Preservation of Ready to Serve Blended Carrot and Kinnow (Mandarin) Drink by Ginger Extract

Naeem Ullah*, Ihsan Mabood Qazi, Shaista Masroor, Ifitkhar Ali, Abbas Khan, Majid Khan and Afsheena Gillani

Department of Food Science and Technology, The University of Agriculture, Peshawar, Pakistan

Abstract

This study explore the effect of lemon and ginger extract on carrot and kinnow blended ready to serve (RTS) drinks during three months refrigeration temperature storage. The treatments were CKG0, CKG1, CKG2, CKG3, CKG4, CKG5 and CKG6 having 0.5 liter carrot juice, 0.5 liter kinnow juice, 1 g/kg CMC, 1 kg sugar, 5 liter water with variations in lemon and ginger extract in different levels. All the RTS samples were evaluated for total solids, moisture, ash, pH, reducing sugar, ascorbic acid, non-reducing sugar, titratable acidity, total soluble solids, total microbial count and sensory attribute (taste, colour, flavor and overall acceptability). Statistical analysis revealed that treatment as well as storage had significant (p<0.05) effect on physicochemical and sensory properties. Results showed that pH and sugar acid ratio of the treated samples was decrease during storage. While TSS, acidity, reducing and non-reducing sugar and vitamin C increased were observed during storage. Generally this is observed from the results that CKG6 sample was more acceptable than RTS of the samples on the basis of physiochemically. On the other hand, in terms of taste and flavor CKG6 sample was highly acceptable, sample CKG3 had good color and over all acceptability. However, RTS drinks prepared from with carrot and kinnow blends (CKG6) is recommended for commercial use and for production on large scale.

Keywords: Ginger; Ready to serve beverage; Physico-chemical properties; Sensory properties; Microbial analysis

Introduction

Carrot (Daucus carota) is winter vegetable, production wise carrot ranked in third position. In Pakistan, carrot is produced 192000 metric tons annually in an area of 11000 hectares. Carrots are one of the rich sources of moisture, protein, carbohydrate, crude fiber and minerals.

Kinnow Mandarin (Citrus reticulate) is a citrus fruits having sweet taste, bright colour and appearance grown. Mandarin is an important fruit and contain vitamins mostly vitamin C, vitamin A, minerals such as iron, phosphorus and calcium and citric acid [1]. Citrus fruit juice contains highly ascorbic acid 60 to 70 mg which is good for body health. It is also contains antioxidants (vitamin C) and flavonoids which has healthier effect than dietary benefits.

Ginger has been widely used as spice and flavoring agents in foods and beverages. Ginger has been used as a spice for over 2000 years. The composition of raw ginger is water, Protein, carbohydrate, fiber and Ash. Ginger is used to obtain different extracts. It is a good source of polyphenol compounds and composed as other roots. Ginger used as an antioxidants and their extracts is used as anti tumor effects which caused due to Epstein-Barr virus or applied against cancer.

This is quite challenging to prepare RTS beverage without the addition of chemical preservatives. The aim of study is to develop an acceptable quality RTS by blending carrot, kinnow, lemon juices and with addition of ginger extract to determine the most suitable concentration of lemon juice and ginger extract for the commercial preparation of RTS beverage with longer shelf life. This study also aimed to formulate carrot and kinnow blend RTS beverage to take advantage of both fruits which are nutritionally diverse and have synergetic effect when consume simultaneously. Citrus fruits are considered to be the rich source of ascorbic acid, pectin, carotenes, citric acid, and minerals like calcium and phosphorous. Carrots contain high levels of carbohydrates and ß-carotene. Keeping in view the nutritional and medicinal importance of ginger, the treatments has been formulated with a unique formulation.

Objectives

• To produce value added ready to serve beverage from various blends of carrot, kinnow and lemon.
• To develop suitable combination of carrot, kinnow and lemon RTS juice.
• To study the effect of ginger extract as an alternate of chemical preservative in prepared RTS juice.
• To study physicochemical and organoleptic properties of blended carrot and kinnow RTS juice.

Methods and Materials

This study was carried out in Agriculture research institute (ARI), Tarnab and Department of Food Science and Technology laboratories. Carrot, kinnow, lemon and ginger were purchased from the local market at Tarnab, Peshawar and brought to the laboratory of ARI Tarnab, Peshawar for preparation of ready to serve drinks.

Preparation of ready to serve drink (RTS)

The carrots were peeled and then heated in water having temperature up to 90-95°C for 25-30 minutes in order to soften the pulp. The boiled carrot was put in the pulping machine (Pulper juicing machine made in Jiangsu China) to get the pulp. The pulp was pushed through muslin cloth in order to get clear juice. The kinnow were cut into two equal halves and the juice was extracted through juice cutters.
extractor. Then juice was passed through muslin cloth to separate juice from pulp. The lemon were cut into two equal halves and the juice was extracted manually and filtered through muslin cloth to remove debris and unwanted materials. Ginger were peeled and cut into small pieces then crushed and juice was extracted with the help of blender and filtered from muslin cloth to separate juice from pulp. Ready to serve drinks were prepared in three replications from carrot, kinnow and lemon juice. All the juices were mixed in water along with other ingredients namely; sugar, CMC (used as a viscosity modifier or thickener, dissolves rapidly in cold or hot water and stabilize emulsions in various products these properties and functions make it suitable for use in a broad range of applications in the food) and ginger extract (Table 1).

Physicochemical analysis

pH, Total Soluble Solids, Total Titratble Acidity, Sugar acid ratio, Ascorbic acid Reducing and Non reducing sugars were determined by the standard method of AOAC [2].

Sensory evaluation

The sensory evaluation for taste, flavor, color and overall acceptability should be conducted by using nine hedonic [3].

Microbial study

The sample will be analyzed for the total fungal by total plate count (TPC) method as described by Kumar et al. [4].

Statistical analysis

Statistically the data was analyzed by using CRD with two factors (treatment and storage) and mean were separated by LSD test at 0.05% significant level [5].

Result and Discussion

pH

Table 2 shows the impact of storage and treatments on pH of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger. Statistically both storage and treatments had significant (p <0.05) effect on pH of ready to serve drinks. This is observed from the data that pH of the treated sample were in range of 3.5 (CKG6) to 3.76 (CKG4) after 90 days of storage. Highest mean pH (3.83) was observed for treatment CKG4, while the lowest mean pH (3.56) was observed for control sample. In term of storage maximum mean pH (3.69) was noticed at zero day of storage while minimum mean pH (3.54) was recorded after 90 days of storage prepared RTS. However higher pH decrease was found in sample CGG0 (4.44%) while lower pH was observed in CKG4 (3.71%). The degradation of reducing sugar and formation of acidic compounds from it causes a decline in pH (Zia).

| Treatment | Carrot juice | Kinnnow juice | CMC | Sugar | Water | Ginger extract | Lemon juice |
|-----------|--------------|---------------|-----|-------|-------|----------------|-------------|
| CKG0(control) | 0.5 L | 0.5 L | 1 g/kg | 1 kg | 5 L | 50 ml |
| CKG1 | 0.5 L | 0.5 L | 1 g/kg | 1 kg | 5 L | 50 ml |
| CKG2 | 0.5 L | 0.5 L | 1 g/kg | 1 kg | 5 L | 10 ml |
| CKG3 | 0.5 L | 0.5 L | 1 g/kg | 1 kg | 5 L | 10 ml |
| CKG4 | 0.5 L | 0.5 L | 1 g/kg | 1 kg | 5 L | 10 ml |
| CKG5 | 0.5 L | 0.5 L | 1 g/kg | 1 kg | 5 L | 20 ml |
| CKG6 | 0.5 L | 0.5 L | 1 g/kg | 1 kg | 5 L | 20 ml |

Table 1: Proposes study plan, shows the ratios of different ingredients for ready to serve drinks.

| Treatment | Storage Intervals | % decrease | Means |
|-----------|------------------|------------|-------|
| CKG4 | 3.6 3.55 3.49 3.44 | 4.44 3.52f |
| CKG5 | 3.8 3.75 3.69 3.65 | 3.95 3.72b |
| CKG6 | 3.7 3.65 3.56 3.54 | 4.32 3.62d |
| CKG7 | 3.71 3.65 3.56 3.57 | 3.77 3.63c |
| CKG8 | 3.91 3.86 3.78 3.76 | 3.84 3.83a |
| CKG9 | 3.63 3.58 3.53 3.48 | 4.13 3.56e |
| CKG10 | 3.5 3.46 3.41 3.37 | 3.71 3.44g |
| Means | 3.69a 3.64b 3.59c 3.54d |

Figures having different small letters shows significant difference (p<0.05)

Table 2: Effect of ginger extract on the pH of carrot and kinnow ready to serve beverage.

| Treatment | Storage Intervals | % decrease | Means |
|-----------|------------------|------------|-------|
| CKG1 | 15.5 15.9 16.4 16.9 | 8.28 16.17a |
| CKG2 | 15.5 15.9 16.4 16.8 | 7.74 16.15a |
| CKG3 | 15.6 16 16.5 17 | 8.24 16.27a |
| CKG4 | 15.4 15.7 16.2 16.6 | 7.23 15.97b |
| CKG5 | 15.6 15.9 16.5 16.9 | 7.69 16.22a |
| CKG6 | 15.3 15.8 16.2 16.6 | 7.83 15.97b |
| CKG7 | 15.4 15.7 15.9 16.3 | 5.52 15.82c |
| Means | 15.47d 15.84c 16.30b 16.72a |

Figures having different small letters shows significant difference (p<0.05)

Table 3: Effect of ginger extract on the TSS (0Brix) of carrot and kinnow ready to serve beverage.

Similarly, decreased was observed in pH of ginger and kinnow squash during storage. The pH has got importance to maintain shelf stability and it can also influence the flavor of ready to serve beverage [6].

Total soluble solids (TSS)

The impact of storage and treatments on Total soluble solids TSS of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger stored at refrigeration temperature presented in Table 3. Statistically both storage and treatments had significant (p<0.05) effect on TSS of ready to serve drinks. This is observed from the data that TSS of the treated sample were in range of 15.3 (CKG4) to 15.6 (CKG2 and CKG4) on zero day of storage, which increase up to 16.3 (CKG1) to 17 (CKG0) after 90 days of storage. Highest mean TSS (3.83) was observed for treatment CKG4, while the lowest mean TSS (3.56) was observed for control sample. In term of storage maximum TSS (16.72) was noticed at 90 day of storage, while minimum TSS (15.47) was recorded at day first of storage prepared RTS. However higher TSS increase was found in sample CGG0 (8.82%) while lower TSS was observed in CKG5 (5.52%). Polysaccharides conversion into sugars during hydrolysis processes might be the reason for increase in TSS. Similarly, Sarolia and Mukherjee, Mehta and Bajaj, Bhardwaj and Mukherje [7] reported that TSS increased during processing and storage of mandarin juice. This might be due to ginger juice inhibit microbial growth and subsequently reducing metabolic rate.

Acidity

Table 4 shows the impact of storage and treatments on acidity of value added ready to serve drinks made from blend of carrot, kinnow and ginger. Statistically both storage and treatments had significant (p<0.05) effect on acidity of ready to serve drinks. Similarly to TSS, acidity of prepared treated RTS drinks was increased during three months of storage from 0.45-0.5% CKG6 and CKG0 to 0.59% CKG6.
The effect of storage and treatments on sugar acid ratio of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger stored at refrigeration temperature was presented in Table 5. Statistically both storage and treatments had significant (p<0.05) effect on non-reducing sugar of ready to serve drinks. This was observed from the data that non reducing sugar of the treated sample were in range of 4.87 (CKG9) to 7.79 (CKG4) on zero day of storage, which decrease up to 4.75 (CKG9) to 7.64 (CKG4) after 90 days of storage. Highest mean non reducing sugar (7.71) was observed for treatment CKG4, while the lowest mean non reducing sugar (4.80) was observed at CKG6. In term of storage maximum mean non reducing sugar (6.97) was noticed at zero day storage prepared RTS. However, higher reducing sugar was found in sample CGG6 (1.40%) while lower sugar acid ratio was observed in CKG, (0.87%). The results are parallel to result of Babsky et al. [9], Pruthi et al., [10]; Tripathi et al., [11] Attiri et al. [12] which studied raise in reducing sugar of juice in storage duration, which might be influenced by the conversion of non-reducing sugar (sucrose).

### Table 5: Effect of ginger extract on the sugar acid ratio of carrot and kinnow ready to serve beverage.

| Treatment | Storage Intervals | % decrease | Means |
|-----------|------------------|------------|-------|
|           | 0    | 30   | 60 | 90 |
| CKG1      | 0.47 | 0.52 | 0.58 | 0.63 | 25.40 | 0.55c |
| CKG2      | 0.47 | 0.52 | 0.57 | 0.62 | 24.19 | 0.54c |
| CKG3      | 0.48 | 0.53 | 0.59 | 0.64 | 25.00 | 0.56b |
| CKG4      | 0.5  | 0.55 | 0.61 | 0.65 | 23.08 | 0.57a |
| CKG5      | 0.45 | 0.49 | 0.55 | 0.59 | 23.73 | 0.52d |
| CKG6      | 0.49 | 0.55 | 0.6  | 0.65 | 24.62 | 0.57a |
| CKG7      | 0.46 | 0.5  | 0.55 | 0.59 | 22.03 | 0.52d |
| Means     | 0.47d | 0.52c | 0.57b | 0.62a |

Figures having different small letters shows significant difference (p<0.05)
RTS. However higher non reducing sugar was found in sample CGG$_5$ (3.07%) while lower non reducing sugar was observed in CKG$_1$ (1.72%). Pruthi et al., [10] suggested that the decrease in non-reducing sugar might be due to conversion of non-reducing sugar into reducing sugar during their study on Kinnow and Malatia juice. Similar decline in non-reducing sugar were also observed in sugar contents, of pasteurized yellow passion fruit juice during storage during his study.

**Vitamin C**

Table 8 shows the effect of storage and treatments on vitamin C of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger. Statistically both storage and treatments had significant ($p<0.05$) effect on vitamin C of ready to serve drinks. Differences in ascorbic acid contents were noticed in various treatments. This was observed from the data that vitamin-C of the treated sample were in range of 25.23 (CKG$_7$) to 28.34 (CKG$_5$) on zero day of storage, which decreased to 25.09 (CKG$_7$) to 27.19 (CKG$_5$) after 90 days of storage. Highest mean vitamin C (28.26) was observed for treatment CKG$_5$, while the lowest mean vitamin C (25.15) was observed at CKG$_7$. In term of storage maximum mean vitamin-C (26.84) noticed at zero day of storage, while minimum (26.70) mean vitamin-C recorded after 90 days of storage prepared RTS. However higher vitamin-C was found in sample CGG$_5$ (0.55%) while lower vitamin C was observed in CGG$_1$ (0.45%). Decline trend in ascorbic acid contents was reported during changes in Aonla pulp under different storage conditions [13]. Ascorbic acid content in orange squashes reduced due to exposure to light. The degradation of vitamin C in RTS may pursue anaerobic and aerobic pathways [14].

**Taste**

Table 9 shows the effect of storage and treatments on taste of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger stored at refrigeration temperature was presented in Table 10. Statistically both storage and treatments had significant ($p<0.05$) effect on color of ready to serve drinks. This was observed from the data that color of the treated sample were in range of 8.1 (CKG$_5$) to 8.5 (CKG$_1$) on zero day of storage, which decreases up to (6) at CKG$_7$ to (6.8) at CKG$_5$ after 90 days of storage. Highest mean taste (8.25) was observed for treatment CKG$_5$, while the lowest mean taste (7.30) was observed at CKG$_7$. In term of storage maximum mean taste (8.34) noticed at zero day of storage, while minimum (7.05) mean taste recorded after 90 days of storage prepared RTS. However higher taste was found in sample CGG$_5$ (19.28%) while lower taste was observed in CKG$_5$ (8.14%). Loss in the taste of kinnow anola juice was reported due to changes in volatile compounds throughout storage [15]. The difference in taste might be due to in stored products. Similarly, loss in taste of juice was observed by Jain and Khurdiya, Jain et al., [16] during their study on physicochemical and sensory properties of orange drink.

**Color**

The effect of storage and treatments on color of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger stored at refrigeration temperature was presented in Table 10. Statistically both storage and treatments had significant ($p<0.05$) effect on color of ready to serve drinks. This was observed from the data that color of the treated sample were in range of 8.1 (CKG$_7$) to 8.5 (CKG$_1$) on zero day of storage, which decreases up to (6) at CKG$_7$ to (6.8) at CKG$_5$ after 90 days of storage. Highest mean color (8.25) was observed for treatment CKG$_5$, while the lowest mean color (7.40) was observed at CKG$_7$. In term of storage maximum mean color (8.35) was recorded after at first day of storage, while minimum mean color (7.17) was noticed at 90 days storage prepared RTS. However higher decrease in color was found in sample CGG$_5$ (27.71%) while lower decrease in color was observed in CKG$_5$ (8.14%). Millard reaction was accelerated throughout storage which resulted in loss of color of carrot and kinnow RTS. Loss of color in beverage during storage of 2-Methyl-3-furanthiol and methanol are possible off-flavors in stored orange juice were [17]. Ascorbic acid retention in orange squashes as related to exposure to light and container types well as action of acids present in RTS beverage.

**Flavor**

Table 11 shows the effect of storage and treatments on flavor of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger. Statistically both storage and treatments had significant ($p<0.05$) effect on flavor of ready to serve drinks. This was observed from the data that flavor of the treated sample were in range of 8.1 (CKG$_7$) to 8.5 (CKG$_1$) on zero day of storage, which decrease up to 6.7 (CKG$_5$) to 7.7 (CKG$_5$) after 90 days of storage. Highest mean...
Effect of ginger extract on the overall acceptability of carrot and kinnow

Table 12:

| Treatment | Storage Intervals | % decrease | Means |
|-----------|------------------|------------|-------|
|           | 0    | 30   | 60   | 90   |
| CKG₁      | 8.2  | 7.8  | 7.3  | 6.7  | 18.29 | 7.50bd |
| CKG₂      | 8.3  | 7.9  | 7.5  | 7    | 15.66 | 7.67od |
| CKG₃      | 8.4  | 8.1  | 7.7  | 7.2  | 14.29 | 7.85bc |
| CKG₄      | 8.5  | 8.3  | 8    | 7.7  | 9.41  | 8.12a  |
| CKG₅      | 8.1  | 7.7  | 7.4  | 7    | 13.58 | 7.55d  |
| CKG₆      | 8.3  | 7.7  | 7.3  | 6.8  | 16.07 | 7.52d  |
| CKG₁      | 8.4  | 8.1  | 7.9  | 7.6  | 9.52  | 8.00ab |
| Means     | 8.31a | 7.94b | 7.58c | 7.14d |

Figures having different small letters shows significant difference (p<0.05)

Table 12: Effect of ginger extract on the overall acceptability of carrot and kinnow ready to serve beverage.

flavor (8.12) was observed for treatment CKG₁, while the lowest mean flavor (6.7) was observed at CKG⁶. In term of storage maximum mean flavor (8.31) noticed at zero day of storage, while minimum (7.14) mean taste recorded after 90 days of storage prepared RTS. However higher flavor was found in sample CGG₀ (18.29%) while lower flavor was observed in CKG₆ (9.41%). Off flavour was reported due to changes in volatile compounds of kinnow anola beverages. The difference in flavor might be due to storage conditions and storage time. Similar observation during research on physiochemical and sensory properties of orange drink were also noticed by Jain et al., [16]. A decrease in flavor during storage study on 2-Methyl-3-furanthiol and methional in stored orange juice of beverage was also reported by Bezman [17].

Overall acceptability

The impact of storage and treatments on overall acceptability of value added ready to serve drinks prepared from blend of carrot, kinnow and ginger stored at refrigeration temperature was presented in Table 12. Statistically both storage and treatments had significant (p<0.05) effect on overall acceptability of ready to serve drinks. This was observed from the data that Overall acceptability of the treated sample were in the range of 8.1 (CKG and CKG₆) to 8.5 (CKG₂) on zero day of storage, which decreases up to (6) at CKG₆ to (7.6) at CKG after 90 days of storage. Highest mean over all acceptability (8.10) was observed for treatment CKG₁, while the lowest mean overall acceptability (7.30) was observed at CKG₆. In term of storage maximum mean overall acceptability (8.27) noticed at zero day of storage, while minimum (7.07) mean overall acceptability recorded after 90 days of storage prepared RTS. However higher overall acceptability was found in sample CGG₀ (25.93%) while lower overall acceptability was observed in CKG₆ (10.59%). These results are in agreement with result showed by Rosario [18], who observed decline in overall acceptability is due to increase in storage interval which leads to progressive degradation.

Loss of overall acceptability in orange juice might be due to processing conditions like, temperature and storage time.

Conclusion and Recommendation

Carrot and kinnow RTS was prepared in this research, Study concluded that the ginger can be effectively used in different proportions as natural antioxidant and alternative source of chemical preservatives for inhibition of microbial growth in carrot and kinnow RTS. Ready to serve beverage was packed in glass bottles, stored at –refrigeration temperature and for three months. The products were studied for physico-chemical and sensory evaluations at the interval of 30 days. On the basis of result obtained it is concluded that treatments CKG₁ and CKG₆ were best treatments having best keeping quality during storage and can be used in commercialization of carrot and kinnow RTS. Some changes were noticed in physiochemical characteristics but these changes did not influence the product considerably. The sensory parameters decrease slightly but remains in acceptable range during storage period.

Recommendations

• Further research work should be done on various proportions of ginger.
• The present research work was conducted at refrigeration temperature, so this research work should also be carried out in other storage conditions.
• Same proportions of ginger can also be used in other RTS beverages.

Other natural anti oxidant can also be used in carrot and kinnow RTS.

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