Impacts of blending of fruit pulp on sensory quality of ready to drink beverage

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ABSTRACT: District Sargodha is known as California of Pakistan due to production of excellent quality of citrus especially kinnow. Although most of kinnow is exported or processed into different products, however, post-harvest loss is very high. To reduce these losses and to change the consumption pattern of kinnow juice, it was planned to blend it with different seasonal fruits like guava, grapes and pomegranate. It will not only increase the nutritional quality but taste profile of blended juice. So, keeping in view the above mentioned benefits, this project was designed to get the most suitable combination of blended drinks. Different treatments were evaluated for their physico-chemical, microbial and sensory properties. The drinks were also evaluated for their shelf stability for two months. The drinks were analyzed for titerable acidity. The highest acidity was observed in case of T$_4$ (0.181) followed by T$_3$ (0.180), while minimum acidity was found in T$_2$ (0.159). The leading TSS was observed in examination of T$_3$ (13.167). The TSS level of blended juices changed with passage of time. The drinks were also analyzed for their reducing, non-reducing and total sugar content. The leading reducing sugar content was noted in case of T$_4$ (5.100), while minimum reducing sugar content was noted in T$_3$ (3.840). The change in the level of reducing sugars may be due to the change in the amount and type of fruit pulp added. The highest non-reducing sugar content was noted in case of T$_6$ (8.536), while minimum non-reducing sugar content was noted in T$_7$ (7.710). The sugar acid ratio is an important quality parameter for drinks. The leading sugar to acid ratio was noticed in case of T$_4$ (81.840). The treatments were analyzed for total plate count (TPC) and mold count (MC) during storage. The highest TPC was observed in case of T$_2$ (163.33cfu/ml), while less TPC was found in T$_5$ (117.83cfu/ml). However all treatments remained acceptable during storage. The highest MC was observed in case of T$_2$ (73.500cfu/ml), while less MC was found in T$_3$ (22.33cfu/ml). As far as sensory evaluation is concerned, the highest score of flavor, color, taste, mouth feel and overall acceptability was achieved by the judges in case of T$_4$. However all treatments remained acceptable during storage and obtained acceptable score for overall acceptability.

KEYWORDS: RTD; Fruit blending, Sensory evaluation; Fruit pulp; Juices

INTRODUCTION

Fruits are very perishable and during distribution and marketing, considerable losses occur ranging from slight quality loss to complete spoilage. Another method of fruit preservation for long time is processing. Preparation of the beverages and juices is being experienced for long time. 100 % pure juice can be consumed or it can be blended different juices to improving taste, sugar: acid blend and it also improves its acceptability (Campos et al., 2010). Beverages based on fruit juices are consumed due to their medicinal, nutritional and energy values as compared to the carbonated beverages. Fruit and fruit juices are vital for good health and are good for all age groups. They form a sufficient part of our healthy diet (Campos et al., 2010). Fruit and fruit juices play a good role in maintaining and enhancing the human health (Saenz and Elena, 2001). Blending different juices in different proportion is one of the best method to improve sensory and nutritional qualities in the current scenario. Apart from the quality improvement, blended juices also have the combined effect of all the juices being blended. New product can be made through blending juices having specific nutritional benefits. Due to blending, the vitamin and mineral content of the juices increased depending upon quality and kind of fruit being used (De Carvalho et al., 2007).

Ready to drink (RTD) is a type of beverage containing no less than fruit (10%), TSS (10%) and acid about (0.3%). It is planned for undiluted utilization and made from pure unfermented fruit juice. It contains any carbohydrate and water with pulp or sometimes without pulp. According to the code of federal regulations (2001), a juice blend with other ingredients is known as a juice drink or juice cocktail. Fruit nectars can be made from pure juices or from the diluted juices with the sugar syrup. Usually they contain one fruit
like apple, peach or orange and can also be produced by blending one or more fruit pulps and juices. Getting ready the blended fruit juices with the minimum contents of fruit are continued by the industrial specifications, government standards, and other mandatory and voluntary requirements. For ensuring international trade, all these standards follow recommendations of the Codex Alimentarius of FAO/WHO (Food Standard Program).

Orange juice is very healthy and nutritious drink containing many essential nutrients. After extraction, the juice of kinnow turns bitter due to the conversion of limonite to limonin. So, blending of juices is helpful for making a nutritious RTD which may be economical and convenient for the consumers (Premi et al., 1994). Kinnow juice was amalgamated with other juices like Aonla and pomegranate juices for the improvement of taste, nutritive value, aroma, palatability and refreshing properties (Deka and Sethi, 2001; Deka, 2000). More than one fruit juices can be blended to prepare RTD and nectar. Due to blending the taste, nutrients and aroma of the beverages can be improved. Quality parameters of blended kinnow juice during storage remained acceptable (Bhardwaj and Mukherjee, 2011).

This project was designed about production of RTS drink having good nutritional value, sensory quality and longer shelf life. It was achieved by using different proportions of different fruit pulp so that the most suitable pulp concentration could be determined for the production of RTS drink with increased storage life. Pulp blends of the citrus (Kinnow), guava, grapes and pomegranates were made. The shelf stable juice blends were prepared with the aims to reduce post-harvest loses of fruits and changing the consumption pattern of these fruits. This study involves preserving the fresh fruit blends held in storage for period up to 12 weeks at ambient condition (i.e. 25±5°C). The main objectives of the project were:

1- Utilization and preservation of seasonal fruits in the form of pulp and drinks
2- To develop a nutritious fruit blends with good sensory quality
3- To study the suitability of different fruits in appropriate proportion for making RTD beverage
4- To study the shelf stability of fruit blends through physico-chemical and microbial analyses

**MATERIALS AND METHODS**

The research work was carried out to study the suitability of blending of fruit pulp for preparation of ready to drink (RTD) beverage and their impact on shelf stability, physical, nutritional and sensory properties of RTD. The research work was conducted at Institute of Food Science and Nutrition, University of Sargodha, Sargodha. Fully ripe seasonal fruit like Kinnow, Guava, Grapes and Pomegranate were procured from local fruit market of Sargodha, and other raw materials like sugar, CMC, preservatives, and plastic bottles were purchased from the native market.

These fruits were sorted and washed to remove dirt, dust, damaged fruits. The fruit after peeling and trimming were converted into fruit pulp by passing through pulping machine and preserved by the addition of sodium benzoate 0.1% and it was stored under cool conditions for further preparation of ready to serve drinks. Seven treatments of different combinations of fruit pulp blends were made to check the suitability of best combination in terms of organoleptic and nutritional value. Pulp 20%, sugar 12%, CMC 0.1% and citric acid 0.2% were used for preparing drinks. The treatment plan for the fruit blends is given in the Table 1.

**Total soluble solids (TSS)**

Determination of the TSS (°Brix) is an important measurement conducted in a wide range of juices. These soluble solids are originally sugars; glucose, fructose, and sucrose. The sugar measured (percentage) in degrees Brix (°Brix), indicates the sweetness of the fruit by calculating the number of soluble solids in the juice. Citric acid and minerals in the juice do take part to the soluble solids. The division of the Brix to total acid reading must be above a certain tolerance level.

The surface of refracto-meter was cleared and dried. A couple of drops of juice were dropped on the prism of the refractometer. The prism was pointed in the direction of good light and looked through the eye piece. Focused and reading was taken where the base of blue color sat on the scale and percentage sugar was recorded (AOAC, 2000).

**Acidity**

Acidity of the juices was measured by the method no. 942.15 as described in AOAC (2000). Citric acid and small amounts of other acids in these fruits gave blended drinks tartness and unique taste. The quantity of acid in the juice was reported as percent citric acid. To determine this value we used a titration method with sodium hydroxide.

Amount of 0.1 N sodium hydroxide added = A

Milliliters of 0.1 N sodium hydroxide x 0.064 = citric acid concentration (g per 100 mL)

\[
\text{Percentage acid} = \frac{\text{Titre} \times \text{acid factor} \times 100}{10 \text{ (ml juice)}}
\]

**pH**

pH of the juices was measured by the method no. 981.12 as described in AOAC (2000). The measurement of H+ ion activity is called pH. It is measurement of active acidity. pH
may be determined by calculating the electrode potential between glass and reference electrodes; pH meter is standardized using standard pH buffers.

Sensory Analysis

The ready to serve drinks were evaluated by a panel of judges from Institute of Food Science and Nutrition (UOS) for flavor, color, taste, texture and overall acceptability according to procedure described by Meilgaard et al. (2007) to find out the most suitable combination of drinks.

RESULTS AND DISCUSSIONS

Acidity

The drinks were analyzed for titerable acidity. The treatments differ highly significantly for their acid content (p≤0.01). The highest acidity was observed in case of T3 (0.181) followed by T2 (0.180), while minimum acidity was found in T2 (0.159). The change in acid content might be due to variation in fruit pulp and type of fruit used for preparation of ready to serve blended juices. The acidity level of blended juices changed with passage of time. It was noticed that there was a notable increase in acidity with storage interval.

Similar results of increase in acidity due to citric acid addition and rise in level of orange juice were noted by Awsi and Dorcus (2012), who prepared pineapple juice blends with carrot and orange juice. The increase in acidity might also be due to the reason that the concentration of weekly ionized acids and their salts thrive during the storage. The similar changes were also indicated by Imtiaz et al. (2008) in apricot and apple juices that acidity thrives with the passage of time. Saldar et al. (1999) also observed increase in acidity in tomato concentrate during storage. The increase in acidity is due to the acid formation by oxidation of reducing sugars, degradation of polysaccharides or by breakdown of pectin substances. Similar views are shown by Iqbal et al. (2001). The similar changes were also reported by Nilugin and Mahendran (2010) in a study related to preparation of RTS beverage from palmyrah pulp in which acidity increases.

pH

The treatments differ non-significantly for their pH (p>0.05). The effect of storage on pH of ready to serve blended juices is highly significant (p<0.01). The highest pH was observed in case of T6 (3.452) followed by T6 (3.447), while minimum pH was found in T2 (3.318). The change in pH of blended juices might be due to change in acidity level of juices. The decrease in pH of the blended drinks was due to the increase in acidity due to which organoleptic properties are affected as shown by Bhardwaj and Mukherjee (2012).

Similar results of decrease in pH due to increase in acidity were shown by Awsi and Dorcus (2012) who prepared pineapple juice blends with carrot and orange juice. The similar changes were also observed by Nilugin and Mahendran (2010) in a study related to preparation of RTS beverage from palmyrah pulp. There was significant (p<0.05) reduction in pH. The results showed that lower the pH, the higher the acidity in the RTS beverages of palmyrah. A study carried out by Abbo et al. (2006) showed that there is reduction in pH as the acidity increases. This is supported by Cole et al. (2000) that the pH of most juices and soft drinks is less than 4.

Total soluble solids (TSS)

The total soluble solids content of drinks were noted with the help of hand held refractometer. The treatments differ highly significantly for their TSS content (p≤0.01). The highest TSS was observed in case of T7 (13.167) followed by T4 (13.100), while minimum TSS was found in T1 (12.850). The TSS level of blended juices changed with passage of time. The increase in TSS may be due to the reason that sucrose converts into glucose and fructose with the addition of one water molecule or due to hydrolysis of the polysaccharides into oligosaccharides and monosaccharide.

Similar outcome of increase in TSS due to hydrolysis and inversion were shown by Awi and Dorcus (2012) who prepared pineapple juice blends with carrot and orange juice. The similar changes were also reported by Deka and Sethi (2001) in the fruit juice blends. Deka (2000) also found increase in total soluble solids during storage at low temperature in the mango- pineapple RTS beverages.

Color

As far as sensory evaluation is concerned, the treatments differ highly significantly for their color (p<0.01). The highest score of color was achieved by the judges in case of T4 (7.300) followed by T7 and T3 (7.050), while minimum score of color was obtained by T5 and T6 (5.850). The change in color of blended drinks might be due to different coloring pigments of the fruit used in the drink. However all treatments obtained acceptable color score. The shelf life study of ready to serve drinks indicated that color score decreases with storage interval which might be due to the decrease in pH.

Similar results of loss in color were reported by Balaswamy et al. (2011) during storage study of sour grape beverages. Similarly, color losses are also reported in juice blends of blueberry with grapes and cranberry juices after 3 months storage by Main et al. (2001). The similar changes of loss in color were also noted by Lund et al. (2000) and Gould et al. (1995) who preserved the juices. These results are in agreement with the Bhardwaj and Mukherjee (2011) who found decrease in color score with storage advancement while studying effect of blending of kinnow juice preservation and storage.
Flavor

The treatments differ highly significantly for their flavor (p≤0.01). The highest score of flavor was achieved by judges in case of T4 (7.500) followed by T5 (7.250), while minimum score of flavor was found in T6 (6.300). The change in flavor of blended drinks might be due to different flavoring compounds present in the fruit used in the drinks. pH plays an important role in preserving and improving flavor of the juice. However all treatments obtained acceptable flavor score. The shelf life study of ready to serve drinks indicated that flavor score decreases with storage interval. Flavoring compounds are major contributors to aroma of the juice. These flavoring compounds do not exhibit higher stability due to microbial contamination and growth which causes loss in flavor.

The similar results of loss in flavor were also reported by Shirly and Eyal (2005) during storage study of orange juice. These results are in agreement with the Bhardwaj and Mukheerjee (2011) who found decrease in flavor score with storage advancement while studying effect of blending of kinnow juice preservation and storage. Lund et al. (2000) and Gould et al. (1995) who preserved the juices showed loss in flavor with advancement in storage.

Taste

The treatments differ non-significantly for their taste (p>0.05). The highest taste score was observed in case of T4 (7.200) followed by T7 (6.900), while less taste score was found in T6 (6.450). The change in taste of blended drinks might be due to different fruit and in different proportion of pulp used in the drink and due to change in acidity of the blended drinks. Sugar acid ratio is an important parameter which changes during storage due to which the taste profile of the blended drinks changes. However all treatments obtained acceptable taste score. The shelf life study of ready to serve drinks indicated that taste score decreases with storage interval.

These results are in agreement with the Bhardwaj and Mukheerjee (2011) who found decrease in taste score with storage advancement while studying effect of blending on kinnow juice preservation and storage. Lund et al. (2000) and Gould et al. (1995) who preserved the juices found loss in taste with advancement in storage.

Overall acceptability

The treatments differ significantly for their overall acceptability (p<0.05-0.01). The highest score of overall acceptability was achieved by judges in case of T4 (7.300) followed by T7 (7.250), while less score of overall acceptability was observed in T3, T5 and T6 (6.600). The change in overall acceptability of blended juices might be due to decrease in color and flavor. Initial blending improved sensory qualities which changes with the passage of time. There is a minor decrease in overall acceptability during storage which might be due to the loss in color, flavor, taste, texture and mouth feel of the blended fruit drinks. However all treatments remained acceptable during storage and obtained acceptable score for overall acceptability.

The similar changes of slight decrease in overall acceptability due to loss of color and flavor were reported by Balaswamy et al. (2011) during storage study of sour grape beverages. These results are in agreement with the Bhardwaj and Mukheerjee (2011) who found decrease in overall acceptability score with storage advancement while studying effect of blending on kinnow juice preservation and storage. Lund et al. (2000) and Gould et al. (1995) who preserved the juices found decrease in scores of overall acceptability with advancement in the storage.

CONCLUSION AND RECOMMENDATIONS

Blending has many advantages when compared to whole fruits. The biggest advantages that blended fruit juice is assimilated much faster and better by the body than the fruit. There are obvious benefits for blending because it helps people reap the benefits of fruits more easily. Wishing to promote a healthier option different treatments of various combinations were made to check the best suitable combination. Sensory evaluation was done and it was found that the most effective treatment was T4 and this blend consist of orange juice (50%), blended with guava (25%) and grapes (25%). This blend excelled in terms of nutrients and sensory qualities than other blends.

This blend is recommended due suitable for blending on commercial scale in the form of pulp blend and RTD. This RTD will help to change the consumption pattern of seasonal fruit along with increasing shelf stability, marketability and reducing post-harvest losses.

AUTHOR’S CONTRIBUTIONS

All authors contributed equally in the designing, performance, data analysis and write-up of the manuscript. All authors read and approved the manuscript for submission.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

REFERENCES


## Table 1: Treatment plan for the different seasonal fruit blends

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<th>Guava (%)</th>
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## Table 2: Mean values of acidity, pH and TSS of treatments

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