.66%, 21.34% and 22.43%, respectively). Lowest (8.86%, 9.16% and 9.64%) non-reducing sugar was reported in T2 at 30, 45 and 60 gays of storage. Increase in concentration of citric acid and tartaric acid during storage was also reported to be influenced by their concentration and percentage increase in sugar content of litchi fruit juice was reported to be negatively correlated with the concentration of these preservatives in the juice. Increase in sugar content with increased level of citric acid and tartaric acid during storage might be associated with better substrate hydrolysis of complex compounds like poly-saccharides and even the organic acids added as preservatives. These findings are in conformity with findings of Ranote and Bains (1982) in pasteurized Kinnow juice, Sarmah *et al.* (1981) who reported increase in reducing sugar content in single strength Kinnow juice at room temperature.

Sensory Analysis and Overall Acceptability

Acceptability of litchi juice was significantly influenced by various preservation methods and preservatives concentration and has been gradually changed during the storage. Highest consumer acceptability at all evaluation was reported with non-pasteurized litchi juice under cold storage. The lower acceptability of preserved litchi juice in all the treatments except T11 might be due to off flavour developed due to pasteurization of litchi juice.

Browning

It is clear from the observation that absorbance has significantly increased during storage of litchi juice as at 0 days absorbance for all treatments were less than 0.2 which has increased for most of the treatments above 0.2. The treatments reported to have higher absorbance at 30 days of storage were T8. This reflects that only high concentration of Tartaric acid and citric acids were able to inhibit the enzymatic browning of preserved litchi juice. KMS @ 0.5% and low temperature storage have been effectively controlled the browning of juice. This efficient regulation of enzymatic browning of litchi juice by KMS and high concentration of citric and tartaric acid might be due to their ability to prevent oxidation of sugar in the juice as they are supposed to effectively bind with substrate or enzymes to prevent oxidation.

Microbial count

No any bacterial colonies were reported at 15 days of storage. At 30 days of storage bacterial colonies were recorded only in juice without any preservatives stored at ambient temperature (T1) while other treatment

does not have given any sign of bacterial colonies. At 30 and 60 days of storage highest number of colonies were recorded in T1 followed by T3 whereas T11 (Non-pasteurized juice stored at 4^0C temperature).

Conclusion

The salts of various organic acids like citric acid, tartaric acid, ascorbic acid have been tested for preservation of fruit juice due to their greater solubility in water. The primary inhibitory action of these acids is against yeasts and moulds. While the activity against bacteria is not comprehensive and appears to be selective. Overall citric acid appears to be the safest food preservative for litchi juice preservation which can be effectively used to inhibit chemical, enzymatic or microbiological deterioration at concentration as low as 0.1- 0.25 %. Potassium meta-bisulphite is highly soluble in water so is preferred as an effective preservative and its 0.05% concentration can satisfactorily control the microbiological, physical and chemical quality of litchi juices during ambient temperature or controlled atmosphere storage.

Table-1. Effect of preservatives on TSS of litchi fruit juice during storage

Treatments	Overall Acceptability of Litchi Juice				
	At 0 days of Storage	At 15 days of storage	At 30 days of storage	At 45 days of storage	At 60 days of storage
T1	8.53	8.4	7.93	6.40	5.40
T2	8.60	8.53	8.07	7.40	6.63
T3	8.50	8.10	7.70	6.87	6.23
T4	8.13	7.73	7.30	6.53	5.93
T5	7.97	7.57	7.17	6.30	5.80
T6	7.87	7.47	7.07	6.20	5.70
T7	8.53	8.13	7.40	6.93	6.00
T8	8.30	7.90	7.50	6.63	6.07
T9	7.97	7.57	7.10	6.33	5.70
T10	7.87	7.47	7.00	6.20	5.63
T11	9.07	9.00	8.50	7.80	6.40
Mean	8.303	7.988	7.521	6.691	5.954
Sem(±)	0.067	0.064	0.093	0.077	0.145
CD	0.195	0.186	0.272	0.226	0.426
CV	1.390	1.378	2.134	1.998	4.226

Table-2. Effect of preservatives on Ascorbic Acid Content of litchi fruit juice during storage

Treatments	Ascorbic Acid (mg/l)				
	At 0 days of Storage	At 15 days of storage	At 30 days of storage	At 45 days of storage	At 60 days of storage
T1	220.89	122.55	85.80	45.89	14.77
T2	219.95	129.61	96.77	65.96	34.84
T3	220.49	125.15	86.91	50.77	19.65
T4	220.15	124.81	87.41	51.83	20.71
T5	221.09	125.75	87.87	52.86	21.74
T6	220.42	127.66	92.06	61.91	30.79
T7	220.67	125.19	87.06	51.19	20.07
T8	220.39	124.91	87.10	51.93	20.81
T9	221.04	125.56	88.24	52.15	21.03
T10	220.59	127.92	90.54	61.72	30.60
T11	221.01	132.67	101.46	65.61	34.49

Mean	220.61	126.52	90.11	55.62	24.50
Sem(±)	0.616	0.616	0.374	0.378	0.378
CD	1.805 (NS)	1.805	1.095	1.108	1.108
CV	0.483	0.842732	0.718	1.177	2.671

Table-3. Effect of preservatives on Titratable Acidity of litchi fruit juice during storage

Treatments	Acidity (%)				
	At 0 days of Storage	At 15 days of storage	At 30 days of storage	At 45 days of storage	At 60 days of storage
T1	0.297	0.347	0.397	0.410	0.431
T2	0.287	0.317	0.349	0.362	0.383
T3	0.30	0.353	0.385	0.398	0.419
T4	0.300	0.350	0.381	0.394	0.415
T5	0.308	0.343	0.375	0.388	0.409
T6	0.307	0.336	0.367	0.380	0.401
T7	0.292	0.342	0.374	0.387	0.408
T8	0.299	0.349	0.380	0.393	0.414
T9	0.305	0.344	0.3765	0.3889	0.410
T10	0.327	0.366	0.388	0.401	0.422
T11	0.336	0.345	0.374	0.396	0.423
Mean	0.305	0.3445	0.377	0.391	0.412
Sem(±)	0.0078	0.00690	0.0060	0.006	0.006
CD	0.023	0.0202	0.0176	0.0178	0.0178
CV	4.475	3.466	2.754	2.695	2.55462

Table-4. Effect of preservatives on pH of litchi juice during storage

Treatments	pH				
	At 0 days of Storage	At 15 days of storage	At 30 days of storage	At 45 days of storage	At 60 days of storage
T1	4.27	3.74	3.06	3.49	3.84
T2	4.33	4.33	4.36	4.45	5.27
T3	3.23	3.534	3.89	4.08	4.25
T4	3.04	3.32	3.74	4.03	4.17
T5	2.82	3.18	3.47	3.71	3.95
T6	2.64	2.99	3.20	3.645	3.86
T7	3.08	3.58	3.82	4.03	4.22
T8	2.74	2.99	3.14	3.68	4.20
T9	2.54	2.90	3.13	3.51	4.06
T10	2.26	2.59	3.03	3.34	3.93
T11	3.05	3.17	3.25	3.17	3.10
Mean	3.09	3.303	3.464	3.739	4.078
Sem(±)	0.015	0.044	0.059	0.049	0.044
CD	0.044	0.131	0.173	0.145	0.130
CV	0.841	2.335	2.956	2.288	1.885

Table-5. Effect of preservatives on Non-reducing sugar of litchi fruit juice during storage

Treatments	Non-reducing Sugar				
	At 0 days of Storage	At 15 days of storage	At 30 days of storage	At 45 days of storage	At 60 days of storage
T1	8.24	9.84	11.77	11.42	11.94
T2	8.18	8.58	8.86	9.16	9.64
T3	8.40	10.08	10.88	11.19	11.72
T4	8.31	9.99	10.78	11.18	11.70
T5	8.53	9.84	10.63	11.05	11.55
T6	8.50	9.65	10.42	10.74	11.26
T7	8.12	9.80	10.59	10.91	11.43
T8	8.31	9.99	10.74	11.16	11.68
T9	8.44	9.85	10.64	11.12	11.64
T10	8.98	10.41	11.10	11.58	12.25
T11	9.21	9.10	9.43	9.94	10.96
Mean	8.47	9.74	10.53	10.86	11.43
Sem(±)	0.185	0.170	0.181	0.203	0.242
CD	0.542	0.499	0.53	0.597	0.710
CV	3.778	3.023	2.974	3.246	3.670

Table-6. Effect of preservatives on Total sugar of litchi fruit juice during storage

Treatments	Reducing Sugar				
	At 0 days of Storage	At 15 days of storage	At 30 days of storage	At 45 days of storage	At 60 days of storage
T1	6.75	7.66	8.27	9.32	9.86
T2	6.69	7.12	7.41	7.72	8.22
T3	6.93	7.76	8.59	8.93	9.47
T4	6.83	7.66	8.48	8.73	9.28
T5	7.06	7.50	8.33	8.56	9.12
T6	7.03	7.30	8.11	8.45	9.00
T7	6.62	7.45	8.285	8.62	9.17
T8	6.82	7.65	8.45	8.69	9.23
T9	6.97	7.50	8.33	8.51	9.05
T10	7.53	8.09	8.49	8.66	9.04
T11	7.78	7.86	8.01	8.54	9.61
Mean	7.00	7.60	8.25	8.61	9.188
Sem(±)	0.195	0.179	0.13	0.117	0.117
CD	0.571	0.525 (NS)	0.38	0.344	0.349
CV	4.814	4.090	2.799	2.363	2.211

Table-7. Overall acceptability of litchi juice at various days of storage

Treatments	Overall Acceptability of Litchi Juice				
	At 0 days of Storage	At 15 days of storage	At 30 days of storage	At 45 days of storage	At 60 days of storage
T1	8.53	8.4	7.93	6.40	5.40
T2	8.60	8.53	8.07	7.40	6.63

T3	8.50	8.10	7.70	6.87	6.23
T4	8.13	7.73	7.30	6.53	5.93
T5	7.97	7.57	7.17	6.30	5.80
T6	7.87	7.47	7.07	6.20	5.70
T7	8.53	8.13	7.40	6.93	6.00
T8	8.30	7.90	7.50	6.63	6.07
T9	7.97	7.57	7.10	6.33	5.70
T10	7.87	7.47	7.00	6.20	5.63
T11	9.07	9.00	8.50	7.80	6.40
Mean	8.303	7.988	7.521	6.691	5.954
Sem(±)	0.067	0.064	0.093	0.077	0.145
CD	0.195	0.186	0.272	0.226	0.426
CV	1.390	1.378	2.134	1.998	4.226

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