

## Preparation and Evaluation of Carrot and Apple Blended Jam

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### Abstract

The aim of this study was to evaluate a suitable combination, check the effect of storage period on the quality of carrot apple blended jam to be studied at ambient temperature (18°C-25°C). The treatments were CA<sub>0</sub> (carrot pulp 100%), CA<sub>1</sub> (carrot pulp 90% + apple pulp 10%), CA<sub>2</sub> (carrot pulp 80% + apple pulp 20%), CA<sub>3</sub> (carrot pulp 70% + apple pulp 30%), CA<sub>4</sub> (carrot pulp 60% + apple pulp 40%) and CA<sub>5</sub> (carrot pulp 50% + apple pulp 50%). All the treatments were examined for physicochemical properties i.e., total soluble solids (°Brix), pH, reducing sugars (%), percent acidity, non-reducing sugars (%), ascorbic acid (mg/100 g) and for sensory properties i.e., taste, color, texture and overall acceptability at fifteen days interval for a total storage period of 90 days. A significant increase of (p<0.05) was examined in TSS from (67.45 to 70.40°Brix), acidity (0.64 to 0.80) and reducing sugars (16.64 to 27.78) while Significant decrease of (p<0.05) was examined in pH from (3.63 to 3.44), non-reducing sugars (45.04 to 27.69), ascorbic acid (7.81 to 5.52 mg/100 g), color (7.33 to 4.35), taste (7.40 to 4.12), texture (7.22 to 4.06) and overall acceptability (7.36 to 4.14). During physicochemical and sensory analysis it was studied that CA<sub>5</sub> carrot, apple (5:5) followed by CA<sub>4</sub> carrot, apple (6:4) were of good qualities among the treatments.

**Keywords:** Carrot; Apple; Jam; Physico-chemical and sensory evaluation

### Introduction

Jam is a semi-solid food product, obtained upon cooking of fruits or vegetables pulp with sugar, citric acid and pectin. Jam can be defined as an intermediate moisture food prepared by cooking sugar with fruit pulp, pectin, acid and other ingredients to a sensibly consistency. Jam should contain 65% or more TSS and at least 45% pulp. Jams generally have two types, the one which is developed from pulp of single fruit while the second type is prepared by blending two or more fruits pulp [1]. Carrot is rich source of many vitamins like A, C, β-carotene, B1, B2 and B3 and minerals like calcium, potassium, phosphorus and sodium [2], good source of dietary fibers, carotenoids and phenols compounds [3]. It is tougher to preserve fresh apple for a long period of time. It is processed to get ready juices, jams, jelly, canned apple slices and dehydrated apple slices, etc. In jam, jellies sugar stops growth of microorganisms and prevent spoilage. Sugar holds water due to which shelf life of the products is increased [4]. Pectin being a gelling agent is responsible for gel formation in the jam preparation [5]. Stabilizing, thickening and textural characteristics are improved by pectin in different foods like jam, jelly, bakery products, confectionery and beverages [6]. Citric acid is essential to accurate balance, which is required in jam and jellies preparation. For the replacement of citric acid lime and lemon juice can be used in the jam preparation because lemon and lime juices have greater amount of citric acid [7].

### Objectives

1. To prepare consumer acceptable and best quality carrot and apple blended jam.
2. To study physicochemical and sensory properties of the blended jam.
3. To study the effect of storage conditions on the overall quality of carrot apple blended jam.

### Materials and Methods

For the research work carrots and apples were purchased from the local market.

### Sample preparation

Carrots and apples were cleaned and peeled. Slices of apple were

dipped in water containing 1% citric acid to avoid oxidation while carrots were boiled in water for softness. To get pulp the raw materials were put in pulping machine. Carrot and apple pulp was combined in 6 different proportions for jam preparation by method as recommended by Awan and Salim-ur-Rehman [8]. All batches were cooked to a reasonably consistency for the jam preparation.

### Proposed plan of the study

Carrot and apple jam was prepared with following different ratio.

CA<sub>0</sub>: Carrot pulp (100%) + Apple pulp (0%)

CA<sub>1</sub>: Carrot pulp (90%) + Apple pulp (10%)

CA<sub>2</sub>: Carrot pulp (80%) + Apple pulp (20%)

CA<sub>3</sub>: Carrot pulp (70%) + Apple pulp (30%)

CA<sub>4</sub>: Carrot pulp (60%) + Apple pulp (40%)

CA<sub>5</sub>: Carrot pulp (50%) + Apple pulp (50%)

### Packaging and storage of carrot apple jam

Carrot and apple carrot jam was packed in sterilized 550 g glass jar. Samples were analyzed for physicochemical and sensory characteristics. The samples were examined at fifteen days intervals and were kept for three months.

### Physicochemical analysis

Samples were examined for physicochemical properties; TSS,

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pH, acidity, reducing sugar, non-reducing sugar and ascorbic acid. To determine Total soluble solids digital refractometer was used and was examined by standard method of AOAC [9], method 932.14 and 932.12. To examine Titratable acidity standard method of AOAC [9], 942.15 was applied. pH is determined for the concentration of hydrogen ion. To examine pH the standard method of AOAC [9], method 2005.02 was applied. To analyze Reducing sugar of carrot apple jam the standard method of AOAC [9], 920.183 was applied. The Ascorbic acid content was determined by the standard method of AOAC [9], 967.21.

### Sensory evaluation

Carrot apple jam samples were evaluated for sensory characteristics such as color, taste, texture and overall acceptability. Samples were examined by 10 judges by using 9 hedonic scale as described by Larmond [10].

### Statistical analysis

The data was analyzed by using two factorial CRD and means were separated by applying LSD test at 0.05% significant level as described by Shakir et al. [11].

## Results and Discussion

### Total soluble solids (°Brix)

The TSS of the samples in the initial day were 67.6, 67.4, 67.3, 67.5, 67.6 and 67 from CA<sub>0</sub> to CA<sub>5</sub>, which gradually rises to 71.7, 70.8, 70.3, 70.3, 70.2 and 69.6 in respective way, during 90 days of storage. Mean TSS value was recorded 67.45 at initial day of storage, while 70.40 at 90 days storage. CA<sub>0</sub> showed the maximum mean value (69.46) among the treatments, while CA<sub>5</sub> showed the lowest (68.41) value. The maximum percent increase was found in CA<sub>0</sub> (5.72), which is followed by CA<sub>1</sub> (4.80), while the lowest percent increase was recorded at CA<sub>4</sub> (3.70) and CA<sub>5</sub> (3.02). The observed values represented that storage period and different treatments significantly influence TSS of the carrot and apple blended jam samples (Table 1). The present findings are in accordance with observed value of Khan et al. [12], who discovered an increasing tendency (68.5°Brix-71.2°Brix) during 90 days storage period of

pear apple jam. Similarly, Ehsan et al. [13] also observed an increase in TSS from 66.5 to 68.8°Brix in fruit jam. Ehsan et al. [14], Hussain and Shakir [15] also found an increase in TSS (70°Brix to 70.8°Brix) in watermelon and lemon jam. The increase in TSS might be due to hydrolysis of starch into simple sugar.

### pH

pH of carrot/apple jam decreased step by step with the passage of time during storage. The fresh values of the samples were 3.7, 3.65, 3.63, 3.58, 3.59 and 3.61, from CA<sub>0</sub> to CA<sub>5</sub>, which gradually decreased to 3.48, 3.45, 3.44, 3.41, 3.43 and 3.47 respectively for 90 days period. The mean value at initial day for pH was recorded as 3.63, which then decreased to 3.44 during storage. The highest mean value of 3.60 was observed in case of CA<sub>0</sub>, while the lowest mean value of 3.50 was found in case of CA<sub>3</sub> (Table 2). The highest percent decrease (5.95) was noted at CA<sub>0</sub> followed by CA<sub>1</sub> (5.48), however CA<sub>5</sub> (3.88) and CA<sub>4</sub> (4.46) showed the lowest percent decrease in pH of the jam samples. The present findings are supported by the work of Hussain and Shakir [15], who investigated that the pH of watermelon lemon jam samples showed decreasing trends during time intervals. pH of the fruit sample is very important, as it help in the formation of optimum gel in the preparation of jam. In contrast, the pH value of apple and apricot jam studied by Anjum et al. [16] were found to be somewhat higher than present findings. The raise in acidity of jam samples during storage period resulted from the formation of acidic compound resulted in the decrease of pH. Similarly, previous literature supported the present finding, as they also studied fall in the pH values of fruit jam during storage [12].

### Titratable acidity

The percent acidity of the jam samples was 0.65, 0.63, 0.65, 0.61, 0.64 and 0.64 (CA<sub>0</sub> to CA<sub>5</sub>) at first day, while showed an increasing trend of 0.87, 0.81, 0.82, 0.75, 0.78 and 0.76 correspondingly during three months storage interval. Mean acidity value at first day of storage was 0.64 which increased to 0.80 (Table 3). The highest mean value of 0.75 was recorded at CA<sub>0</sub> while the lowest value of 0.67 was recorded at CA<sub>3</sub>. CA<sub>0</sub> showed the maximum percent increase in acidity (25.29), followed by CA<sub>1</sub> (22.22), while CA<sub>5</sub> showed the minimum increase

| Treatments      | Storage intervals (Days) |                     |                    |                    |                    |                    |                    | % increase | Means               |
|-----------------|--------------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|---------------------|
|                 | 0                        | 15                  | 30                 | 45                 | 60                 | 75                 | 90                 |            |                     |
| CA <sub>0</sub> | 67.6                     | 68                  | 68.4               | 68.9               | 70.5               | 71.1               | 71.7               | 5.72       | 69.46 <sup>a</sup>  |
| CA <sub>1</sub> | 67.4                     | 67.7                | 68.1               | 68.7               | 69.3               | 70                 | 70.8               | 4.80       | 68.86 <sup>b</sup>  |
| CA <sub>2</sub> | 67.3                     | 67.6                | 68                 | 68.5               | 69.1               | 69.7               | 70.3               | 4.27       | 68.64 <sup>bc</sup> |
| CA <sub>3</sub> | 67.5                     | 67.8                | 68.1               | 68.5               | 69.1               | 69.7               | 70.3               | 3.98       | 68.71 <sup>bc</sup> |
| CA <sub>4</sub> | 67.6                     | 67.9                | 68.2               | 68.6               | 69.1               | 69.6               | 70.2               | 3.70       | 68.74 <sup>bc</sup> |
| CA <sub>5</sub> | 67.5                     | 67.7                | 68                 | 68.3               | 68.7               | 69.1               | 69.6               | 3.02       | 68.41 <sup>c</sup>  |
| Means           | 67.45 <sup>f</sup>       | 67.75 <sup>ef</sup> | 68.10 <sup>e</sup> | 68.58 <sup>d</sup> | 69.15 <sup>c</sup> | 69.75 <sup>b</sup> | 70.40 <sup>a</sup> | ---        | ---                 |

<sup>a-f</sup> p<0.05

Table 1: Influence of treatments and storage intervals on total soluble solids of carrot and apple blended jam.

| Treatments      | Storage intervals (Days) |                   |                   |                   |                   |                   |                   | % decrease | Means              |
|-----------------|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------|--------------------|
|                 | 0                        | 15                | 30                | 45                | 60                | 75                | 90                |            |                    |
| CA <sub>0</sub> | 3.7                      | 3.67              | 3.64              | 3.6               | 3.56              | 3.52              | 3.48              | 5.95       | 3.60 <sup>a</sup>  |
| CA <sub>1</sub> | 3.65                     | 3.62              | 3.59              | 3.56              | 3.53              | 3.49              | 3.45              | 5.48       | 3.56 <sup>b</sup>  |
| CA <sub>2</sub> | 3.63                     | 3.61              | 3.58              | 3.55              | 3.52              | 3.48              | 3.44              | 5.23       | 3.54 <sup>c</sup>  |
| CA <sub>3</sub> | 3.58                     | 3.56              | 3.53              | 3.5               | 3.47              | 3.44              | 3.41              | 4.75       | 3.50 <sup>e</sup>  |
| CA <sub>4</sub> | 3.59                     | 3.57              | 3.55              | 3.52              | 3.49              | 3.46              | 3.43              | 4.46       | 3.52 <sup>d</sup>  |
| CA <sub>5</sub> | 3.61                     | 3.6               | 3.58              | 3.56              | 3.53              | 3.5               | 3.47              | 3.88       | 3.55 <sup>bc</sup> |
| Means           | 3.63 <sup>a</sup>        | 3.61 <sup>b</sup> | 3.58 <sup>c</sup> | 3.55 <sup>d</sup> | 3.51 <sup>e</sup> | 3.48 <sup>f</sup> | 3.44 <sup>g</sup> | ---        | ---                |

<sup>a-g</sup> p<0.05

Table 2: Influence of treatments and storage intervals on pH of carrot and apple blended jam.

| Treatments      | Storage intervals (Days) |                   |                   |                   |                   |                   |                   | % increase | Means              |
|-----------------|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------|--------------------|
|                 | 0                        | 15                | 30                | 45                | 60                | 75                | 90                |            |                    |
| CA <sub>0</sub> | 0.65                     | 0.68              | 0.71              | 0.74              | 0.78              | 0.82              | 0.87              | 25.29      | 0.75 <sup>a</sup>  |
| CA <sub>1</sub> | 0.63                     | 0.65              | 0.67              | 0.7               | 0.73              | 0.77              | 0.81              | 22.22      | 0.71 <sup>c</sup>  |
| CA <sub>2</sub> | 0.65                     | 0.67              | 0.69              | 0.72              | 0.75              | 0.78              | 0.82              | 20.73      | 0.73 <sup>b</sup>  |
| CA <sub>3</sub> | 0.61                     | 0.63              | 0.65              | 0.67              | 0.69              | 0.72              | 0.75              | 18.67      | 0.67 <sup>e</sup>  |
| CA <sub>4</sub> | 0.64                     | 0.66              | 0.68              | 0.7               | 0.72              | 0.75              | 0.78              | 17.95      | 0.70 <sup>cd</sup> |
| CA <sub>5</sub> | 0.64                     | 0.65              | 0.67              | 0.69              | 0.71              | 0.73              | 0.76              | 15.79      | 0.69 <sup>d</sup>  |
| Means           | 0.64 <sup>a</sup>        | 0.66 <sup>f</sup> | 0.68 <sup>e</sup> | 0.71 <sup>d</sup> | 0.73 <sup>c</sup> | 0.77 <sup>b</sup> | 0.80 <sup>a</sup> | ---        | ---                |

<sup>a-g</sup> p<0.05

**Table 3:** Influence of treatments and storage intervals on percent acidity of carrot and apple blended jam.

| Treatments      | Storage intervals (Days) |                    |                    |                    |                    |                    |                    | % increase | Means               |
|-----------------|--------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|---------------------|
|                 | 0                        | 15                 | 30                 | 45                 | 60                 | 75                 | 90                 |            |                     |
| CA <sub>0</sub> | 16.74                    | 18.08              | 19.67              | 21.95              | 24.44              | 27.05              | 29.92              | 44.05      | 22.55 <sup>a</sup>  |
| CA <sub>1</sub> | 16.71                    | 18.43              | 20.37              | 22.15              | 24.37              | 26.62              | 28.86              | 42.10      | 22.50 <sup>a</sup>  |
| CA <sub>2</sub> | 16.54                    | 17.46              | 18.83              | 20.34              | 21.95              | 24.36              | 27.42              | 39.68      | 20.99 <sup>bc</sup> |
| CA <sub>3</sub> | 16.56                    | 17.69              | 19.12              | 20.83              | 22.55              | 24.48              | 26.65              | 37.86      | 21.13 <sup>b</sup>  |
| CA <sub>4</sub> | 16.65                    | 17.72              | 19.04              | 20.55              | 22.13              | 23.82              | 26.07              | 36.13      | 20.85 <sup>bc</sup> |
| CA <sub>5</sub> | 16.58                    | 17.36              | 18.41              | 19.78              | 21.26              | 23.17              | 25.28              | 34.41      | 20.26 <sup>c</sup>  |
| Means           | 16.64 <sup>a</sup>       | 17.88 <sup>f</sup> | 19.41 <sup>e</sup> | 21.16 <sup>d</sup> | 23.09 <sup>c</sup> | 25.27 <sup>b</sup> | 27.78 <sup>a</sup> | ---        | ---                 |

<sup>a-g</sup> p<0.05

**Table 4:** Influence of treatments and storage intervals on percent reducing sugar of carrot and apple blended jam.

| Treatments      | Storage intervals (Days) |                    |                    |                    |                    |                    |                    | % decrease | Means              |
|-----------------|--------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------|--------------------|
|                 | 0                        | 15                 | 30                 | 45                 | 60                 | 75                 | 90                 |            |                    |
| CA <sub>0</sub> | 43.4                     | 41.28              | 38.2               | 34.95              | 31.28              | 27.11              | 23.56              | 45.71      | 34.25 <sup>d</sup> |
| CA <sub>1</sub> | 45.1                     | 42.45              | 39.67              | 36.56              | 33.12              | 29.66              | 26.8               | 40.58      | 36.19 <sup>c</sup> |
| CA <sub>2</sub> | 43.2                     | 41.64              | 39.05              | 36.17              | 32.92              | 29.65              | 26.26              | 39.21      | 35.56 <sup>c</sup> |
| CA <sub>3</sub> | 47                       | 44.75              | 42.07              | 39.21              | 36.11              | 33.23              | 30.08              | 36.00      | 38.92 <sup>b</sup> |
| CA <sub>4</sub> | 46.5                     | 44.78              | 42.38              | 40.05              | 37.83              | 34.55              | 31.77              | 31.68      | 39.69 <sup>a</sup> |
| CA <sub>5</sub> | 46.36                    | 44.77              | 42.95              | 40.73              | 38.36              | 35.85              | 33.54              | 27.65      | 40.37 <sup>a</sup> |
| Means           | 45.04 <sup>a</sup>       | 42.98 <sup>b</sup> | 40.27 <sup>c</sup> | 37.39 <sup>d</sup> | 34.25 <sup>e</sup> | 30.84 <sup>f</sup> | 27.69 <sup>g</sup> | ---        | ---                |

<sup>a-g</sup> p<0.05

**Table 5:** Influence of treatments and storage intervals on percent non-reducing sugar of carrot and apple blended jam.

in percent acidity followed by CA<sub>4</sub> (17.95). The present findings are supported by the findings of Sogi and Singh [17], who found an increase in percent acidity (0.65%-0.70%) of apricot jam during storage period. Similarly, the increase in acidity from 0.68 to 0.86 percent was observed in strawberry jam by Ehsan et al. [13]. Hussain and Shakir [15] Also found an increase in percent acidity of the jam throughout storage interval. Similarly, Khan et al. [12] also found raise in acidity from 0.60% to 0.78% during storage. The high acidity of fruit jam might be due to the hydrolysis of pectin and degradation of ascorbic acid. The increase in acidity of fruit jam also resulted due to sugar breakdown and increase in the total soluble solid contents of the samples [18].

### Reducing sugar

The observed value of reducing sugars of the jam samples from CA<sub>0</sub> to CA<sub>5</sub> at initial day were 16.74, 16.71, 16.54, 16.56, 16.65 and 16.58. The reducing sugar of the various samples increased gradually (29.92, 28.86, 27.42, 26.65, 26.07 and 25.28) during storage period. The mean value at initial day was 16.64, which increased to 27.78 during the storage period. Among the treatments CA<sub>0</sub> showed the maximum mean value of 22.55, however the minimum value of 20.26 was recorded at CA<sub>5</sub>. The maximum percent increase (44.05) was found in CA<sub>0</sub>, while the lowest percent increase of 34.41 was found in CA<sub>5</sub> (Tables 4 and 5) The analysis of reducing sugar of strawberry jam during storage interval showed an increasing trend [19], hence justifying the present results. Similarly, the reducing sugar of apricot jam also increased significantly

during storage period [17]. Ehsan et al. [14] Found that the reducing sugar of grape and apple marmalade increased from 16.55 to 31.36 during keeping period. The raise in the reducing sugar is caused by the conversion of sucrose to glucose and fructose, due to temperature and acidic condition [20].

### Non-reducing sugar

The observed value from CA<sub>0</sub> to CA<sub>5</sub> of non-reducing sugar at initial day was 43.40, 45.10, 43.20, 47.00, 46.50 and 46.36 respectively. While, during storage period the non-reducing sugar content decreased gradually to 23.56, 26.80, 26.26, 30.08, 31.77 and 33.54 correspondingly. The mean value for non-reducing sugar at initial day was found to be 45.04, which further decreased to 27.69. CA<sub>5</sub> showed the maximum mean value (40.37) among the treatments, while CA<sub>0</sub> showed the minimum value (34.25). The sample CA<sub>0</sub> showed the maximum percentage decrease (45.71) in case of non-reducing sugar, which is followed by the sample CA<sub>1</sub> (40.58). However, showed the minimum % decrease, which is followed by the sample CA<sub>4</sub> (31.68). The present results are in close contract with the findings of Singh et al. [19], who found a decline in the non-reducing sugars (44.64 to 32.35) of the strawberry jam during storage period. A decline in non-reducing sugar during the storage intervals is obtained in grape and apple marmalade throughout the storage period [14]. Similarly, Khan et al. [12] also observed a decline in non-reducing sugar in pear apple jam. The increase in reducing sugar is caused by conversion of sucrose to glucose and fructose, due to temperature and acidic condition [20].

### Ascorbic acid

The initial day reading for ascorbic acid content from CA<sub>0</sub> to CA<sub>5</sub> were 4.52, 5.78, 7.82, 8.86, 9.22 and 9.65 respectively, which substantially decreased to 2.8, 4.55, 5.40, 6.35, 6.77 and 7.25 respectively during 3 months of storage period. Mean ascorbic acid value of 7.81 was observed at initial day, which decreased to 5.52 during 90 days of storage period. The highest mean value of 8.61 was noted by the sample CA<sub>5</sub>, while lowest mean value of 3.83 was noted at CA<sub>0</sub>. Maximum percent decrease of 38.05 was observed at CA<sub>0</sub> followed by the sample CA<sub>1</sub> (32.89), while the minimum percent decrease was found at CA<sub>5</sub> (24.87) followed by CA<sub>4</sub> (26.57) (Table 6). The ascorbic acid content of strawberry jam significantly decreased from 18 mg/100 g to 13 mg/100 g throughout the storage interval [19]. Similar trend of decline in ascorbic acid content of fruit jam was observed by Veltman et al. [21]. The loss of ascorbic acid content is because of light in the storage environment of the product. Ascorbic acid is the most important nutrient that represents the quality characteristics of the product, which is substantially affected due to oxidation during processing and storage [22].

### Color

At initial day, the sensory score for color of the samples from CA<sub>0</sub> to CA<sub>5</sub> were 6.7, 7.0, 7.1, 7.7, 7.7 and 7.9, which decreased substantially to 1.5, 3.6, 4.3, 5.2, 5.6 and 5.9 respectively throughout storage intervals. The mean score of color at initial day of storage was 7.33, which lowered

to 4.35 (Table 7). The maximum mean value of 7.00 was noted by CA<sub>5</sub>, while minimum value of 4.34 was noted by CA<sub>0</sub>. The highest percentage decrease of 77.61 was observed at CA<sub>0</sub> followed by CA<sub>1</sub> (48.57), while the minimum percentage decrease was noted at CA<sub>5</sub> (24.36) followed by CA<sub>4</sub> (27.27). Similarly, Ehsan et al. [13] investigated that color mean was decrease from 9.00 to 7.00 in strawberry jam. The color of food product is the most important parameters regarding consumer's opinion. During storage, the color of product is significantly degraded [23]. Decline in color score may be due to degradation of ascorbic acid and enzymatic browning.

### Taste

The sensory score for taste of carrot and apple blended jam at initial day were 6.1, 6.8, 7.8, 8.20, 8.10 and 8.20 (CA<sub>0</sub> to CA<sub>5</sub>), which gradually obtained a lower score from the sensory panels (1.3, 3.9, 4.7, 5.2, 5.5 and 6.2) during the period of storage. The mean taste scores at initial day of storage were found 7.40, which substantially lowered to 4.12. The highest mean score for taste was observed at CA<sub>5</sub> (7.37), while the lowest score was observed at CA<sub>0</sub> (4.01). The maximum decrease of 78.69% was observed by CA<sub>0</sub> which was followed by CA<sub>1</sub> (42.65), while minimum decrease of 24.39 was observed by CA<sub>5</sub>, followed by CA<sub>4</sub> (32.10) (Table 8). The present results are in accordance with the previous works [24], who investigates decrease in taste scores of apple jam from 8.60 to 5.90 throughout 90 days. However, Husain and Shakir [15] recorded a decline in the taste scores of watermelon and lemon

| Treatments      | Storage intervals (Days) |                   |                   |                   |                   |                   |                   | % decrease | Means             |
|-----------------|--------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------|-------------------|
|                 | 0                        | 15                | 30                | 45                | 60                | 75                | 90                |            |                   |
| CA <sub>0</sub> | 4.52                     | 4.4               | 4.22              | 3.97              | 3.65              | 3.24              | 2.8               | 38.05      | 3.83 <sup>f</sup> |
| CA <sub>1</sub> | 6.78                     | 6.52              | 6.23              | 5.92              | 5.48              | 5.09              | 4.55              | 32.89      | 5.80 <sup>e</sup> |
| CA <sub>2</sub> | 7.82                     | 7.43              | 7.15              | 6.76              | 6.44              | 5.95              | 5.4               | 30.95      | 6.71 <sup>d</sup> |
| CA <sub>3</sub> | 8.86                     | 8.62              | 8.28              | 7.83              | 7.37              | 6.83              | 6.35              | 28.33      | 7.73 <sup>c</sup> |
| CA <sub>4</sub> | 9.22                     | 9                 | 8.66              | 8.29              | 7.85              | 7.31              | 6.77              | 26.57      | 8.16 <sup>b</sup> |
| CA <sub>5</sub> | 9.65                     | 9.43              | 9.14              | 8.81              | 8.28              | 7.74              | 7.25              | 24.87      | 8.61 <sup>a</sup> |
| Means           | 7.81 <sup>a</sup>        | 7.57 <sup>b</sup> | 7.28 <sup>c</sup> | 6.93 <sup>d</sup> | 6.51 <sup>e</sup> | 6.03 <sup>f</sup> | 5.52 <sup>g</sup> | ---        | ---               |

<sup>a-g</sup> p<0.05

**Table 6:** Influence of treatments and storage intervals on ascorbic acid content (mg/100 g) of carrot and apple blended jam.

| Treatments      | Storage intervals (Days) |                    |                    |                    |                   |                   |                   | % decrease | Means             |
|-----------------|--------------------------|--------------------|--------------------|--------------------|-------------------|-------------------|-------------------|------------|-------------------|
|                 | 0                        | 15                 | 30                 | 45                 | 60                | 75                | 90                |            |                   |
| CA <sub>0</sub> | 6.7                      | 6.2                | 5.5                | 4.6                | 3.5               | 2.4               | 1.5               | 77.61      | 4.34 <sup>c</sup> |
| CA <sub>1</sub> | 7                        | 6.6                | 6.2                | 5.8                | 5.1               | 4.4               | 3.6               | 48.57      | 5.53 <sup>b</sup> |
| CA <sub>2</sub> | 7.1                      | 6.8                | 6.5                | 6.1                | 5.6               | 5                 | 4.3               | 39.44      | 5.91 <sup>b</sup> |
| CA <sub>3</sub> | 7.7                      | 7.4                | 7.1                | 6.7                | 6.3               | 5.8               | 5.2               | 32.47      | 6.60 <sup>a</sup> |
| CA <sub>4</sub> | 7.7                      | 7.4                | 7.1                | 6.8                | 6.5               | 6.1               | 5.6               | 27.27      | 6.74 <sup>a</sup> |
| CA <sub>5</sub> | 7.8                      | 7.6                | 7.4                | 7.1                | 6.8               | 6.4               | 5.9               | 24.36      | 7.00 <sup>a</sup> |
| Means           | 7.33 <sup>a</sup>        | 7.00 <sup>ab</sup> | 6.63 <sup>bc</sup> | 6.18 <sup>cd</sup> | 5.63 <sup>d</sup> | 5.02 <sup>e</sup> | 4.35 <sup>f</sup> | ---        | ---               |

<sup>a-f</sup> p<0.05

**Table 7:** Mean score of judges for color of carrot apple jam.

| Treatments      | Storage intervals (Days) |                    |                   |                   |                   |                   |                   | % decrease | Means              |
|-----------------|--------------------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------------|--------------------|
|                 | 0                        | 15                 | 30                | 45                | 60                | 75                | 90                |            |                    |
| CA <sub>0</sub> | 6.1                      | 5.6                | 5                 | 4.4               | 3.4               | 2.3               | 1.3               | 78.69      | 4.01 <sup>e</sup>  |
| CA <sub>1</sub> | 6.8                      | 6.5                | 6.1               | 5.7               | 5.2               | 4.6               | 3.9               | 42.65      | 5.54 <sup>d</sup>  |
| CA <sub>2</sub> | 7.8                      | 7.5                | 7.1               | 6.7               | 6.2               | 5.6               | 4.7               | 39.74      | 6.51 <sup>c</sup>  |
| CA <sub>3</sub> | 8.2                      | 7.9                | 7.5               | 7                 | 6.5               | 5.9               | 5.2               | 36.59      | 6.89 <sup>bc</sup> |
| CA <sub>4</sub> | 8.1                      | 7.8                | 7.5               | 7.1               | 6.6               | 6.1               | 5.5               | 32.10      | 6.96 <sup>b</sup>  |
| CA <sub>5</sub> | 8.2                      | 8                  | 7.8               | 7.5               | 7.2               | 6.7               | 6.2               | 24.39      | 7.37 <sup>a</sup>  |
| Means           | 7.40 <sup>a</sup>        | 7.06 <sup>ab</sup> | 6.64 <sup>b</sup> | 6.18 <sup>c</sup> | 5.58 <sup>d</sup> | 4.90 <sup>e</sup> | 4.12 <sup>f</sup> | ---        | ---                |

**Table 8:** Mean score of judges for taste of carrot apple jam.



| Treatments      | Storage intervals (Days) |                    |                    |                   |                   |                   |                   | % decrease | Means              |
|-----------------|--------------------------|--------------------|--------------------|-------------------|-------------------|-------------------|-------------------|------------|--------------------|
|                 | 0                        | 15                 | 30                 | 45                | 60                | 75                | 90                |            |                    |
| CA <sub>0</sub> | 6.9                      | 6.5                | 6                  | 5.2               | 4.3               | 3.2               | 1.8               | 73.91      | 4.84 <sup>e</sup>  |
| CA <sub>1</sub> | 7                        | 6.7                | 6.3                | 5.8               | 5.3               | 4.7               | 4                 | 42.86      | 5.69 <sup>d</sup>  |
| CA <sub>2</sub> | 7.1                      | 6.8                | 6.5                | 6.1               | 5.6               | 5                 | 4.3               | 39.44      | 5.91 <sup>cd</sup> |
| CA <sub>3</sub> | 7.5                      | 7.2                | 6.9                | 6.5               | 6                 | 5.5               | 4.9               | 34.67      | 6.36 <sup>bc</sup> |
| CA <sub>4</sub> | 7.6                      | 7.3                | 7                  | 6.7               | 6.3               | 5.8               | 5.3               | 30.26      | 6.57 <sup>ab</sup> |
| CA <sub>5</sub> | 7.7                      | 7.5                | 7.2                | 6.9               | 6.6               | 6.2               | 5.8               | 24.68      | 6.84 <sup>a</sup>  |
| Means           | 7.22 <sup>a</sup>        | 6.90 <sup>ab</sup> | 6.54 <sup>bc</sup> | 6.06 <sup>c</sup> | 5.50 <sup>d</sup> | 4.84 <sup>e</sup> | 4.06 <sup>f</sup> | ---        | ---                |

<sup>a-f</sup> p<0.05

Table 9: Mean score of judges for texture of carrot apple jam.

| Treatments      | Storage intervals (Days) |                    |                    |                   |                   |                   |                   | % decrease | Means              |
|-----------------|--------------------------|--------------------|--------------------|-------------------|-------------------|-------------------|-------------------|------------|--------------------|
|                 | 0                        | 15                 | 30                 | 45                | 60                | 75                | 90                |            |                    |
| CA <sub>0</sub> | 6.8                      | 6.3                | 5.8                | 5.1               | 4.3               | 3.1               | 1.6               | 76.47      | 4.71 <sup>d</sup>  |
| CA <sub>1</sub> | 7                        | 6.7                | 6.4                | 6                 | 5.4               | 4.8               | 4                 | 42.86      | 5.76 <sup>c</sup>  |
| CA <sub>2</sub> | 7.2                      | 6.9                | 6.5                | 6.1               | 5.6               | 5                 | 4.4               | 38.89      | 5.96 <sup>c</sup>  |
| CA <sub>3</sub> | 7.8                      | 7.5                | 7.1                | 6.7               | 6.2               | 5.7               | 5.1               | 34.62      | 6.59 <sup>b</sup>  |
| CA <sub>4</sub> | 8                        | 7.7                | 7.4                | 7                 | 6.6               | 6.1               | 5.6               | 30.00      | 6.91 <sup>ab</sup> |
| CA <sub>5</sub> | 8                        | 7.8                | 7.6                | 7.3               | 7                 | 6.6               | 6.1               | 23.75      | 7.20 <sup>a</sup>  |
| Means           | 7.36 <sup>a</sup>        | 7.02 <sup>ab</sup> | 6.64 <sup>bc</sup> | 6.18 <sup>c</sup> | 5.62 <sup>d</sup> | 4.94 <sup>e</sup> | 4.14 <sup>f</sup> | ---        | ---                |

<sup>a-f</sup> p<0.05

Table 10: Mean score of judges for overall acceptability of carrot apple jam.

jam during five month of storage period. Decline in taste score might be due to fluctuations in acids or decrease in pH [25].

### Texture

The panelist scores for texture of carrot and apple jam from CA<sub>0</sub> to CA<sub>5</sub> at day one were 6.9, 7.0, 7.1, 7.5, 7.6 and 7.7. However, during storage interval texture of the jam samples decreased gradually to 1.8, 4.0, 4.3, 4.9, 5.3 and 5.8 in respective form. Mean texture score obtained at initial day of storage was found 7.22, which decreased to 4.06 throughout the storage period. The highest score of 6.84 was obtained by CA<sub>5</sub>, while the lowest score of 4.84 was recorded CA<sub>0</sub> (Table 9). The maximum percent decrease in the texture of the mixed jam was recorded in CA<sub>0</sub> (73.91) followed by CA<sub>1</sub> (42.86), while minimum decrease of 24.68% was observed at CA<sub>5</sub> followed by CA<sub>4</sub> (30.26). The present findings are in accord with observed values of Suutarinen et al. [25], who observed a gradual decline in the texture properties of strawberry jam. The present value for texture are found to be slightly lower than the findings of Ehsan et al. [14], who observed a decrease in the value of texture of grape and apple marmalade during storage. Similarly, Rathore et al. [24] analyzed decrease in texture score from 9.00 to 6.70 in apple jam. Texture consists of those properties of product which is judges visually or by touch.

### Overall acceptability

The overall acceptance score of carrot and apple jam at first day from CA<sub>0</sub> to CA<sub>5</sub> were 6.8, 7.0, 7.2, 7.8, 8.0 and 8.0, which fall gradually to 1.6, 4.0, 4.4, 5.1, 5.6 and 6.1 respectively during the storage time. The mean overall acceptance score at initial day was 7.36, which lowered to 4.14 during the storage period. The highest score of 7.20 was observed at CA<sub>5</sub>, while minimum score of 4.71 was observed at CA<sub>0</sub> (Table 10). The highest percent decrease of 76.47 was recorded at CA<sub>0</sub> followed by CA<sub>1</sub> (42.86), while minimum percent decrease of 23.75 was recorded at CA<sub>5</sub> followed by CA<sub>4</sub> (30.00). The overall acceptance of grape and apple marmalade decreased from 8.8 to 7.96 during the storage interval [14], thus supporting the present results. Ehsan et al. [13] also examined similar results of decreasing trends (9.00 to 7.00) in overall acceptability

in fruit jam. Similarly, Hussain and Shakir [15] found decline in the overall acceptability of lemon and watermelon jam.

### Discussion

The research was done to prepare carrot and apple jam and to study it for physicochemical and sensory characteristics. Due to the nutritional value of carrot has much importance in our diet. Carrot is easily available and cheap source of  $\beta$ -carotene. Carrot is used to reduce risks of several kinds of cancer such as skin and breast cancer and also play vital role in liver health and eye sight. Apple is processed to get ready juices, jam and jelly etc. Apple fruits play a vital role in preventing colon cancer, heart diseases, weight loss and cholesterol level. It also provides a good amount of energy, Vitamin A, phosphorus, calcium, and iron, etc. Jam is a semi-solid mixture, obtained upon cooking of fruits or vegetables with sugar, citric acid and pectin. All the jam samples were analyzed for physicochemical and sensory characteristics at 15 days interval for three months of storage.

TSS of carrot and apple jam increased from 67.45 to 70.40 during storage. pH of carrot and apple jam decreased from 3.63 to 3.44 during keeping time. Percent acidity of carrot and apple jam increased from 0.64 to 0.80 during storage. Reducing sugar of carrot and apple jam increased from 16.64 to 27.78 throughout keeping time. Non-reducing sugar of carrot and apple jam declined from 45.04 to 27.69 throughout storage. Ascorbic acid of carrot and apple jam decreased from 7.81 to 5.52 during storage period. Color of the carrot and apple jam declined from 7.33 to 4.35 throughout 90 days. Taste value of carrot apple jam fall from 7.40 to 4.12 throughout 90 days. Texture of the carrot apple jam declined from 7.22 to 4.06 throughout 90 days. The overall acceptability of carrot and apple jam declined from 7.36 to 4.14 throughout 90 days. Overall Results showed that during storage treatments CA<sub>5</sub> followed by CA<sub>4</sub> were best in physicochemical and sensory characteristics while CA<sub>0</sub> followed by CA<sub>1</sub> were not of good quality.

### Conclusion

Blended jam was prepared from carrot and apple pulp which was evaluated for physicochemical and sensory characteristics for

3 months. It was demonstrated that storage has great effect on the quality and stability of carrot apple jam. On the basis of different analysis and parameters, it was concluded that treatment CA<sub>5</sub> carrot, apple (5:5) followed by CA<sub>4</sub> carrot, apple (6:4) were of good qualities among the treatments during analysis of physicochemical and sensory characteristics.

## Recommendations

1. Further work is needed to determine calories value of carrot apple jam.
2. Microbial count during storage is suggested in further research.
3. Further research work should be carried out on the effect of different packaging materials on carrot apple jam.

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