Pak. j. sci. ind. res., vol. 32, no. 8, August 1989

STUDIES ON THE PREPARATION AND STORAGE STABILITY OF COMMINUTED KINNOW FRUIT BEVERAGE BASE

RIAZ AHMAD RIAZ, AMJAD ALI AND MUHAMMAD SALEEM
Food Technology Department, University of Agriculture, Faisalabad

(Received December 9, 1988; revised May 8, 1989)

An investigation was made to study the physico-chemical and organoleptic changes occuring during 120 days storage of comminuted Kinnow fruit beverage base kept at ambient temperature. The comminuted beverages were found to be not only more nutritious but also superior to the conventional squashes in colour, aroma and cloudiness. Furthermore these types of beverages were better protected against oxidative deterioration during extended period of storage.

Key words: Comminution, Blanching, Base.

Introduction

Among the citrus fruits, in Pakistan Kinnow (*Citrus reticulata*) is very popular because of its attractive bright colour, appealing taste and flavour. The fruit is a good source of ascorbic acid, pectin, citric acid, peel oil and some of essential minerals like calcium, iron and phosphorus. The peel contains more than twice the amount of ascorbic acid than does the juice of this fruit [1]. It needs special care in transportation due to its delicate skin. The storage life of fresh Kinnow fruit is comparatively shorter than those of tight skinned oranges even in cold storage, and the taste also becomes insipid within a short period of time.

The first detail account of comminuted citrus beverage in Britain [2]. These types of novel drinks were made by reducing the blanched whole fruit including peel, pith, and seeds to form homogeneous mass having a stable emulsion [2, 3]. In this process a simultaneous sterilization, inactivation of enzymes and efficient disintegration of the fruit is achieved producing a superior drink than is obtained in conventional squashes with regard to colour, aroma, flavour and cloud stability [1, 4, 5].

In this country no such products are being produced presently. This study was, therefore, planned to develop from whole fruit a comminuted beverage base that may be superior in colour, nutritive value, and storage stability. Another possibility of achieving more pectin and essential oil in the finished product than is possible by conventional method. This may in turn give a heavy body as well as a rich enduring flavour.

Experimental

Technique for preparation of comminuted kinnow beverage base. Fully mature kinnow fruits were purchased from the local market then washed thoroughly and divided into 3 lots for the extraction of juice:

(a) *Conventional method.* After halving the individual fruit, juice was extracted with the help of rosehead machine and passed through the muslin cloth (Treatment 1).

(b) *Comminution before blanching the fruit.* The whole kinnow fruits were reduced to homogeneous mass using Osterizer. The juice was separated from coarse pulp by passing through basket press and diluted (2:1 juice:water) with water (Treatment 2).

(c) *Comminution after blanching the fruit.* The whole fruits were submerged in hot water so as to obtain a temperature of 90° at the centre of fruit. After cooling, the fruits were blended to make a uniform mass in an Osterizer. The juice was separated from the coarse pulp by passing through basket press and diluted (2:1 juice:water) with water (Treatment 3).

The kinnow fruit beverage base was prepared from the juice so obtained in each lot separately using citric acid 2 kg, sugar 10 kg per 100 kg of fruit juice. The beverage base from each lot after addition of 750 ppm SO_2 was filled in clean glass bottles (250 ml capacity), sealed with crown cork and stored at ambient temperature ranging from 10° in February to 45° in May.

Beverage base evaluation. The kinnow fruit beverages base was analysed after suitable storage intervals for ascorbic acid, acidity, pH, °Brix and pectin content by using the methods of Ruck [6] and for beta-carotene by the method of Bauernfeind *et. al* [7]. The degree of settling in each 1 lot during storage was determined according to a method reported earlier [1].

The comminuted beverage base was also evaluated organoleptically for colour, taste and flavour during storage intervals of 0, 60 and 120 days by numerical scoring method [8].

Results and Discussion

This study was conducted to find the possibility of production of comminuted drink in Pakistan. The comminuted kinnow fruit beverage base, prepared from juice extracted with different techniques on a laboratory scale, was stored at ambient temperature for 120 days. The results obtained are discussed with respect to ascorbic acid, acidity, pH, degree of Brix, pectin, rate of settling, beta-carotene, and organoleptic characteristics.

Ascorbic acid. The methods of juice extraction showed pronounced influence ($p \leq 0.01$) on the ascorbic acid contents of beverage base. In freshly prepared fruit beverage base the amount of ascorbic acid was the lowest (50 mg/100 ml) in product prepared by conventional procedure and the highest (70 mg/100 ml) in the base obtained by comminution of fresh fruit alone. This increase may be due to additional ascorbic acid incorporation in the beverage base from the peel of the fruit during comminution. When the fresh fruits were blanched in hot water and base was obtained thereafter by comminution, a decrease in ascorbic acid content (from 70-62 mg/100 ml) occurred. This loss was due to the heat treatment of the fruit.

There was a substantial decrease ($p \leq 0.01$) in ascorbic acid contents during storage as indicated in Fig. 1. The retention of ascorbic acid after a storage period of 120 days was 50 per cent, 65 per cent and 69 per cent in conventional, unblanched comminuted and blanched comminuted fruit beverage bases respectively.

These results are in agreement with those of an earlier report [9]. Decrease in ascorbic acid during storage may be attributed to rise in storage temperature during summer similar to those reported elsewhere [5].

Acidity and pH. Table 1 indicates the effect of storage on acidity of fruit beverage base prepared under different conditions. The initial acidity was 2.37 per cent in the product prepared by conventional procedure, 2.50 per cent in

TABLE 1. SHOWING PERCENTAGE ACIDITY OF COMMINUTED KINNOW BEVERAGE BASES PREPARED BY DIFFERENT TREATMENTS.

	Storage in days					
Preparatory treatments	0	15	30	60	90	120
T_1	2.87	2.88	2.89	2.90	2.91	2.92
T_2	2.50	2.51	2.52	2.53	2.54	2.55
T_3	2.40	2.41	2.42	2.43	2.44	2.45

T_1 = Prepared by conventional method; T_2 = Comminuted base prepared from whole fresh fruit; T_3 = Comminuted base obtained after blanching the whole fruit.

Analysis of variance

Source of variance	df	S.S.	M.S.	F-ratio
Treatment	2	0.00525	0.002625	0.03568 NS
Storage	5	0.73560	0.14712	2.00 NS
Error	10	0.73560	0.07356	–
Total	17	1.47645	–	–

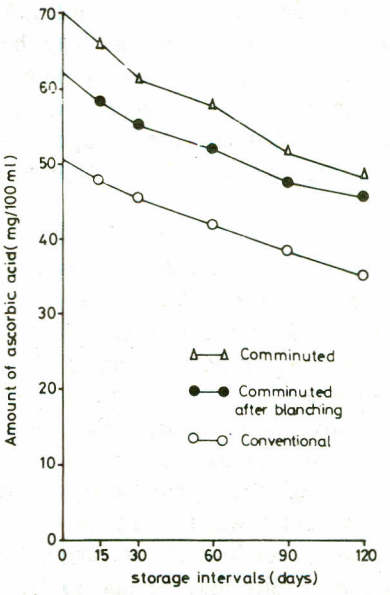

Fig. 1. Ascorbic acid retension during storage in comminuted Kinnow beverage bases prepared by different treatments.

TABLE 2. SHOWING PH OF COMMINUTED KINNOW BEVERAGE BASES PREPARED BY DIFFERENT TREATMENTS.

	Storage in days					
Preparatory treatments	0	15	30	60	90	120
T_1	2.55	2.55	2.50	2.45	2.40	2.40
T_2	2.60	2.60	2.55	2.50	2.45	2.40
T_3	2.65	2.65	2.60	2.55	2.55	2.50

Analysis of variance

Source of variance	df	S.S.	M.S.	F-ratio
Treatment	2	0.0358	0.0179	79.50**
Storage	5	0.0729	0.0146	73.00**
Error	10	0.0025	0.0002	–
Total	17	0.1106	–	–

** Highly significant.

Treatments		T_3		T_2		T_1	
Means		2.583 a		2.517 b		2.475 c	
Storage (days)	0	15	30	60	90	120	
Means	2.60 a	2.60 a	2.55 b	2.50 c	2.47 d	2.43 f	

Values sharing the same letters are in-significant.

comminuted base before blanching, and 2.4 per cent in comminuted base obtained after blanching the whole fruit. After 120 days of storage, the acidity ranged in between 2.45 – 2.92 per cent in all the three beverages bases prepared by different methods. The storage as well as treatments during preparation showed insignificant effect on acidity.

The pH values of conventionally prepared sample, freshly comminuted and hot water blanched comminuted products ranged from 2.40 – 2.55, 2.40 – 2.60 and 2.50 – 2.65 respectively during a storage period of 120 days (Table 2). A highly significant effect ($p \leq 0.01$) on pH for preparatory treatments and storage intervals was observed.

A gradual increase in acidity with a corresponding decrease in pH values was noticed during a storage period of 120 days in beverage bases prepared by different methods. This increase in acidity was found to be in agreement with the results reported for lime [1] and orange [9] squashes. This increase in acidity may be due to the formation of some organic acids by degradation of pectin and sugar.

Degree of brix. The initial degree of Brix ranged from 17.00 – 18.00 in all the three treatments. A slight increase in total soluble solids expressed as degree of Brix was observed in all the three treatments during storage period of 120 days (Table 3). A highly significant effect ($P \leq 0.01$) on degree of Brix for both methods of preparation and storage was noted. This increase in degree of Brix may be attributed to the formation of water soluble pectin from protopectin as reported earlier [5-9].

Pectin. Table 4 indicates the pattern in results on pectin under the different treatments of preparation of Kinnow base during storage period of 120 days at ambient temperature. A consistent and slight decrease in pectin was recorded throughout the storage period in all types of products so prepared except for the comminuted base prepared after blanching the fresh fruit. The actual values in per cent for pectin were 0.22, 1.56 and 1.57 at zero day; and 0.09, 1.12 and 1.69 after 120 days of storage for treatment 1, 2 and 3 respectively.

A substantially ($p \leq 0.01$) higher pectin content in comminuted beverage bases was due to incorporation of peel in the fruit extract as indicated by the results in Table 4. A further increase in soluble pectin in the case of comminuted base prepared after blanching the whole fruit was observed. The heating may have not only protected the pectin from enzymatic degradation but also converted protopectin into water soluble pectin.

TABLE 3. SHOWING DEGREE OF BRIX IN COMMINUTED KINNOW BEVERAGE BASES PREPARED BY DIFFERENT TREATMENTS.

	Storage in days					
Preparatory treatments	0	15	30	60	90	120
T_1	17.0	17.5	18.0	18.3	18.5	18.5
T_2	18.0	18.0	18.5	18.7	19.0	19.5
T_3	17.0	17.3	17.5	17.5	18.0	18.0

Analysis of variance

Source of variance	df	S.S.	M.S.	F-ratio
Treatment	2	3.46	1.730	45.53**
Storage	5	3.94	0.788	20.74**
Error	10	0.38	0.038	–
Total	17	7.78	–	–

Treatments	T_3	T_2	T_1
Means	18.62 a	17.97 b	7.55 c

Storage (days)	120	90	60	30	15	0
Means	18.67 a	18.50 ab	18.17 ab	18.00 b	17.60 c	17.33 c

TABLE 4. SHOWING PERCENTAGE OF PECTIN OF COMMINUTED BEVERAGE BASES PREPARED BY DIFFERENT TREATMENTS.

	Storage in days					
Preparatory treatments	0	15	30	60	90	120
T_1	0.22	0.19	0.18	0.17	0.13	0.09
T_2	1.56	1.40	1.32	1.24	1.16	1.12
T_3	1.57	1.56	1.58	1.62	1.63	1.69

Analysis of variance

Source of variance	df	S.S.	M.S.	F-ratio
Treatment	2	6.950	3.4750	271.48**
Storage	5	0.046	0.0092	0.719 NS
Error	10	0.128	0.0128	–
Total	17	7.124	–	–

Treatments	T_3	T_2	T_1
Means	1.610 a	1.300 b	0.163 c

The further increase in pectin content may be explained in part by the formation of water soluble pectin from insoluble pectin fraction during storage. The presence of pectin enzymes in case of first two treatments caused further loss in pectin during storage. These results are comparable with observations of earlier workers [1].

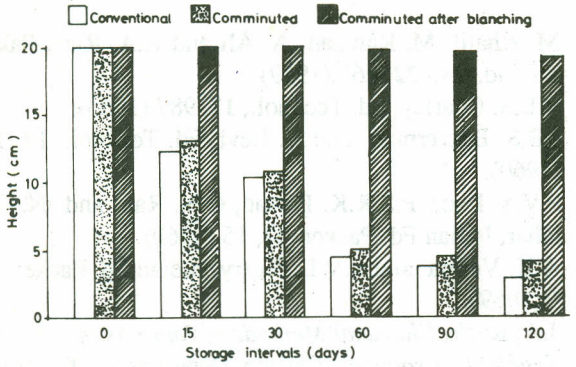

Fig. 2. Showing the degree of pulp settling in comminuted kinnow beverage base during storage under different treatments.

Degree of settling. The trend on degree of settling of comminuted beverage bases prepared by three different treatments during storage is illustrated in Fig. 2. The degree of settling was determined in centimeter (cm) by measuring the distance between the bottom and the point of separation in each bottle kept undisturbed.

The rate of pulp settling increased with passage of storage time in bases prepared from Kinnow fruit in all the 3 treatments. After a storage period of 120 days the maximum pulp settling (15 cm) in base prepared by conventional procedure was noticed, whereas pulp settling was minimum (1.5 cm) in comminuted beverage base prepared after blanching the whole fruits. The high settling rate in case of conventional beverage can be attributed to the presence of active enzymes and large particle size in suspended pulp. The reduction of particle size in suspended pulp to homogeneous mass by the process of comminution decreased substantially the rate of pulp settling during storage.

The maximum cloud stability in comminuted beverage base from blanched fruit may be due to the inactivation of enzymes by blanching and the fine state of particle subdivision of suspended colloids caused by the process of comminution.

The particles size less than 2 mu constituted a stable cloud. The fraction consisted of needle like crystals of hesperidin, chromoplastids, amorphous particles and oil globules on the rag particles enhanced stability of suspension by decreasing density [11, 12].

The methods of juice extraction ($P \leq 0.01$) as well as storage intervals ($P \leq 0.05$) showed significant influence on cloud stability. These findings on pulp settling are comparable with previous observations [1].

Beta carotene. The results in Table 5 indicate that beta carotene contents (µg/ml) were 11.48, 14.20, 13.33 at zero day; 8.95, 11.32, 10.44 after 30 days of storage, and 1.44, 2.99, 2.02 after 120 days of storage in beverage bases prepared by treatment 1, 2 and 3 respectively.

There was a substantial ($P \leq 0.01$) decrease during storage in beta carotene in the juice prepared by different treatments. Similarly a significant difference ($P \leq 0.01$) was noticed due methods of preparation. These results are in agreement with those of the earlier findings [7].

Organoleptic quality. Ready-to-serve drinks were prepared by taking 80 ml of each beverage base, 150 g of sugar and finally diluting to one litre with iced water. These drinks were evaluated organoleptically by a panel consisting of ten judges using score ranking test for colour, taste and flavour after 0, 60 and 120 days of storage.

For colour the mean score values were in the range of 8 to 9 (out of the total scores of ten for standard of excellence) for all the three treatments.

TABLE 5. SHOWING THE BETA CAROTENE CONTENT OF COMMINUTED KINNOW BEVERAGE BASES PREPARED BY DIFFERENT TREATMENTS.

	Beta carotene µg/ml of base					
	Storage in days					
Preparatory treatments	0	15	30	60	90	120
T_1	11.48	10.15	8.95	5.94	3.28	1.44
T_2	14.20	12.76	11.32	8.74	6.85	2.99
T_3	13.33	11.95	10.44	7.92	5.12	2.02

Analysis of variance

Source of variance	df	S.S.	M.S.	F-ratio
Treatment	2	20.66	10.33	79.48**
Storage	5	256.94	51.39	395.31**
Error	10	1.30	0.13	–
Total	17	278.90	–	–

** Highly significant.

Treatments	T_1	T_3	T_2
Means	9.48	8.47	6.88
	a	b	c

Storage (days)	0	15	30	60	90	120
Means	13.01	11.62	10.24	7.54	5.09	2.15
	a	b	c	d	e	f

The taste mean score values were from 6 – 7 and 8 – 9 for the drinks prepared from conventional, unblanched comminuted, and blanched comminuted beverage base respectively after a storage period of 120 days.

TABLE 6. SHOWING THE MEAN NUMERICAL SCORES OF EIGHT JUDGES FOR ORGANOLEPTIC CHARACTERISTICS OF COMMINUTED KINNOW BASE PREPARED UNDER DIFFERENT TREATMENTS DURING STORAGE.

Out of maximum score of 10 for standard of excellence

Storage in days	Colour treatments			Taste treatments			Flavour treatments		
	1	2	3	1	2	3	1	2	3
0	8	9	9	7	9	9	6	8	8
60	8	9	9	6	8	8	5	7	8
90	8	9	9	6	8	8	5	7	7

The mean score values for flavour varied from 5 – 6 for the conventional sample whereas in the case of comminuted beverage base it varied from 7 – 8 both for unblanced and blanched whole fruit (Table 6).

The higher scores in the case of both comminuted samples were observed for the colour, taste and flavour than for conventionally (control) prepared beverage base. This better flavour and taste in case of comminuted beverage samples may be due to incorporation of more flavedo portion containing oil by process of comminution. Moreover a tocopherol like substance rich in antioxidant activity was isolated from the flavedo of the citrus fruits. This substance might be the cause of remarkable stability of flavour in the comminuted drinks [10, 11].

Acknowledgement. The authors wish to express their thanks to Syed Aulad Hussain, Chairman, Food Technology Department, University of Agriculture, Faisalabad for providing facilities to conduct this research.

References

1. M. Khalil, M. Ramzan, A. Ali and R.A. Riaz, Pak. j. sci. ind. res., **22**, 267 (1969).
2. V.L.S. Charley, Fd. Technol., **17**, 987 (1963).
3. J.B.S. Braverman and A. Levi, Fd. Technol., **14**, 106 (1960).
4. P.V.S. Rao, P.S.R.K. Parsad, G.N. Rao and N. Giridhar, Indian Fd. Packer, **22**, 15 (1960).
5. A.K. Verma and L.V.L. Sastry, Indian Fd. Packer, **23**, 5 (1969).
6. J.A. Ruck, *Chemical Methods of Analysis of Fruit and Vegetable Products* (Canada Department of Agriculture, (1969) Pub. No. 115.
7. J.C. Bauernfeind, M. Osadca and R.H. Bunnel, Fd. Technol., **16**, 101 (1962).
8. J.K. Krum, Fd. Engg., **27**, 74 (1955).
9. U. Metha and S. Bajaj, Indian Fd. Packer, **37**, 42 (1983).
10. S. Herel and J. Kanner, Int. Fruchtsaft-Unio, Wiss. Tech. Komm., **18**, 185 (1984); cf., Chem. Abst., **103**, (17), 140581k (1985).
11. F. Engelhardt, Fd. Manuf., **39**, 72 (1964).
12. B.N. Shalom, R. Pinto and J. Kanner, Int. Fruchtsaft-Unio, Wiss-Tech. Komm., **18**, 67 (1984); cf., Chem. Abst. **103** (17), 140447 (1985).