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Effect of preservative and storage condition on biochemical and sensory quality of pomegranate and plum blended carbonated drink

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Abstract
Fruits based carbonated drinks are rich source of nutritional components, vitamins, minerals and other phytochemical constitution. Pomegranate and plum blended carbonated drink was developed and standardized which was studied for the effect of preservative and storage condition on biochemical and sensory quality of blended carbonated drink for 90 days under ambient and low temperature storage condition. The result showed gradually increase in TSS, pH, total sugars and reducing sugars whereas, decrease observed in acidity and sensory scores of carbonated drink. The changes in the biochemical parameters in the ambient condition was significantly deferred ($P < 0.05$) as compared to the low temperature stored blended carbonated drink. The blend had 80 ppm sodium benzoate which was stored at low temperature condition found to be superior in terms of sensory quality with good amount of biochemical retention.

Keywords: blended, drink, pomegranate, plum

Introduction
Pomegranate fruit is considered to be a suitable fruit for processing and utilization due to its excellent flavour, colour, physicochemical constitution and therapeutic properties (Dhumal *et al.*, 2014) [1] and Pomegranate juice is a polyphenol-rich fruit juice with high antioxidant capacity. Several studies suggested that pomegranate juice can exert anti-atherogenic, antioxidant, antihypertensive, and anti-inflammatory effects (Sahebkar *et al.*, 2017) [2]. Plum are important source of compounds influencing human health and preventing the occurrence of many diseases. Plum have abundance of bioactive compounds such as phenolic acids, anthocyanin's, carotenoids, flavanols, organic acids, fibre, tannins, aromatic substances, enzymes, minerals and vitamin A, B, C & K. (Birwal *et al.*, 2017) [3].
Unfermented beverages were consumed by diverse groups of people for nutritional, medicinal and socializing purpose. Inclusion of fruit juices in the soft drinks not only impart characteristics color and flavor but also provides some nutrients(Solanke *et al.*, 2017) [4]. Since the demand for soft drinks is increasing day by day, we can exploit this trend by developing enriched fruit juice beverages, as the consumers are becoming conscious of the ways in which diet is linked to the healthy life.
Carbonated fruit based beverages is a new concept which provides nutritional elements of the fruit along with natural pigments and flavor in addition to carbonation effects (Thongrote *et al.*, 2016) [5]. Carbonation of juices improves aroma, taste and storage life of the beverage. Carbonation is a process of mixing carbon dioxide under pressure with water, juice or a beverage so that the product when served gives off gas in fine bubbles and has the characteristic fizzy taste. Carbonated beverages are generally bottled with carbon dioxide content ranging from 1 to 8 g L^{-1} even Though the concentration is much lower than that required (14.6 g l^{-1}) for complete inhibition of microbial growth, yet it is significant in supplementing the lethal effect of acidity on pathogenic bacteria (Srivastava and Kumar, 2002) [6].

Methods and Material
Fresh pomegranate fruits (Bhagwa) with uniform size were purchased from a local farmer and juice was extracted by using box type juice extractor. Fresh plum (Indian plum) fruits having uniform size and color were purchased from wholesale market and its was undergone with enzyme treatment to obtain clear and high juice recovery.

The required quantity of Syrup prepared by blending pomegranate juice (10 %), plum juice (10%) and sugar was added to get 15°Brix. Sodium benzoate (0, 40, 80 and 120 ppm) was added to the syrup according to different treatments. Prepared syrup added to bottles (65ml for each 275ml capacity bottle) and the syrup contained bottles pasteurized was at 65ºC for 15 minutes. Carbonation was done by using industrial carbonation unit supplied by M. G. Industries, Coimbatore. Carbon dioxide was incorporated in each bottle at 100 psi pressure. The kokum water (consist of 1.5% kokum extract) used for carbonation was chilled and the steel caps used for sealing pre-sterilized and kept for storage study under low and ambient temperature condition. For low temperature storage respective treatment bottles are kept in refrigerated condition maintained at 4-7°C. Later, biochemical and organoleptic qualities were evaluated at different intervals during storage.

Methods of Analysis

Digital pH meter (model number BP3001) was used to measure the pH and the temperature was kept constant while taking sample observations. The total titratable acidity (%) of carbonated pomegranate and plum drink was determined by visual titration method as explained by Ranganna (1986) [7]. The content of total soluble solids (TSS) determined with the help of digital hand refractometer (Make: Erma Optical Work Ltd., Tokyo, Japan, 0-32°B range) and expressed as degree Brix (°B) (Anon., 1984) [8]. Sugars present in the carbonated pomegranate and plum drink sample were estimated by following the Lane and Eynon method (1923) [9]. Organoleptic evaluation of blended carbonated drink conducted on the basis of Colour, Odour, Taste, Body/Texture, After Taste and Overall acceptability by a panel of ten judges using a nine point Hedonic scale as laid out by Amerine *et al*. (1965) [10]. Completely Randomized Design (CRD) was used for conducting the experiment and results were analysed as per the guidelines suggested by Panse and Sukhatme (1978) [11].

Result and Discussion

Significant difference was recorded in pH of pomegranate and plum blended carbonated drink during 90 day of storage period (Table 1). The blended carbonated drink showed an increasing trend in pH during storage period with maximum increase in pH was observed in blend contain with 80 ppm sodium benzoate which were stored under ambient condition. Irrespective of the treatments, the juice stored at low temperature recorded a significantly lower increase in pH as compared to ambient storage. Increase of pH values during storage may be due to simultaneous decrease in organic acid content of carbonated drink. Similar results reported by Shelar (2001) [12] in storage of pomegranate beverage.

Titratable acidity (%) of the prepared carbonated drink during 90 days of storage differed significantly and it is tabulated in Table 1. A decreasing trend was recorded in all treatments during storage period with a maximum decrease in titratable acidity was recorded in blend with 80 ppm sodium benzoate which was stored under ambient condition. The decrease in acidity might be attributed to the bioconversion of acids into sugars or it could be attributed to the chemical interaction between the organic constituents of the juice induced by the temperature and action of enzymes (particularly invertase). Similar results reported by Sandhan and Kushare (2009) [13] for storage of pomegranate carbonated beverage.

Gradual increase in reducing sugars was observed during storage of carbonated drink for 90 days (Table 2). The increase in reducing sugars was significantly higher in ambient condition storage as compared to low temperature storage. Blend with 80 ppm sodium benzoate stored in ambient temperature increased maximum. Increase may be due to hydrolysis of non-reducing sugars like sucrose in to reducing sugars (glucose and fructose). These results are in accordance with the findings reported by Byanna and Gowda (2013) [14] in sweet orange and kokum blended RTS beverage.

Significant difference was recorded in total sugars among all blends after 90 days of storage. Maximum increase in total sugar from 14.07 per cent to 14.29 per cent was observed in blend stored with 40 ppm sodium benzoate under low temperature storage condition. The increase in total sugar might be due to the hydrolysis of polysaccharides like pectin, cellulose, starch *etc.* and its conversion into simple sugars like glucose and fructose. Similar finding reported by Sandhan and Kushare (2008) [13] for storage of pomegranate carbonated beverage.

An increasing trend was observed in TSS content after 90 days of storage (Table 3). Maximum TSS was increased from initial 14.87 to 15.25 in blend stored with 80 ppm preservative under ambient storage condition. This increase might be due to hydrolysis of insoluble polysaccharides like starch and organic acids into sugars. Similar findings reported by Dhineshkumar *et al.* (2016) [15], in effect of carbonation on storage and stability of pomegranate fruit juice.

The blends which was stored at ambient temperature without preservative and 40 ppm preservative had spoiled during 60 and 90 days of observations respectively, this might be due to failure in pasteurization of juice, improper sanitization of carbonated machine and absence or low concentration of sodium benzoate preservative which is required for inhibition of microbial growth. Similar finding were reported by Sandhan and Kushare (2009) [13], in storage studies of carbonated beverage from pomegranate juice and Dhineshkumar *et al*. (2016) [15], in storage and stability of pomegranate juice.

The sensory scores for colour, odour, taste, body/tesxture, after taste and overall acceptibility were declined gradually during 90 days of storage in ambient and low temperature storage condition of blended carbonated drink. The higher scores for sensory quality was recorded in the low temperature stored carbonated drink as compared to the ambient storage condition. It implies that in low temperature condition the sensory quality of the carbonated drink will be maintained. The highest score recorded for blend stored with 80ppm preservative under low temperature condition after 90 days of storage period.

Table 1: Effect of preservative and storage condition on pH and titratable acidity of pomegranate and plum blended carbonated drink

Treatments	pH			Acidity (%)		
	Days after storage			Days after storage		
	30	60	90	30	60	90
T_1- no preservative + low temperature	3.22^{c}	3.37^{b}	3.37^{bc}	0.43^{a}	0.39^{bcd}	0.37^{b}
T_1- SB (0ppm) + LT	3.22^{c}	3.37^{b}	3.37^{bc}	0.43^{a}	0.39^{bcd}	0.37^{b}
T_2- SB (0ppm) + AT	3.28^{ab}	X	X	0.37^{c}	X	X

T_3- SB (40ppm) + LT	3.23^{c}	3.32^{cd}	3.35^{cd}	0.43^{a}	0.41^{ab}	0.38^{ab}
T_4- SB (40ppm) + AT	3.28^{a}	3.39^{a}	X	0.39^{b}	0.36^{d}	X
T_5- SB (80ppm) + LT	3.22^{c}	3.28^{e}	3.34^{d}	0.43^{a}	0.40^{abc}	0.39^{ab}
T_6- SB (80ppm) + AT	3.25^{bc}	3.34^{bc}	3.42^{a}	0.41^{ab}	0.37^{cd}	0.35^{c}
T_7- SB (120ppm) + LT	3.23^{c}	3.32^{de}	3.34^{d}	0.44^{a}	0.43^{a}	0.40^{a}
T_8- SB (120ppm) + AT	3.25^{bc}	3.33^{bc}	3.38^{b}	0.42^{a}	0.40^{abc}	0.38^{b}
S. Em ±	0.01	0.01	0.01	0.01	0.01	0.01
CD@ 5%	0.03	0.03	0.03	0.03	0.04	0.02

Note: Initial pH: 3.19; acidity: 0.44 (%); X: Terminated due to spoilage; SB: sodium benzoate; LT: low temperature; AT: Ambient temperature.

Table 2: Effect of preservative and storage condition on reducing sugar and total sugar of pomegranate and plum blended carbonated drink

Treatments	Reducing sugars (%)			Total sugars (%)		
	Days after storage			Days after storage		
	30	60	90	30	60	90
T_1- SB (0ppm) + LT	10.24^{a}	10.27^{bc}	10.39^{c}	14.11	14.14^{b}	14.24^{c}
T_2- SB (0ppm) + AT	10.33^{c}	X	X	14.14	X	X
T_3- SB (40ppm) + LT	10.22^{a}	10.25^{c}	10.35^{d}	14.10	14.16^{b}	14.29^{a}
T_4- SB (40ppm) + AT	10.26^{b}	10.37^{a}	X	14.09	14.20^{a}	X
T_5- SB (80ppm) + LT	10.28^{a}	10.25^{c}	10.40^{c}	14.08	14.17^{ab}	14.24^{c}
T_6- SB (80ppm) + AT	10.24^{ab}	10.28^{bc}	10.51^{a}	14.11	14.15^{b}	14.27^{ab}
T_7- SB (120ppm) + LT	10.20^{a}	10.30^{b}	10.38^{c}	14.13	14.17^{ab}	14.20^{d}
T_8- SB (120ppm) + AT	10.23^{a}	10.28^{bc}	10.44^{b}	14.06	14.10^{c}	14.25^{bc}
S. Em ±	0.01	0.01	0.01	0.02	0.01	0.01
CD@ 5%	0.03	0.04	0.03	0.05	0.03	0.03

Note: Initial pH: 10.19(%); acidity: 14.06 (%); X: Terminated due to spoilage; SB: sodium benzoate; LT: low temperature; AT: Ambient temperature.

Table 3: Effect of preservative and storage condition on TSS and anthocyanin content of pomegranate and plum blended carbonated drink

Treatments	TSS (°Brix)		
	Days after storage		
	30	60	90
T_1- SB (0ppm) + LT	14.73	14.97^{bc}	15.10^{b}
T_2- SB (0ppm) + AT	14.90	X	X
T_3- SB (40ppm) + LT	14.80	15.03^{ab}	15.15^{ab}
T_4- SB (40ppm) + AT	14.97	15.20^{a}	X
T_5- SB (80ppm) + LT	14.83	14.90^{bc}	15.22^{ab}
T_6- SB (80ppm) + AT	14.87	15.07^{ab}	15.25^{a}
T_7- SB (120ppm) + LT	14.90	14.93^{bc}	14.97^{c}
T_8- SB (120ppm) + AT	14.77	14.80^{c}	15.17^{ab}
S. Em ±	0.08	0.07	0.04
CD@ 5%	0.23	0.20	0.13

Note: Initial TSS: 14.72 (°B); X: Terminated due to spoilage; SB: sodium benzoate; LT: low temperature; AT: Ambient temperature.

Table 4: Effect of preservative and storage condition on sensory quality of pomegranate and plum blended carbonated drink at 90th day of storage

Treatments	Colour	Odour	Taste	Body/ Texture	After Tast	Overall Acceptibility
T_1- no preservative + low temperature	3.22^{c}	3.37^{b}	3.37^{bc}	0.43^{a}	0.39^{bcd}	0.37^{b}
T_1- SB (0ppm) + LT	7.92	7.21	7.33	7.68	7.53	7.42
T_2- SB (0ppm) + AT	X	X	X	X	X	X
T_3- SB (40ppm) + LT	7.85	7.33	7.43	7.57	7.62	7.72
T_4- SB (40ppm) + AT	X	X	X	X	X	X
T_5- SB (80ppm) + LT	7.88	7.38	7.53	7.79	7.66	7.75
T_6- SB (80ppm) + AT	7.53	7.06	6.95	7.31	7.19	6.97
T_7- SB (120ppm) + LT	7.85	7.20	7.25	7.60	7.50	7.61
T_8- SB (120ppm) + AT	7.72	7.09	7.06	7.11	7.59	7.30
Initial scores	8.31	7.85	8.15	8.19	8.12	8.16

Note: X: Terminated due to spoilage; SB: sodium benzoate; LT: low temperature; AT: ambient temperature.

Conclusion

Blended carbonated drink from pomegranate and plum having 15°Brix TSS and 100 psi pressure level added with different concentration of sodium benzoate were stored at ambient and cold condition. During 90 days of storage period TSS, pH, total sugars and reducing sugars were increased gradually whereas, decrease in acidity and sensory scores was observed in blended carbonated drink. The changes in the biochemical parameters was maximum in ambient storage as compared to the low temperature stored pomegranate and plum blended carbonated drink. The result indicated that the treatments which stored without and 40 ppm of sodium benzoate

preservative were spoiled during 60 and 90 days at ambient storage condition, respectively.

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