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STUDIES ON THE PREPARATION AND STORAGE STABILITY OF CARBONATED POMEGRANATE DRINK

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This study was conducted to investigate the effect of different levels of fruit juice on physico-chemical properties and consumer acceptability of carbonated pomegranate drink during an extended period of storage. On the basis of organoleptic evaluation carbonated pomegranate drink containing 10% of fruit juice was found to be the best, having 1.0 mg% ascorbic acid, 11.78% sucrose, 1.3% reducing sugar, 0.24% acidity and 3.14 pH. Decreases in ascorbic acid and sucrose, with corresponding increases in acidity and reducing sugars were noted after a storage period of 80 days, yet the drink remained acceptable to the consumers.

Key words: Carbonated, Kandhari, Kieselguhr.

Introduction

Pomegranate (*Pumica granatum*) thrives well in Pakistan, India, Afghanistan, Persia and also in the coastal regions of Mediterranean both of Europe and Africa. It is a fruit of tropical and subtropical regions, but the best quality pomegranates are found where cool winters and hot dry summers prevail. In Pakistan it is grown over an area of about 4000 hectares [1].

Pomegranate grows into a bush which flowers in spring. The fruit is a drupe and filled with a large number of grains in several compartments. The weight of pomegranate fruit varied from 175 - 300 g, having 46.4 % grains, 36.8 % peel, 17.8 % seeds, and 70.3% juice in grains. The juice contained 17.3% dry matter with 13.2% sugar, 0.5 - 1.6% acids, 5 - 7 mg% ascorbic acid and 0.5 - 1.2% pectin [2-5]. The fruit is delightly refreshing in character. Its most common use is as a dessert fruit. The fresh fruit is delicate and any injury will spoil the fruit rapidly. Low temperature is usually recommended for long term storage of fruits but it is observed that during such storage the taste of pomegranate becomes insipid [6]. Most of the aerated drinks, available in the market, are prepared from artificially coloured and flavoured syrups without natural fruit juices. Preliminary investigations have proved that some pure fruit juices could readily be converted into syrups suitable for preparation of carbonated drinks with public preference [7]. Carbonated fruit drinks not only have a pleasent and refreshing taste but they also improve the circulation of blood particularly in skin and increase the absorptive capacity of the mucous memberane in the stomach [8]. The growth of microorganisms can be inhibited by carbon dioxide concentration greater than 5 g/l without any deterimental effect on taste [9].

Little work has so far been done on the utilization of pomegranate fruit in Pakistan. It was, therefore, planned to prepare a carbonated drink from pomegranate fruit and to evaluate its quality during storage with an ultimate aim to introduce a new refreshing fruit drink in Pakistan.

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Experimental

Preparation of base and carbonated drink from pomegranate fruit. Fully ripe 'Kandhari' pomegranate fruits were procured from the local market. After through washing the individual fruits were cut into quarters with the help of a stainless steel knife. The grains were separated manually.

The juice was extracted from the grains with help of a basket press. The juice was tested for acidity and total soluble solid contents to formulate the fruit bases in such a way (when added 75 ml/bottle of 250 ml capacity) so as to obtain 5, 10, 15 and 20% fruit juice in the final carbonated products with 0.24 % acid and 13% sugar (Table 1). Just before use the fruit beverage bases were finally filtered after mixing with 1% by weight of food grade Kieselguhr to obtain clear and sparkling carbonated drinks.

The crown corks were applied after filling the bottle with chilled carbonated water at 2 atmospheric pressure of carbon

TABLE 1. RECIPES FOR FRUIT BASES FOR PREPARATION OF CARBONATED BEVERAGES.

Ingredients	Pomegranate fruit bases			
	1	2	3	4
To obtain juice in finished products(%)	5	10	15	20
Juice (l)	0.9	1.0	2.7	3.6
Sugar (kg)	4.646	4.412	4.178	3.944
Citric acid (g)	81	72	63	54
Sodium benzoate (%)	0.06	0.06	0.06	0.06
Water to make up (l)	10.8	10.8	10.8	10.8

dioxide. The drinks so obtained were stored at ambient temperature for 80 days.

Evaluation of carbonated fruit beverages. The carbonated pomegranate beverages were analysed for acidity, pH, total soluble solids, ascorbic acid, and sugars by the standard methods [10]. The carbonated fruit drinks were also evaluated organoleptically for colour, flavour and tastes by numerical scoring method [11] and results are expressed on overall ratings. The results so obtained were statistically analysed [12] to see the effect of different concentration of juice as well as storage on the quality of carbonated fruit juice.

Results and Discussion

This study was conducted to see the effect of different levels of fruit juice on the physico-chemical properties and on consumer acceptability of carbonated pomegranate drinks during storage of 80 days when kept at ambient temperature.

'Kandhari' pomegranates were selected for its peculiar attractive characteristics taste, flavour and natural colour. This fruit contained 44.12% juice on the basis of whole fruit Table 2. Whereas its juice contained 14.9% total soluble solids, 1.25% acidity, 13.25% total sugars and 7.5 mg ascorbic acid per 100 ml of juice. These above results are well within the range of values reported earlier [3-5].

The carbonated drinks containing 5, 10, 15 and 20% pomegranate juice were analysed physico-chemically and organoleptically at suitable intervals during ambient temperature storage. The results reported in Table 3 are discussed as under:-

Acidity and pH. The initial acidity of all the 4 drinks was 0.24% and at the end of storage it was 0.28%.

As is evident from the results (Table 3) there is a gradual increase ($P \leq 0.05$) in the amount of titratable acidity with the advancement of storage time in the carbonated drinks containing varying qualities of fruit juice. This increase in titratable acidity of drinks may be attributed to increase in release of hydrogen ions during storage. The initial values of pH ranged in between 3.14 - 3.16 and at the end of 80 days it was in the range of 3.00 - 3.05. With the increase in titratable acidity of drinks, there was a corresponding decrease ($P<0.05$) in pH values. The statistical analyses of data on titratable acidity and pH (Table 4) showed insignificant influence due to the varying amount of fruit juice in the carbonated drinks.

These findings substantiate those of earlier workers [7,13] who also reported increase in titratable acidity with simultaneous decrease in pH of citrus juices during storage.

Ascorbic acid. With increase in fruit juice, there was propotional increase ($P \leq 0.05$) in the quality of asrorbic acid in the carbonated drinks. A substantial decrease ($P \leq 0.05$) Table 4) in ascorbic acid was observed in the carbonated drinks containing varying amounts of fruit juice after 40 days of storage. At the end of storage period (i.e., after 80 days) the ascorbic acid was almost totally lost in the drinks. The decrease in ascorbic acid during storage might be due to elevated storage temperature.

The statistical analysis of the data (Table 5). showed highly significant difference in results for the treatments con-

TABLE 2. COMPOSITION OF POMEGRANATE FRUIT AND JUICE.

(a) *FRUIT*	
Peel	42.16 % of whole fruit
Grain	57.84 % of whole fruit
Seed	13.72 % of whole fruit
Juice content	44.12 % of whole fruit
Juice in grains	76.27 % on the basis of grain weight
(b) *JUICE*	
Total soluble solids	14.9 %
Total sugars	13.25 %
Acidity	1.25 %
Ascorbic acid	7.5 mg/100 ml

TABLE 3. EFFECT OF STORAGE ON SOME CHEMICAL CONSTITUENTS OF CARBONATED POMEGRANATE DRINKS PREPARED WITH VARYING QUANTITIES OF FRUIT JUICE.

Storage (days)	Components	Juice concentration (%) in drink			
		5	10	15	20
0	Acidity (%)	0.24	0.24	0.24	0.24
	pH	3.15	3.14	3.15	3.16
	Vitamin C (mg%)	0.5	1.00	1.50	2.00
	Reducing sugars %	0.65	1.30	2.00	2.60
	Sucrose (%)	12.34	11.70	11.00	10.40
20	Acidity (%)	0.25	0.25	0.25	0.25
	pH	3.14	3.14	3.13	3.15
	Vitamin C (mg%)	0.50	0.75	1.50	1.75
	Reducing sugars %	1.09	1.75	2.50	3.15
	Sucrose (%)	11.92	11.26	10.46	9.98
40	Acidity (%)	0.26	0.26	0.26	0.26
	pH	3.10	3.12	3.10	3.12
	Vitamin C (mg %)	0.25	0.50	1.00	1.50
	Reducing sugars(%)	1.54	2.26	2.98	3.63
	Sucrose (%)	11.50	10.78	10.00	9.36
60	Acidity (%)	0.27	0.27	0.27	0.27
	pH	3.00	3.10	3.05	3.10
	Vitamin C (mg %)	0.00	0.00	0.05	1.00
	Reducing sugars(%)	2.02	2.74	3.51	4.05
	Sucrose (%)	11.00	10.25	9.49	8.93
80	Acidity (%)	0.28	0.28	0.28	0.28
	pH	3.05	3.05	3.00	3.05
	Vitamin C (mg %)	0.00	0.00	0.00	0.50
	Reducing sugars(%)	2.50	3.35	4.00	4.60
	Sucrose (%)	10.60	9.72	9.03	8.41

Results are expressed as means for three observations.

taining varying quantities of fruit juice and also for loss of ascorbic acid during storage. Similar trends in results were found during storage in different other fruit juices [7, 13, 14].

Sugars. The amount of sucrose in the freshly prepared drinks containing varying amounts of juice ranged in between 10.40-12.34 % and after a storage period of 80 days it varied from 8.41-10.60%. On the other hand the reducing sugars ranged in between 0.65–2.60% in the fresh drinks and 2.50-4.60% after 80 days of storage.

This data showed a continuous decrease ($P \leq 0.1$, Table 4) in non-reducing sugars with proportional increase ($P \leq 0.01$) in reducing sugars during storage. Acidity and high storage temperature may be responsible for this inversion of sucrose to reducing sugars. A similar inversion of sucrose in fruit juices during storage is reported in earlier literature [6, 13, 14].

There was a highly significant effect of different concentration of juice present in drinks both for non-reducing and reducing sugars as indicated in Table 4.

Organoleptic evaluation. The refrigerated carbonated pomegranate drinks prepared with varying quantities of fruit juice were evaluated organoleptically by hedonic ranking test for colour, flavour and taste attributes during storage intervals of 0, 40 and 80 days. These results were converted to over all ratings including all sensory attributes and expressed as mean values of 10 judges (Table 5).

TABLE 4. SHOWING F-RATIO VALUES AS AFFECTED BY JUICE CONTENT AND STORAGE FOR VARIOUS PARAMETERS IN CARBONATED POMEGRANATE DRINKS.

Source of variation	pH	Acidity	Ascorbic acid	Reducing sugars	Sucrose	Overall organoleptic rating
Juice content	2.50^{NS}	1.00^{NS}	35.29*	273.33**	152**	103.10**
Storage	37.50*	33.33*	27.05*	150.00**	172**	23.16*

NS = Non-significant * = Significant at $P \leq 0.05$, ** = Significant at $P \leq 0.01$

TABLE 5. EFFECT OF STORAGE ON ORGANOLEPTIC QUALITY OF CARBONATED DRINKS PREPARED WITH VARYING QUANTITIES OF POMEGRANATE JUICE.

Storage in days	Overall ratings out of 30 scores for standard of excellence			
	Juice concentration (%) in drinks			
	5	10	15	20
0	14	27	26	26
40	12	27	23	22
80	10	24	20	19

Results are expressed as means for 10 judges.

In freshly prepared carbonated pomegranate drinks with 5, 10-15 and 20% juice respectively scored 14, 27, 26 and 26 overall sensory ratings. After 80 days of storage the over all sensory scores were 10, 24, 20 and 19 for carbonated pomegranate drinks containing 5, 10, 15 and 20% fruit juice respectively. The carbonated drink containing 5% fruit juice was not acceptable because the scores were less than 50% of the overall sensory ratings. The content of juice also influenced ($P \leq 0.01$) the quality of the carbonated drinks.

There was loss of overall scores ($P \leq 0.05$, Table 4) with advancement of storage period. A similar loss in aroma was noticed in freshly extracted aroma solution of Valencia orange when kept in glass-screw capped vials at 30° [15].

The carbonated drink containing 10% pomegranate juice was recommended for commercial production not because of the highest overall sensory scores but also keeping in view the economics of production.

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