Effects of Herbal Extracts on Preservation and Storage Stability of Vegetable Juice

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ABSTRACT

Vegetable juices are consumed due to polyphenols present in them. Major issues related to storage of vegetables juices are oxidative rancidity and microbial deterioration. Oxidative rancidity induces undesirable flavor and color in vegetable juices. Plants materials such as herbs are rich in antioxidant and antimicrobial compounds. This work aims to investigate the quality characteristics of herbal enriched vegetable (cucumber) juice during freezing storage. Cucumber juice was processed as control juice T0, in which no herbal extract was added, T1, T2, T3 in which cucumber juice was enriched with rosemary, thyme and clove extract respectively. Whereas T4, T5 and T6 in which blends of herbal extracts were added. After two months of freezing storage antioxidant activity and total phenolic contents of all treatments were decreased significantly but this decrease was higher in control juice T0. Chemical parameters like pH decrease significantly during storage in all treatments while titratable acidity and total soluble contents increased. T3 in which juice was enriched with clove extracts and T6 in which juice was supplemented with blend of all extracts attained the best sensorial scores than that of all.

Keywords: Herbal extracts; Cucumber juice; Antibacterial; Antioxidant

Introduction

Vegetables and vegetable juices are rich source of polyphenols. Their consumption in diet is very beneficial for health due to their anti-diabetic, antithrombotic, anti-inflammatory, and anti-carcinogenic properties (Maroun et al., 2018). Several studies strongly suggested the health benefits of human health as the intake of polyphenols through diet help to prevent the diseases like cardiovascular, liver diabetes and cancers such as colon cancer (Rasouli et al., 2017). Juicing is considered to be a good way to consume vegetables. Cucumber (*Cucumis sativus*) belongs to family cucurbitaceae. Cucumber is the potential source of phytochemicals and polyphenols. Cucumber shows the anti-inflammatory and antioxidant properties due to chemical composition in it. Cucumber is rich in Mg, Mn, P, Beta carotene, flavonoids and vitamins such as vitamin A and C (Aderinola & Abaire, 2019). Cucumber has high moisture contents in it. Cucumber possesses anti-inflammatory, anti-carcinogenic, hypolipidemic and antioxidant activities (Uthpala et al., 2020). Composition of juices is varied than that of the raw vegetables as when it comes to juices, they are highly rich in minerals and polyphenols. Polyphenols are very beneficial for healthy lifestyle as they increase the growth of beneficial bacteria in gut and limiting the number of detrimental bacteria (Aravind et al., 2021). But the problem is spoilage of vegetable juices during their long storage. Hence there is a need to prolong the shelf life of vegetable juice with some beneficial means. Use of chemical preservatives is very common and proved very effective in preventing the microbial spoilage but they are expensive and may cause the serious health problems. Natural preservatives are considered as inexpensive as well as easily available and do not cause any side effect.

Herbs are gaining much popularity with regard to food preservation because of their antimicrobial and anti-fungal properties. They have been used to enhance the food safety in different food products. Different herbs have been used to increase the shelf life of food. For several hundred years' herbs have been used for aroma flavor color and preservation in beverages also. They are rich in polyphenols, plant sterols, and carotenoids and pose the antioxidant activity. Phenolic compounds are the reason behind their anti-microbial activity (Martinez- Gracia et al., 2015). Herbs are regarded as natural preservatives and they are considered as the best substitute or alternative to synthetic additive such as butylated hydroxytoluene (BHT) and butylated hydroxy anisole BHA (Pakorny, 2007). They are gaining interest in consumer as they are all natural. Major issue regarding food spoilage is oxidative rancidity as it leads to affect the flavor and aroma negatively that causes the serious health problems. Herbs show the great antioxidant activity due to polyphenols in them.

Rosemary (*Rosmarinus officinalis L.*) is aromatic plant which belongs to family Liliaceae. Rosemary contains phytochemicals such as terpenes and phenolics. Most important bioactive component in rosemary is carnosic acid which is phenolic diterpene. Carnosic acid is a major antioxidant present in rosemary. Carsonic acid has a great potential of reducing lipid peroxidation both in vitro and in vivo (Loussouarn et al., 2017). Behind a good antioxidant level and

antimicrobial activity of rosemary extracts there are certain phenolic compounds. Antimicrobial activity of rosemary extracts attributed due to two main bioactive compounds rosmarinic acid and carnosic acid (Moreno et al., 2006)

Clove (*Syigium aromaticum*) belongs to family myrtaceous rich in sisquiterpenes and triterpenoids. It is used in preservation of food due to its potential antimicrobial characteristics. It has antifungal and antibacterial properties (Cortés et al., 2014). Thyme (*Thymus vulgaris*) belongs to family *Lamiaceae* is well known for its medicinal and aromatic properties. Thyme is rich in flavonoids and phenolic compounds. Thyme is rich in flavonoids and total phenols which are reason behind antioxidant, antimicrobial and anti-inflammatory properties of thyme (Wisam et al., 2018). Thyme extract possessed antimicrobial properties as it greatly inhibits the *Staphalococcus aereus, Eshercia coli* and *Bacillus subtilis* (Fan & Chen, 2001). The purpose of this study was to investigate the Effects of Herbal Extracts on Preservation and Storage Stability of Vegetable Juice.

2. Materials and Methods

This research work of Effects of Herbal Extracts on Preservation and Storage Stability of Vegetable Juice was conducted at Institute of Food and Nutritional Science, PMAS- Arid Agriculture University, Rawalpindi, Pakistan.

2.1 Collection of Raw Materials

Cucumber (*Cucumis sativus*), Thyme (*Thymus vulgaris*), Rosemary (*Rosmarinus officinalis L.*) and Clove ((*Syigium aromaticum*) was purchased from local market of Rawalpindi.

2.2 Preparation of Herbal Extracts

Extraction of each herbs was done by adding 5g fine powder of each herb with 50ml (50 %) ethanol. Homogeneous mixing is done through placing each sample on orbital shaker for 8 hours. For separation of extract filtrations of the mixture is done by using filter paper (Whatman No.1) After that at 40°C under reduced pressure removal of residual solvent of the ethanolic extract was done by using rotary evaporator (Rotary Vacuum Evaporator, EYELA N.N Series) .Then 24 hours stay of samples was done before further analysis as described by El-Maati et al. (2016) as described by El-Maati et al. (2016)

2.3 Preparation of Herbal Enriched Cucumber juices

Cucumber juice was enriched using herbal extracts. The juice was pasteurized for 3 minutes at 95C and then directly cooled according to method as mentioned in Lemos et al. (2017) with slight modifications. T_1 (Cucumber juice without addition of herbal extracts), T_1 (Cucumber juice with Rosemary extract), T_2 (Cucumber juice with Thyme extract), T_3 (Cucumber juice with

clove extract), T_4 (Cucumber juice with blend of Thyme and Clove), T_5 (Cucumber juice with blend of Clove and Rosemary), T_6 (Cucumber juice with blend of Clove Thyme and Rosemary).

2.4 Chemical Analysis

2.4.1 Determination of Total phenolic content

1ml of a precisely measured sample was dissolved in Folin-Ciocalteu reagent and sodium carbonate solution (7.5%). After the solution had been let to stand for 30 minutes, a UV-VIS spectrophotometer (UV-Vis 3000, ORI, Germany) was used to measure the absorbance at 765 nm. As mg GAE/g, the total phenolic content was calculated by Ivanisova et al. (2021) with slight modifications.

2.4.2 Determination of Antioxidant Activity

Accurately measure 2.0 ml of the sample was thoroughly dissolved in 0.1 ml of 0.0 mM DPPH before being left at room temperature for 30 minutes at 23 °C. After 30 minutes, the sample was filtered to determine the absorbance at 517 nm using a spectrophotometer, (UV-Vis 3000 ORI, Germany). A control solution was created by combining 2.0 ml of DPPH solution with 0.1 ml of ethanol.as mentioned in Farag et al. (2020) with slight modifications.

The Following equation was used for determining antioxidant activity:

$$\text{Radical Scavenging Activity} = \frac{Absorbance\ of\ contol - Absorbance\ of\ sample}{Absorbance\ of\ control} \times 100$$

2.5 Physio-chemical Analysis of Vegetable Juice (Cucumber)

Total soluble solids of juice were estimated through method as illustrated in AOAC (1994) Method No. 983.17 by using Digital refractometer. Titratable acidity of was observed according to AOAC (1994) Method No. 942.15 using juice phenolphthalein as an indicator and the samples was treated against NaOH solution up to light pink color as end point. pH value of juice was estimated through digital pH meter as described in AOAC (2000) Method No. 981.12.

2.6 Sensory Evaluation and Storage Study

Then sensory evaluation was done through a panel using 9 points hedonic scale as mentioned in (Amanyunose et al., 2017). The herbal enriched juice was assessed for respective traits on fortnightly basis up to two months of storage time period according to El-Saadony et al. (2022).

2.7 Statistical Analysis

All parameters were statistically analyzed with Statististix 8.1 software. Two-way analysis of variance (ANOVA) was applied which was then followed by least significant difference (LSD) with alpha is equal to 0.05. All the results were expressed as mean± SD as described by Steel et al. (1997).

3. Results and Discussion

3.1 Total Phenolic Contents (mg GAE/g)

Results of our data showed that treatment and storage had a significant effect ($p<0.05$) on total phenolic contents of cucumber juice. Range of mean values of phenolic contents in treatments was 159.1- 447.7. T6 showed maximum mean value of phenolic contents 447.75 which might be due to blends of herbal extracts used in it. Whereas minimum mean value was experienced by control sample T0 (159.18).Our results are supported by Ivanisova et al. (2015). Results of the data also showed that there was a significant effect of storage on phenolic contents of all samples. As, significantly maximum mean was observed at first interval i.e 0days and minimum mean was recorded at last interval i.e 60 days.. This decrease in total phenolic contents may be attributed due to degradation of juice. Similar outcomes were reported by Gliszczynska-Swiglo et al. (2007).

Table 1: Effect of treatment and storage on total phenolic contents (GAE/g) of vegetable juice

Treatment	**Storage**		**Mean**
	0days	**60 days**	
T_0	243.65 ± 0.5^{L}	74.71 ± 0.1^{N}	159.18^{G}
T_1	279.18 ± 0.4^{J}	140.72 ± 0.6^{M}	209.95^{F}
T_2	370.44 ± 0.05^{F}	257.47 ± 0.4^{K}	313.96^{E}
T_3	421.11 ± 0.08^{C}	306.43 ± 0.4^{H}	363.77^{C}
T_4	408.08 ± 0.07^{D}	295.43 ± 0.4^{I}	351.76^{D}
T_5	444.87 ± 0.5^{B}	321.52 ± 0.2^{G}	383.20^{B}
T_6	495.31 ± 0.1^{A}	400.18 ± 0.6^{E}	447.75^{A}
Mean	380.38^{A}	256.64^{B}	

*Mean values are results of three replications

*Mean carrying same letters are significant at alpha =0.05

3.2 Antioxidant Activity (%)

Results of our data showed that treatment and storage had a significant effect ($p<0.05$) on antioxidant activity of cucumber juice. Range of antioxidant mean values was 44.46-86.84. Maximum antioxidant activity possessed by T6 (86.84), due to having greater phenolic contents than all samples. Minimum antioxidant activity shown by T0 (44.46), which is control sample due to having less phenolic contents than all treatments. Our results are supported by Males et al. (2023).According to the above data there was a significant change in mean values of antioxidant activity of all treatments with the storage interval. At first interval i.e) 0 days mean values for antioxidant value were 78.82 but with the increase in storage decrease in antioxidant activity of all samples was observed. At second interval i.e 60 days mean value was 69.00. This decrease in antioxidant activity of all samples was due to decrease in total phenolic contents of all samples. Our results are supported by Klimczak et al. (2007).

Table 2: Effect of treatment and storage on antioxidant activity (%) of vegetable juice

Treatment	**Storage**		**Mean**
	0days	**60 days**	
T_0	51.70 ± 0.01^{L}	37.23 ± 0.09^{M}	44.46^{G}
T_1	89.70 ± 0.2^{B}	80.87 ± 0.05^{F}	85.29^{B}
T_2	70.55 ± 0.1^{J}	61.74 ± 0.06^{K}	66.14^{F}
T_3	82.09 ± 0.2^{D}	73.00 ± 0.07^{I}	77.55^{D}
T_4	79.37 ± 0.3^{G}	70.34 ± 0.1^{J}	74.85^{E}
T_5	92.14 ± 0.06^{A}	81.54 ± 0.2^{DE}	82.26^{C}
T_6	86.23 ± 0.02^{C}	81.54 ± 0.3^{E}	86.84^{A}
Mean	78.82^{A}	69.00^{B}	

*Mean values are results of three replications

*Mean carrying same letters are significant at alpha =0.05

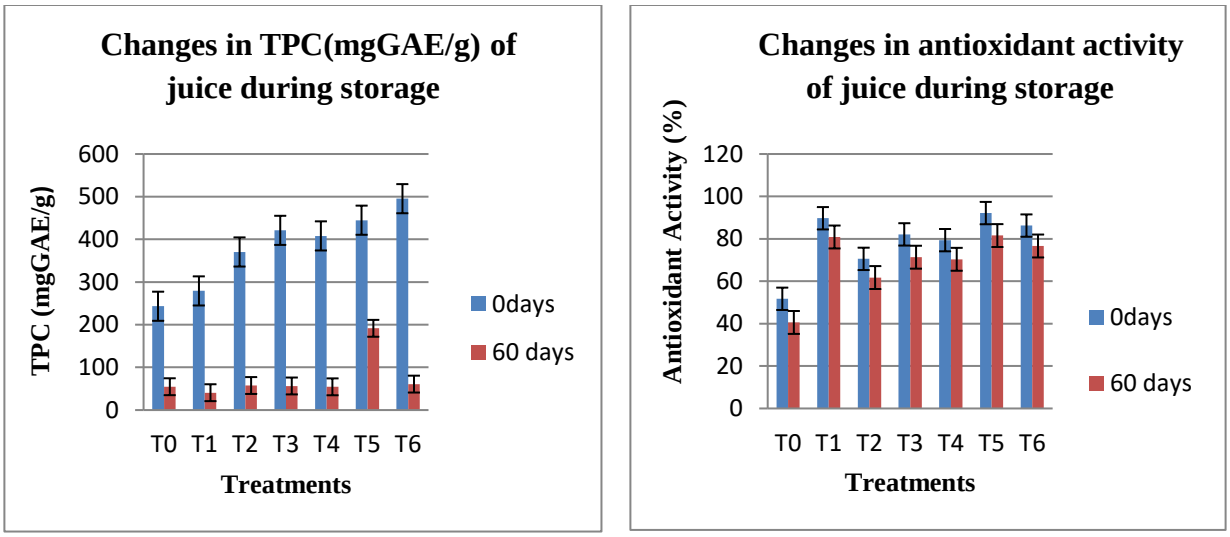


Fig.1. Changes in Total phenolic contents and antioxidant activity of herbal enriched juice during freezing storage.

3.3 Total Soluble Solids (Brix%)

Our data indicated that treatment had a significant effect ($p<0.05$) on antioxidant activity of cucumber juice According to the data shown in table 6, TSS increased with the addition of herbal extracts in cucumber juice. This might be due to the presence of solids present in extracts. Similar trend has also been reported by Tamer et al. (2016)

Table 3: Effect of treatment and storage on total soluble contents (Brix%) of vegetable juice

Treatment	Storage					Mean
	0days	15 days	30 days	45 days	60 days	
T_0	7.24 ± 0.03^{S}	7.25 ± 0.03^{S}	7.29 ± 0.02^{R}	7.33 ± 0.01^{Q}	7.38 ± 0.01^{P}	7.30^{E}
T_1	7.45 ± 0.03^{NO}	7.46 ± 0.01^{MNO}	7.50 ± 0.01^{KL}	7.54 ± 0.02^{J}	7.59 ± 0.01^{I}	7.51^{C}
T_2	7.44 ± 0.01^{NO}	$7.47\ 0.02^{MN}$	7.49 ± 0.01^{LM}	7.53 ± 0.01^{JK}	7.58 ± 0.02^{I}	7.50^{C}
T_3	7.37 ± 0.01^{P}	7.39 ± 0.01^{P}	7.43 ± 0.01^{O}	7.47 ± 0.01^{MN}	7.52 ± 0.02^{JK}	7.44^{D}
T_4	7.65 ± 0.02^{H}	7.67 ± 0.02^{GH}	7.70 ± 0.01^{EF}	7.75 ± 0.04^{CD}	7.79 ± 0.01^{CDE}	7.71^{B}
T_5	7.64 ± 0.03^{H}	7.67 ± 0.01^{GH}	7.69 ± 0.01^{FG}	7.73 ± 0.01^{DE}	7.78 ± 0.01^{BC}	7.70^{B}
T_6	7.74 ± 0.01^{D}	7.75 ± 0.01^{CD}	7.78 ± 0.01^{BC}	7.81 ± 0.01^{B}	7.86 ± 0.03^{A}	7.78^{A}
Mean	7.50^{E}	7.52^{D}	7.55^{C}	7.59^{B}	7.64^{A}	

*Mean values are results of three replications

*Mean carrying same letters are significant at alpha =0.05

According to the data showed in above table storage had a non-significant ($p>0.05$) effect on TSS of all treatments. Which might be due to the hydrolysis of polysaccharides into monosaccharide and oligosaccharides. However according to the data depicted in table it was also observed that during 0 to 15 days there was no significant ($p>0.05$) change in TSS of all samples but with increasing interval of 30 days there was slightly increase in TSS of all treatments. Similar results were obtained by Harsha & Aarti (2015).

3.4 Titratable Acidity (%)

According to statistically analyzed data shown in Table 4. The addition of herbal extracts has a significant effect ($p<0.05$)on titratable acidity of cucumber juice. With the addition of herbal extract TA of cucumber juice decreased. Similar findings were recorded by Saad et al. (2021) where by enrichment of plant extracts significantly in juice. Maximum mean TA value was observed in control sample T0 (0.28) and minimum mean value was recorded in T2 (0.15).

Juice acidity was normally increased in stored juice due to breakdown of total sugars. However in present study with the supplementation of herbal extracts in juice, it was observed that acidity increase was lesser in juices with herbal extracts as compared to the control juice. Our findings are in agreement with the previous study (Ravi et al., 2017).

Table 4: Effect of treatment and storage on titratable acidity (%) of vegetable juice

Treatment	Storage					Mean
	0days	15 days	30 days	45 days	60 days	
T_0	0.17 ± 0.02^{J} KLMNO	0.23 ± 0.01 DEFG	0.27 ± 0.02 C	0.34 ± 0.03^{B}	0.39 ± 0.01^{A}	0.28^{A}
T_1	0.12 ± 0.02^{R} S	0.14 ± 0.02 NOPQRS	0.17 ± 0.03^{J} KLMNO	0.21 ± 0.01^{D} EFGHIJ	0.23 ± 0.01^{C} DE	0.17^{CD}
T_2	0.11 ± 0.01^{S}	0.13 0.01^{PQRS}	0.15 ± 0.02 MNOPQR	0.17 ± 0.02^{K} LMNOP	0.21 ± 0.01^{E} FGHIJK	0.15^{E}
T_3	0.14 ± 0.02^{P}	0.16 ± 0.02 KLMNOP	0.18 ± 0.02 HIJKLM	0.21 ± 0.01^{D} EFGHI	0.25 ± 0.01^{C} D	0.19^{BC}
T_4	0.13 ± 0.02^{Q} RST	0.16 ± 0.02 LMNOPQ	0.18 ± 0.02^{I} JKLMN	0.21 ± 0.01^{D} EFGHIJ	0.23 ± 0.01^{D} EF	0.18^{BC} D
T_5	0.12 ± 0.04^{Q} RS	0.14 ± 0.02 OPQRS	0.17 ± 0.01 KLMNOP	0.19 ± 0.03^{G} HIJKLM	0.22 ± 0.02^{D} EFGH	0.17^{DE}
T_6	0.16 ± 0.04^{L} MNOPQ	0.17 ± 0.01 KLMNOP	0.19 ± 0.02^{F} GHIJKL	0.22 ± 0.02^{D} EFGH	0.25 ± 0.04^{C} D	0.20^{B}
Mean	0.13^{E}	0.16^{D}	0.19^{C}	0.22^{B}	0.25^{A}	

*Mean values are results of three replications

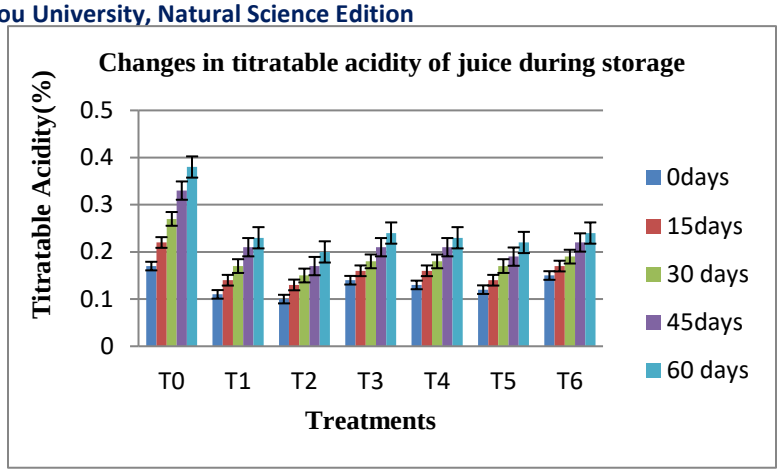
*Mean carrying same letters are significant at alpha =0.05

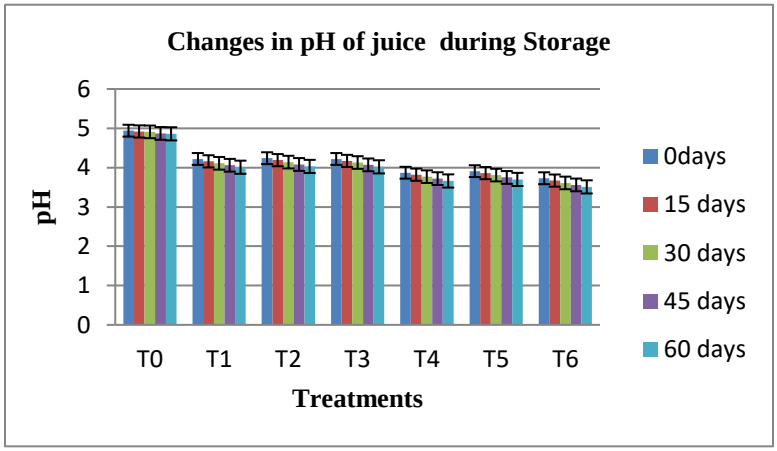
3.5 pH

Results of Statistically analyzed data showed that there was a significant effect on pH of cucumber juice by adding herbal extracts in it, as the PH decrease with addition of herbal extracts. Similar results were concluded Joshi et al. (2013) with adding natural preservatives due to inhibition of enzymatic activity pH decreased. Mean pH values ranged from (3.62 to 4.90). Maximum pH mean value was observed in T0 (control sample) which was 4.90 minimum pH value was observed in T6 (3.62).Results of data showed that there was a significant effect ($p<0.05$) of storage on pH of all treatments. Additionally, according to Chauhan et al. (2002) the pH of the juice declines during storage due to fermentation. Our results coincide with these findings. Generation of acetic acid and lactic acid during storage may be the cause of high acidity and low pH

Table 5: Effect of treatment and storage on pH of vegetable juice

Treatment	Storage					Mean
	0 days	15 days	30 days	45days	60days	
T_0	4.95±0.01 A	4.92±0.03 A	4.91±0.02^{A} B	4.88±0.01^{B} C	4.86±0.02^{C}	4.90^{A}
T_1	4.22±0.01 DE	4.16±0.01 FG	4.12±0.02^{HI}	4.06±0.01^{J} K	4.02±0.02^{L}	4.11^{C}
T_2	4.25±0.01 D	4.20±0.03 EF	4.14±0.01^{G} H	4.09±0.03I J	4.03±0.03 KL	4.14^{B}
T_3	4.22±0.01 DE	4.17±0.01 FG	4.13±0.01^{G} H	4.07±0.01^{J}	4.03±0.02 KL	4.12^{BC}
T_4	3.88±0.01 MN	3.83±0.01 OP	3.77±0.02^{Q} R	3.72±0.02^{S} T	3.66±0.02 U	3.77^{E}
T_5	3.91±0.01 M	3.87±0.02 NO	3.81±0.01^{P} Q	3.75±0.01^{R} S	3.70±0.03^{T} U	3.81^{D}
T_6	3.74±0.07^{R} ST	3.68±0.03 U	3.61±0.01^{V}	3.57±0.01 W	3.51±0.01 X	3.62^{F}
Mean	4.16^{A}	4.12^{B}	4.07^{C}	4.02^{D}	3.97^{E}	





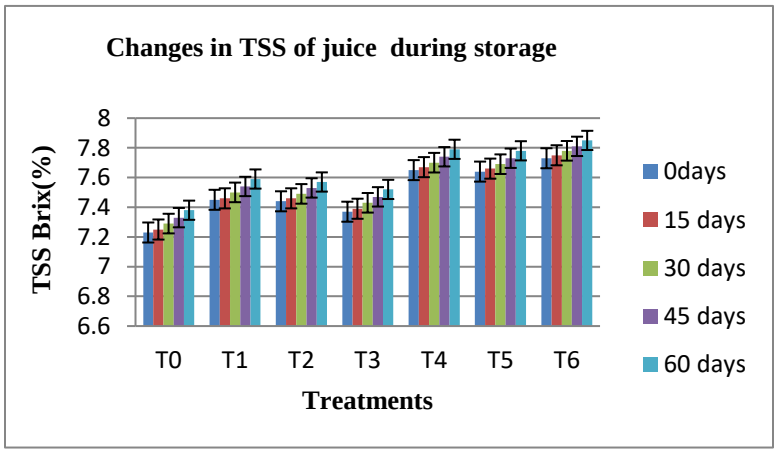


Fig.2. Changes in pH, titratble acidity and total soluble solids of herbal enriched juice during freezing storage.

3.6. Taste

Our data indicated that treatment and storage had a significant effect ($p<0.05$) on taste of cucumber juice. The findings of our study revealed that the there was a prominent improvement in taste of juices with adding herbs and their combination. This might be due to unique flavor and aroma profile of herbs. Our results are supported by Berketova et al. (2021). At first day T3 was liked

maximum with regard to its taste followed by T6 and T5 respectively. After 60 days of storage, T3 and T6 were liked the most. The results showed that there was a decrease in taste of all samples during their storage. This decreasing trend might be due to the degradation of contents of ascorbic acid during storage. Our results are supported by Kausar et al. (2012).

Table 6: Effect of treatment and storage on taste (scores) of vegetable juice

Treatments	**Storage**		**Mean**
	0 days	**60 days**	
T_0	6.94 ± 0.1^{K}	6.05 ± 0.1^{L}	6.50^{G}
T_1	7.65 ± 0.07^{H}	7.45 ± 0.1^{I}	7.55^{E}
T_2	7.44 ± 0.06^{I}	7.04 ± 0.02^{J}	7.24^{F}
T_3	8.56 ± 0.05^{A}	8.35 ± 0.07^{C}	8.45^{A}
T_4	8.04 ± 0.07^{E}	7.85 ± 0.2^{G}	7.94^{D}
T_5	8.24 ± 0.02^{B}	7.95 ± 0.07^{EF}	8.10^{C}
T_6	8.46 ± 0.07^{D}	8.35 ± 0.09^{F}	8.40^{B}
Mean	7.90^{A}	7.58^{B}	

*Mean values are results of five replications

*Mean carrying same letters are significant at alpha =0.05

3.7 Color

According to the data in table treatments and storage had a significant effect ($p< 0.05$) on color of juices. Mean score values for color were ranging 6.47 - 8.53. T3 exhibited the maximum mean scores (8.53) and minimum mean score value observed in T0 (6.47). Our results are supported by Teneva et al (2022). There was significant decrease color of all treatments with increase in storage. This loss in color in all samples might be due to enzymatic browning reaction or improper storage condition. Similar findings were observed by Bezman et al. (2001) about the loss of color during storage of drinks.

Table 7: Effect of treatment and storage on taste (scores) of vegetable juice

Treatments	Storage		Mean
	0 days	60 days	
T_0	6.91 ± 0.05^{H}	6.04 ± 0.1^{I}	6.47^{E}
T_1	7.35 ± 0.07^{F}	7.26 ± 0.02^{G}	7.25^{D}
T_2	7.54 ± 0.02^{E}	7.26 ± 0.2^{FG}	7.40^{C}
T_3	8.63 ± 0.1^{A}	8.44 ± 0.0^{B}	8.53^{A}
T_4	8.12 ± 0.02^{CD}	8.05 ± 0.2^{D}	8.09^{B}
T_5	8.22 ± 0.08^{C}	8.03 ± 0.07^{D}	8.13^{B}
T_6	8.23 ± 0.06^{C}	8.14 ± 0.05^{CD}	8.18^{B}
Mean	7.85^{A}	7.59^{B}	

*Mean values are results of five replications

*Mean carrying same letters are significant at alpha =0.05

3.8 Odor

Our data indicated that treatment and storage had a significant effect ($p<0.05$) on odor of cucumber juice Mean values for odor of all treatments ranged between (6.45- 8.23). Maximum scores (8.23) were attained by T3 followed by T6 (8.18). Minimum scores are attained by control sample T0 (6.45). Enhancements of the odor of juice with adding herbs is may be due to volatile compounds present in herbs.. Findings of our study are supported by Males et al. (2023).

Table 8: Effect of treatment and storage on odor (scores) of vegetable juice

Treatment	Storage		Mean
	0 days	60 days	
T_0	6.85 ± 0.01^{K}	6.04 ± 0.07^{L}	6.45^{G}
T_1	7.70 ± 0.09^{G}	7.54 ± 0.06^{H}	7.62^{E}
T_2	7.33 ± 0.09^{I}	7.14 ± 0.06^{J}	7.23^{F}
T_3	8.34 ± 0.01^{A}	8.13 ± 0.08^{B}	8.23^{A}
T_4	8.16 ± 0.1^{C}	7.93 ± 0.08^{E}	8.05^{C}
T_5	8.04 ± 0.08^{D}	7.85 ± 0.08^{F}	7.94^{D}
T_6	8.24 ± 0.02^{B}	8.13 ± 0.08^{C}	8.18^{B}
Mean	7.81^{A}	7.54^{B}	

*Mean values are results of five replications

*Mean carrying same letters are significant at alpha =0.05

This loss in odor in all treatments might be due to improper storage conditions, or degradation of volatile or aromatic compounds. Results of our data also concluded that the loss in odor was maximum in control treatment in which no herbs was added. While minimum loss of flavor was observed in T6.

3.9 Flavor

Our data indicated that treatment and storage had a significant effect ($p<0.05$) on flavor of cucumber juice Mean scores for all treatments were ranged from (6.35-8.31). Highest mean scores are recorded in T6 (8.31) followed by T3 (8.16) and T5 (8.03). Least mean score for flavor were observed in control sample (6.35). Which might be due to variety of aromatic compounds present in herbs such as terpenes and phenolic compounds. Results of our study supported by Corbo et al. (2014). Maximum mean value is observed in first interval i.e 0 days (7.87) after 60 days of storage the mean value for flavor of juices decreases significantly (7.54).These decrease in flavor might be due to change in volatile compounds of the juices. Similar findings were revealed by Vikrm & Parsad (2016).

Treatments	**Storage**		**Mean**
	0 days	**60 days**	
T_0	6.94 ± 0.05^{K}	5.76 ± 0.04^{L}	6.35^{G}
T_1	7.93 ± 0.03^{F}	7.64 ± 0.07^{H}	7.79^{E}
T_2	7.46 ± 0.02^{I}	7.26 ± 0.02^{J}	7.36^{F}
T_3	8.24 ± 0.07^{C}	8.08 ± 0.04^{E}	8.16^{B}
T_4	8.08 ± 0.07^{E}	7.86 ± 0.05^{G}	7.97^{D}
T_5	8.15 ± 0.05^{D}	8.92 ± 0.08^{F}	8.03^{C}
T_6	8.34 ± 0.06^{A}	8.28 ± 0.08^{B}	8.31^{A}
Mean	7.87^{A}	7.54^{B}	

*Mean values are results of five replications

*Mean carrying same letters are significant at alpha =0.05

3.10 Overall Acceptability

Our data indicated that treatment and storage had a significant effect ($p<0.05$) on overall acceptability of cucumber juice. Overall acceptability of juices is dependent upon all above attributes evaluated during storage Statistically analyzed data revealed that addition of herbs in cucumber juice had a significant effect on it.). Similar results are revealed by Thamilselvi et al. (2015). Mean values ranged between (6.44– 8.34). Maximum mean scores are attained by T3 (8.34). Minimum Scores are attained by control sample (6.44)

Table 10: Effect of treatment and storage on overall acceptability (scores) of vegetable juice

Treatment	Storage		Mean
	0 days	60 days	
T_0	6.91 ± 0.06^{G}	5.97 ± 0.07^{H}	6.44^{G}
T_1	7.65 ± 0.05^{CD}	7.44 ± 0.07^{F}	7.55^{E}
T_2	7.44 ± 0.03^{DE}	7.17 ± 0.03^{f}	7.31^{F}
T_3	8.44 ± 0.01^{A}	8.25 ± 0.1^{CD}	8.34^{A}
T_4	8.10 ± 0.08^{cd}	7.92 ± 0.1^{F}	8.01^{D}
T_5	8.16 ± 0.02^{BC}	7.94 ± 0.04^{E}	8.05^{C}
T_6	8.31 ± 0.02^{B}	8.22 ± 0.02^{DE}	8.27^{B}
Mean	7.86^{A}	7.56^{B}	

*Mean values are results of five replications

*Mean carrying same letters are significant at alpha =0.05

Storage interval also had a significant effect ($p<0.05$) on all treatments. According to the results exhibited in table 4.10. At first interval of storage i.e. 0 days mean scores were (7.86) and at last interval of storage mean scores were (7.56). It was recorded that with the increase in storage interval mean scores for overall acceptability were decreased significantly. Liu et al. (2016) observed a decline in the general acceptability of cucumber juice during cold storage. Our results were coinciding with these findings.

Conclusion

The use of preservation techniques boosted the production of lucrative and high-quality juice while preventing deterioration of the cucumber crop. Herbal extracts are utilized as natural preservatives and flavoring agents because of their high phenolic and flavor component content. This research came to the conclusion that the customer need for polyphenols rich vegetable juice could be satisfied by using blend of thyme, rosemary and clove with cucumber juice. Measured values showed that they are a rich source of polyphenols. The biological evidence reported in this study amply supports the assertion that the herbal extracts can serve as antioxidants. This is quite significant because it suggests that the extract may be able to stop oxidative damage. Herbal extracts can also be employed as possible sources of polyphenols in the food sector to improve the nutritional value and preserve food. More research on herbal extracts, particularly those that are antibacterial, is required in the future in order to boost their potential for application in the pharmaceutical and food industries.

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