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Effects of Chemical Treatments on Storage Stability of Lemon (*Citrus Limon*) Juice

Ritu Sindhu[1], Bhupendar Singh Khatkar[2]

Research Scholar, Dept. of Food Technology, Guru Jambheshwar University of Science & Technology, Hisar, India[1]

Professor, Dept.of Food Technology, Guru Jambheshwar University of Science & Technology, Hisar, India[2]

Abstract: Freshly extracted juice of lemon fruits was subjected to treatments such as pasteurization, addition of potassium metabisulphite and sodium benzoate. Processed and control samples of juice were stored at room and refrigeration temperature for 90 days and analyzed for chemical properties at 15 days of interval during storage. Total soluble solids and pH of juices increased during storage. On the contrary, ascorbic acid content and titratable acidity of juices decreased during storage period. Potassium metabisulphite was found most effective in preservation and keeping quality of juice showing little changes in chemical properties of juice during storage. Results suggested that processed lemon juice can be stored safely at room and refrigeration temperature for 90 days.

Keywords: Lemon, pasteurization, potassium metabisulphite, juice, refrigeration.

1. INTRODUCTION

Lemon (*Citrus limon*) is one of the important citrus fruits appreciated not only for its beautiful appearance and pleasing flavour but also for its excellent food qualities. Citrus juice based beverages are relished by people of all age groups including children and elders due to their refreshing taste and health benefits (Mishra *et al.*, 2015). Being a rich source of flavonoids, vitamin C, citric acid and minerals, lemon provides several health benefits. Baramasi variety of lemon is commonly grown in various agro-climatic zones including sub mountainous tract of Punjab. Owing to its unique flavour and acidity Baramasi lemons are most preferred citrus fruit. Harvesting period of winter crop of Baramasi lemon coincides with the cooler part of the year and there is low consumption of lemon fruits during winters. Baramasi lemons are sensitive to chilling injury and it is difficult to store in the commercial cold stores (Kaur *et al.*, 2014). So, keeping in view its limited shelf-life, the lemon fruits must be processed in the form of juice to minimize the glut in market in its peak season of production. Preservation of fruit juices has become the business activity of great significance and countries with abundant fruit resources and having short harvest season are emphasizing more for established storage to maintain quality of fruits, increase shelf life and preserve fruit juices for off-season use (Franke *et al.*, 2005). Fruits juices are preserved by several methods such as freezing, irradiation, heat processing and use of chemical preservatives but it is well known fact that nutritional and sensory quality of juice changes during extraction, preservation and storage. Pasteurization of citrus juice reduced the ascorbic acid content (Rabia *et al.*, 2014; Holeman *et al.*, 2002). Sulfites and metabisulfites of sodium or potassium are added to fruit juices as potential sources of sulfur dioxide, which acts as an antimicrobial agent and also stabilizes ascorbic acid. A study carried to examine the effect of sodium-benzoate with different concentrations on orange juice packed in various popular packing materials for different time intervals of storage and results revealed that fresh orange juice with sodium benzoate without the additions of sugar could be useable up to 30 days (Shahnawaz *et al.*, 2013). The action of sulphur dioxide as an antimicrobial agent as well as a stabilizer of ascorbic acid depends on the pH of the food (El-Ashwah *et al.*, 1981). It is, therefore, important to test its efficacy in a high acid juice such as orange and lime juice. Keeping all these factors in view, present study was conducted to preserve lemon juice by chemical preservatives and heat processing with the objective to study the effects of different preservation treatments and storage temperature on the some physico-chemical properties of lemon juice during storage.

2. MATERIALS AND METHODS

2.1Preparation of fruits and juice extraction

Fully matured lemon fruits of Baramasi variety were procured from central fruit farm, Hisar. Lemon fruits were washed thoroughly with water to remove dirt and waste, manually graded for size and shape, only sound fruits were taken for extraction of juice. Fruits were cut into halves using kitchen knife and juice was extracted by pressing the fruit pieces in manually operated citrus juice machine. The expressed juice was passed through single layer of muslin cloth to filter out the solids and pulp materials. The filtered juice was filled in sterilized glass bottles with head space 2cm.

2.2 Preservation and storage of juice

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Preservation of juice was done by two methods- by addition of chemical preservatives and by thermal treatment. Filled bottles of juice were divided into four categories and each category was subjected to separated treatment namely addition of potassium metabisulphite (at the rate of 0.1%); sodium benzoate (at the rate of 0.1%); thermal processing of sealed bottles for 15 minutes at 80°C in hot water bath and then cooled under running tap water; and untreated juice was taken as control samples. Processed and control juice samples were labelled and stored at two different temperatures (room temperature and refrigeration temperature) for 90 days.

2.3 Chemical analysis

Fresh and stored juice were analysed for different properties including total soluble solids, pH, titratable acidity and ascorbic acidity. Stored samples were analysed at 15 days interval during storage. The total soluble solids content was recorded with the help of hand refractometer (0–10°Brix). Digital pH meter was used to record pH of juice. Ascorbic acid content and tannin content was determined according to AOAC (1984) method. Titratable acidity and non-enzymatic browning was determined using method described by Ranganna (1986). Total sugars and reducing sugars were estimated according to method described by Hulme and Narain (1931). All the tests were made in triplicate and the data obtained in present investigation was subjected to statistical analysis of variance (ANOVA) techniques using two factorial Completely Randomized Designs (CRD). Chemicals used in the study were of analytical reagent grade obtained from Sigma Chemicals, U.K.

3. RESULTS AND DISCUSSION

3.1 Chemical analysis of fresh lemon juice

Chemical composition of fresh lemon juice is presented in Table 1. In the present study, a good yield (44%) of juice was recorded. The fresh lemon juice had lower (5.65%) titratable acidity than that was reported by Mehta and Bajaj (1983). The pH of lemon juice in the present study was 1.96. The tannin content of juice was recorded as 52.55mg/100ml. Ascorbic acid content of fresh juice was 46.60mg/100ml similar to that stated by Bansal and Dhawan (1993). The fresh juice had lower amount of reducing sugars (0.57g per 100ml of juice) than that noticed in earlier studies (Barwal and Shrera, 2009). The total soluble solids content and total sugars of juice were found to be 7°B and 1.41g/100ml of juice respectively; the results were in conformity with the findings of others (Mehta and Bajaj, 1983). Browning of lemon juice was measured as optical density at 440nm and it was 0.022. Minor differences in results of this study with reported in literature might be due to the differences in equipments used, methods of juice extraction and differences in environmental conditions in which the crop was cultivated.

Table 1 Chemical composition of lemon fresh juice

Parameters	Concentration
Yield (%)	44
TSS (°B)	7
Acidity (%)	5.65
pH	1.96
Tannin content (mg/100ml)	52.55
Ascorbic acid (mg/100ml)	46.60
Reducing sugars (g/100ml)	0.57
Total sugars (g/100ml)	1.41
Browning (O.D. at 440nm)	0.022

All values are mean of triplicates.

3.2 Storage study of juices

Total soluble solids of lemon juice (Table 2) increased gradually during storage. The average total soluble solid content was increased from 7.114 to 7.450°B during storage. The mean total soluble solid content was observed maximum (7.529°B) in pasteurized juice sample stored at room temperature whereas, minimum total soluble solids (7.143°B) was recorded in potassium metabisulphite added juice samples stored at refrigeration temperature. The increase was more (0.30 to 1.0°B) in samples stored at room temperature as compared to samples stored at refrigeration temperature (0.20 to 0.45°B). Non-significant increase in total soluble solids in juice was found during first 15 days of storage while significant increase was noticed during 15 to 90 days of storage period.

Table 2 Effects of different treatments and storage on TSS (°brix) and titratable acidity (%) of lemon juice

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	Treatment	Storage period (days)							
		0	15	30	45	60	75	90	Mean
TSS	C + RT	7.100	7.500	*	*	*	*	*	
	KMS+ RT	7.100	7.100	7.100	7.200	7.200	7.300	7.300	7.186^{d}
	SB + RT	7.100	7.100	7.200	7.300	7.400	7.500	7.750	7.307^{b}
	P + RT	7.200	7.300	7.350	7.500	7.600	7.750	8.000	7.529^{a}
	C + RFT	7.000	7.000	7.300	7.400	7.400	7.500	7.500	7.300^{b}
	KMS + RFT	7.100	7.100	7.100	7.100	7.200	7.200	7.200	7.143^{f}
	SB + RFT	7.100	7.100	7.150	7.200	7.200	7.200	7.200	7.164^{e}
	P + RFT	7.200	7.200	7.200	7.300	7.300	7.300	7.400	7.271^{c}
	Mean	7.114^{f}	7.129^{f}	7.200^{e}	7.286^{d}	7.329^{c}	7.393^{b}	7.450^{a}	
Titratable acidity	C + RT	5.600	4.500	*	*	*	*	*	
	KMS+ RT	5.600	5.400	5.125	4.850	4.800	4.700	4.650	5.018^{b}
	SB + RT	5.550	5.350	5.025	4.725	4.600	4.550	4.400	4.886^{f}
	P + RT	5.600	5.400	5.025	4.800	4.650	4.600	4.500	4.939^{d}
	C + RFT	5.550	5.450	5.025	4.750	4.675	4.550	4.500	4.929^{d}
	KMS + RFT	5.600	5.450	5.175	4.975	4.825	4.750	4.700	5.068^{a}
	SB + RFT	5.550	5.375	5.050	4.775	4.625	4.575	4.450	4.914^{e}
	P + RFT	5.600	5.450	5.050	4.825	4.675	4.600	4.550	4.964^{c}
	Mean	5.579^{a}	5.411^{b}	5.068^{c}	4.814^{d}	4.693^{e}	4.618^{f}	4.536^{g}	

C = Control; KMS = Potassium metabisulphite; SB = Sodium benzoate; P = Pasteurized; RT = Room temperature; RFT = Refrigeration. Means with the same superscript are not significantly different. * Not recorded due to fermentation

The increase in TSS during storage might be due to hydrolysis of sucrose to invert sugars as reported in other studies (Bhatti, 1975; Ullah, 1990). Murtaza *et al.* (2004) also observed significant increase in TSS of strawberry drink during storage at different storage temperatures. Titratable acidity of lemon juice decreased notably during storage. The mean titratable acidity value was 5.579% that reduced to 4.536% during storage. Minimum titratable acidity of 4.886% was noticed in the juice samples stored at room temperature preserved by sodium benzoate. On the contrary, maximum titratable acidity of 5.068% was recorded in juice samples stored at refrigeration temperature preserved by potassium metabisulphite. Reduction in acidity in citrus juice could be attributed to chemical interaction between organic constituents of juice induced by temperature and action of enzymes during storage.

Table 3 Effects of different treatments and storage on ascorbic acid content (mg/100ml), pH of lemon juice

	Treatment	Storage period (days)							
		0	15	30	45	60	75	90	Mean
Ascorbic acid	C + RT	43.400	29.400	*	*	*	*	*	
	KMS+ RT	44.800	43.050	41.300	40.350	37.800	35.350	33.950	39.514^{b}
	SB + RT	44.160	42.350	40.800	38.150	34.300	31.150	28.350	37.037^{d}
	P + RT	44.160	40.950	38.500	36.050	31.850	27.650	25.900	35.009^{g}
	C + RFT	44.800	43.400	41.650	37.450	34.650	29.050	26.250	36.750^{e}
	KMS + RFT	44.800	43.780	42.350	41.300	38.500	36.050	34.650	40.204^{a}
	SB + RFT	44.160	43.400	41.300	38.850	35.700	31.850	29.050	37.759^{c}
	P + RFT	44.160	41.300	39.200	36.750	32.900	28.350	26.950	35.659^{f}
	Mean	44.434^{g}	42.604^{b}	40.729^{c}	38.414^{d}	35.100^{e}	31.350^{f}	29.300^{g}	
pH	C + RT	2.050	2.155	*	*	*	*	*	
	KMS+ RT	2.050	2.180	2.045	2.300	2.360	2.380	2.400	2.245^{c}
	SB + RT	2.070	2.210	2.280	2.350	2.420	2.470	2.520	2.331^{a}
	P + RT	2.050	2.170	2.320	2.390	2.410	2.440	2.460	2.320^{b}
	C + RFT	1.960	2.010	2.060	2.080	2.250	2.350	2.420	2.161^{f}
	KMS + RFT	1.960	1.990	2.040	2.060	2.270	2.350	2.400	2.153^{g}
	SB + RFT	1.980	2.050	2.100	2.130	2.300	2.410	2.540	2.216^{d}
	P + RFT	1.980	2.010	2.160	2.100	2.290	2.360	2.410	2.173^{e}
	Mean	2.007^{g}	2.089^{f}	2.129^{e}	2.201^{d}	2.329^{c}	2.394^{b}	2.450^{a}	

C = Control; KMS = Potassium metabisulphite; SB = Sodium benzoate; P = Pasteurized; RT = Room temperature; RFT = Refrigeration. Means with the same superscript are not significantly different. * Not recorded due to fermentation.

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The results showed a significant increase in pH values during storage period (Table 3). The mean pH value was 2.007 which increased to 2.450 during storage. Significantly higher mean pH values were recorded for samples stored at room temperature as compared to refrigeration temperature. Maximum average value of pH was 2.331 recorded in sodium benzoate treated samples stored at room temperature while minimum average value of pH was 2.153 observed in potassium metabisulphite treated samples stored at refrigeration temperature. Similar results were reported by Thorat *et al.* (2007) for aonla juice based carbonated health drink. As perceived from data (Table 3) it is observed that the ascorbic acid content reduced from 44.434mg to 29.300mg per 100 ml juice during storage. The highest retention of ascorbic acid (40.204mg per100ml) was recorded in potassium metabisulphite treated sample stored at refrigeration temperature. Reduction in ascorbic acid of juice could be ascribed to its oxidation during storage which resulted in the formation of dehydroascorbic acid. Similar results were shown by Majumdar *et al.* (2009) reported 74% loss of vitamin C in cucumber-litchi-lemon juice after six months of storage.

4. CONCLUSION

Lemon juice contained appreciable level of ascorbic acid. Chemical properties of lemon juice were considerably affected by different preservation treatments, storage temperature and storage period. Increase in TSS of juice during storage was the maximum in pasteurized samples whereas the maximum decrease in titratable acidity and increase in pH were observed in samples preserved by sodium benzoate. Retention of ascorbic acid content in juice was the highest in samples preserved with potassium metabisulphite during storage. Substantial changes in all chemical properties of juice were noticed at room temperature than at refrigeration temperature in all treatments during storage. The outcomes of present investigation suggest that untreated lemon juice cannot be stored for more than a week at room temperature but it can be stored for 90 days at refrigeration temperature. Preservation with potassium metabisulphite was most effective during storage as compared to pasteurization and sodium benzoate treatment. Refrigeration temperature was better than room temperature for storage of untreated and processed lemon juice.

REFERENCES

1. AOAC. (1984) Official Methods of Analysis. 14th edition. Washington DC: Association of Official Analytical chemists.
2. Bansal, M. and Dhawan, S. S. (1993) Preservation and keeping quality of bhadri lemon (Citrus limon L Burm) juice. Haryana Journal of Horticultural Science 22 (3), 188-194.
3. Barwal, V. S. and Shrera, S. K. (2009) Standardization of extraction methods and preservation techniques of hill lemon juice. Journal of Scientific and Industrial Research 68, 608-610.
4. Bhatti, M. S. (1975) Studies on some ripening changes in mangoes during storage. Faisalabad, Pakistan: Department of Food Technology, University of Agriculture, MSc Thesis.
5. El-Ashwah, E. T., Tawfik, M. A., El-Hashimy, F. S., Rouf, M. S. and Sarhan, M. A. (1981) Chemical and Physical Studies on Preserved 'Benzahir' Lime Juice. Sudan Journal of Food Science and Technology 1: 64-68.
6. Franke, A. A., Cooney, R. V., Henning, S. M. and Custer, L. J. (2005) Bioavailability and antioxidant effects of orange juice components in humans. Journal of Agriculture and Food Chemistry 53 (13), 5170-5178.
7. Holeman, J. (2002) Nutrition professor says concentrated juice offers high volume of vitamin C. News & Information, ASU.
8. Hulme, A. C. and Narain, R. (1931) The ferricyanide method for determination of reducing sugars. A modification of Hage dorn-Jensen Hanes technique. Biochem Journal 25, 1051.
9. Kaur, S., Jawandha, S. K. and Singh, H. (2014) Response of baramasi lemon to various post-harvest treatments International Journal of Agriculture, Environment & Biotechnology 7(4).
10. Majumdar, T. K., Vasudish, C. R., Premavalli, K. S., and Bawa, A. S. (2009) Development and storage stability of cucumber- litchi- lemon juice. Journal of Food Science and Technology 46 (3), 269-270.
11. Mehta, U. and Bajaj, S. (1983) Effect of storage and methods of preservation on the physico-chemical characteristics of citrus juices. Indian Food Packer 37, 42-51.
12. Mishra, P., Rai, G. K., and Mahatana, C. L. (2015) Process of standardization for development of spray-dried lemon juice powder and optimization of amla-lemon based RTS (Ready-to-serve) drink using response surface methodology. Journal of Food Processing and Preservation 39, 1216-12289.
13. Murtaza, M. A., Huma, N., Javaid, J., Shabbir, M. A., Mueenuddin, G. and Mahmood, S. (2004) Studies on stability of Strawberry drinks stored at different temperatures. International Journal of Agriculture and Biology 6 (1), 58-60.
14. Rabie, M. A, Soliman, A. Z., Diaconeasa, Z. A. S. and Constantin, B. (2014) Effect of pasteurization and shelf life on the physicochemical properties of Physalis (Physalis peruviana L.) juice. Journal of Food Processing and Preservation 39(6), 1051-1061.
15. Ranganna, S. (1986) Handbook of Analysis & Quality Control for Fruit & Vegetable Products. 2nd Edition. New Delhi: Tata McGraw Hill publishing Co. Ltd.
16. Shahnawaz, M., Sheikh, S. A. and Minhas, S. (2013) Role of sodium benzoate as a chemical preservative in extending the shelf life of orange juice. Global Advanced Research Journal of Food Science and Technology 2 (1), 7-18.
17. Thorat, D. N., Patil, R. S. and Dhumul, S. S. (2007) Preparation of aonla juice based carbonated health drink. Beverage and Food World 34, 41-44.
18. Ullah, I. (1990) Development, characterization and evaluation of watermelon, mango, pear and lime-juice blend. Faisalabad, Pakistan: Department of Food Technology, University of Agriculture, MSc Thesis.