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Marat Muratkhan (marat-muratkhan@mail.ru)  
SemGU  https://orcid.org/0000-0002-7248-1531

Adilet Sugyrbai  
NWAFU

Ospankulova Gulnazym  
KazATU

Awais Mutamed  
NWAFU

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Comprehensive effects of different chemical preservatives on dehydrated diced radish during storage

Marat Muratkhan\textsuperscript{a,b,c, *}

\textit{a} College of Food science, Northwest A\&F University, 712100 Yangling, China

\textit{b} College of Food science, Shakarim university, Semey, Kazakhstan

\textit{c} Laboratory of Food processsing, S. Seifullin KATU, Nursultan, Kazakhstan

*e-mail: marat-muratkhans@mail.ru

\textbf{Abstract-} This study aimed to the effect of chemical preservatives on dehydrated diced radish, as well as their effect on the taste, nutritional value and shelf life of the final product. Before dehydration turnip diced were treated with different chemical preservatives and their different concentrations viz. The eight samples were added T1 = 0.1% potassium metabisulphite, T2 = 0.1% sodium benzoate, T3 = 0.1% potassium sorbate, T4 = 0.05% potassium metabisulphite + 0.05% sodium benzoate, T5 = 0.05% potassium metabisulphite + 0.05% potassium sorbate, T6 = 0.05% sodium benzoate + 0.05% potassium sorbate, T7 = 0.05% potassium metabisulphite + 0.025% sodium Benzoate + 0.025% potassium sorbate, T0 = no chemical preservative. Samples were evaluated for physiochemical (moisture, pH, total solid, titratable acidity, ash and ascorbic acid), sensory (color, texture, taste and overall acceptability) and total bacterial count at 15 days interval of 90 days storage. Moisture value was decreased during storage. Maximum decreased was found in T0 (8.65) 3.52% while minimum decrease was observed in T1 (9.23) 1.40%. pH was decreased during storage. The maximum decrease was observed in T0 (5.44) 16.10%. While minimum decreased found in T1 (5.64) 6.36%. Titratable acidity value was increased during storage. Maximum increase was observed in T0 (1.96) 17.78% while minimum increase was observed in T1 (1.81) 8.05%. Total solid was increased during storage. Maximum increase was found in T0 (91.35) 0.34 % and lower limit was detected in T1 (90.77) 0.14%. Ash content was increased with storage interval. Maximum increased in T0 (6.57) 2.31% while minimum in T1 (6.08) 0.99%. Ascorbic acid was decreased during storage. Maximum decreased in T0 (6.15) 80.48% while minimum in T1 (9.05) 37.79%. Color, Texture, Taste and Overall acceptability were decreased with storage interval. Color maximum score was found in T1 (7.70) while minimum score was found in T0 (3.97). Texture maximum score was found in T1 (8.06) and minimum score in T0 (2.97). Taste maximum score was found in T1 (7.56) while minimum was noticed in T0 (3.33). Maximum score of overall acceptability was found in T1 (7.77) while minimum score obtained by T0 (3.42). Total bacterial count was increased with storage interval. Maximum increased in T0 (24.43x107) 800% while minimum increased in T1 (10.57x107cfu/g) 375%. Both chemical preservatives and storage intervals resulted in highly significant (p < 0.000) differences for all parameters. When comparing the chemical preservatives, the best acceptability among all the treatments was obtained by T1 which was treated with 0.1% potassium metabisulphite.
INTRODUCTION

Brassica vegetables also contain significant levels of other health-promoting compounds, such as polyphenols, carotenoids, tocopherols, and vitamin C (Kurilich et al., 1999; Borowski et al., 2008). One of the first cultivated vegetables that has been used by human in nutrition is Turnip (Brassica rapa subsp. rapa.) since times immemorial (Fernandes et al. 2007). The composition of raw turnip (65g) consists of energy (18kcal), water (92%), dietary fiber (1g), carbohydrates (4g), protein (1g) and it comprises of mineral; calcium (20mg), potassium (124mg), magnesium (7mg), phosphorous (18mg), turnip have vitamin C (14mg), vitamin B6 (0.1mg) and folate (9µg) (Murdock, 2002).

Turnip greens are described by a sulfurous whiff, pungent taste, and a vicious taste due to isothiocyanates, degradation products of glycosylates (Jones and Senders, 2002). Brassica vegetables also contain significant levels of other health-promoting compounds, such as polyphenols, carotenoids, tocopherols, and vitamin C (Kurilich et al., 1999; Borowski et al. 2007).

Several studies have shown the turnip in modified atmosphere packaging (MAP) were stored for 5 or 10 d, at 5 °C or 10 °C. Two passive and one active (flushed with 5% O2 at sealing) modified atmospheres were tested, Low temperature and short storage time were the most important criteria to prevent changes of appearance, odors, taste and flavors, and contents of sugar and glycosylates of fresh-cut swede and turnip (Helland et al. 2016).

One of the oldest methods used for preserving food is drying. Different methods can be used for drying purposes like solar drying, oven drying, and drying by using cabinet-type dryers. Before the biblical period; Chinese, Hindus, Persians, Greeks, and Egyptians used solar energy for drying the food. The benefit of dried food is that they do not require big space and refrigeration etc. A large variety of foods can be included in our diet by simply using the drying technique. It is a comparatively easy and less expensive preservation method but requires much more time, skills, and knowledge of drying principles (Brennand, 1994).

Most of the vegetables are experience spoilage within two days perhaps due to chemical, physical and microbial activities. To prolong their shelf life, vegetables are chemically pretreated with the sodium salt of ethylene diamine tetra acetic acid (sodium EDTA), calcium chloride (CaCl2), citric acid and potassium metabisulphite (K2O5S2) dehydrated up to 30 percent moisture. Pretreatment using a combination of 1 mm EDTA,
2.5 percent K2O5S2, 0.5% citric acid, and 2.5% CaCl2 and dehydration of ash gourd sample to 30% moisture observed to be a good process in the preservation of cut ash gourd pieces (Sreenivas, 2011).

The food though drying is preserved by removing water from it thus making an
environment of the food unfavorable for the growth of microorganisms

MATERIALS AND METHODS

2.1 Materials and treatments

2.1.1 Materials

The fresh turnip was collected directly from the Peshawar vegetable market, The
turnip was washed with tap water in order to remove dirt, dust and other foreign
material.

2.1.2 Treatments

After washing the turnip was peeled and cut into uniform pieces using stainless
steel peeler and knife. To prevent browning (oxidation) and cutting of turnip was
carried out in 1% citric acid solution. To control enzymatic deterioration and improve
the color and shape of turnip dices, blanching was carried out in hot water for two
minutes.

Different concentrations of potassium sorbate, sodium benzoate, and potassium
metabisulphite were used to treat the turnips before drying. Before dehydration of
turnip, it was processed by different chemical preservatives as listed below.

\[
T_0 = \text{Diced turnip + no chemical preservative.} \\
T_1 = \text{Diced turnip + (0.1%) potassium metabisulphite.} \\
T_2 = \text{Diced turnip + (0.1%) sodium benzoate.} \\
T_3 = \text{Diced turnip + (0.1%) potassium sorbate.} \\
T_4 = \text{Diced turnip + (0.05%) potassium metabisulphite + (0.05%) sodium} \\
\quad \text{benzoate.} \\
T_5 = \text{Diced turnip + (0.05%) potassium metabisulphite + (0.05%)} \\
\quad \text{potassium sorbate.} \\
T_6 = \text{Diced turnip + (0.05%) sodium benzoate + (0.05%) potassium} \\
\quad \text{sorbate.} \\
T_7 = \text{Diced turnip + (0.05%) potassium metabisulphite +} \\
\quad (0.025%) \text{ sodium benzoate + (0.025%) potassium sorbate.}
\]

2.1.3 Dehydration
Turnip was placed in the oven at 65°C to dehydrate the turnip dice for 24 hrs. The process was repeated until the desired moisture content of 8-10% was obtained (Mazumdar et al., 2012).

2.1.4 Packaging and storage

Diced turnip sample was packed in polyethylene bags and stored at ambient temperature for 90 days. Samples were evaluated for physiochemical (moisture, pH, total solids, titratable acidity, ash, and ascorbic acid), sensory (color, texture, taste, and overall acceptability), and total bacterial count at 15 days 90 days storage.

2.2 Physiochemical Analysis

2.2.1 Moisture Content

A.O.A.C (2000) oven drying method was used to measure the moisture content. Sample was placed at 60°C in oven until it dried and constant weight of sample was obtained. The moisture percentage was calculated by formula given beneath.

\[
\text{Moisture } \% = \frac{W_1 - W_2}{\text{Weight of sample}} \times 100
\]

Where \( W_1 \) was the weight of petri dish add sample after heated in oven, \( W_2 \) was the weight of empty petri dish.

2.2.3 Ascorbic Acid

Ascorbic acid solution (50mg) was taken in a flask and made 250 volumes of solution with oxalic acid were used as a blank. It was prepared 24 hrs. before use and kept in a cool dry place.

2.3.1 Dye Factor

The titration method was used to determine the ascorbic content of the sample as stated in A.O.A.C (2000). Briefly, Sodium bicarbonate (42mg) and 2, 6-Dichlorophenol indophenol dye (50mg) were mixed with distilled water in a beaker. 250ml volume of solution was made, filtered, and stored in a cool dry place.

Two grams of oxalic acid were brought and mixed with distilled water. 500ml volume of solution was prepared for formulation of (0.4%) oxalic acid solution. 5ml solutions of standard ascorbic acid were added in a conical flask and standard dye solution were used to titrate it, unless until the pink light color was obtained for 15 seconds for Calibration of dye. The Dye Factor of the sample was expressed as scavenging rate%
Dye Factor = \frac{\text{ml of ascorbic acid solution taken}}{\text{Volume of dye used}}

2.3.2 Ascorbic Acid

10g oven dehydrated turnips were taken in a measuring beaker and added 0.4% oxalic acid solution till 100ml volume of solution was prepared and made slurry. The slurry of turnips (10ml) was added to a flask and it titrated with standard dye unless until pink light color was obtained for 15 seconds. The formula for calculating Ascorbic acid content

\text{Ascorbic acid (mg/100g)} = \frac{V \times F \times 100 \times 100}{D \times B}

Where \( V \) was the ml of dye volume used, \( D \) was the weight of sample selected for dilution, \( B \) was the ml of sample volume selected for titration, \( F \) was the Dye factor

2.4 Ash

The ash content of the sample was concluded by A.O.A.C (2000) method. A 2g well-mixed sample was taken in a cleaned and dried vessel (W1). It was first burnt with blower pipe and a partly burnt sample was put in a muffle furnace at 550°C until a constant weight was obtained along with vessel (W2). After heating the sample was turned into white ash.

The ash content was measured by the following formula.

\%\text{Ash} = \frac{W2 - W1}{\text{Wt of sample}} \times 100

Where \( W1 \) was the empty crucible weight, \( W2 \) was weight of ash add crucible

2.5 Titratable Acidity

It was calculated by A.O.A.C’s (2000) standard method.

2.5.1 Calibration of NaOH (0.1N) Solution

1000ml solution was made by mixing 6.3g oxalic acid in distilled water. 1000ml solution of NaOH was made by mixing 4.5g NaOH in distilled water. The burette was filled with crudely 0.1N NaOH solution. 0.1N oxalic acid (10ml) was carried in the conical flask. 2-3 drops of the indicator were added to the flask. The 0.1N NaOH solution in the burette was allowed to titrate flask solution dropwise, unless until pink
color is obtained. Three successive readings were taken from the burette. The normality of NaOH was determined by the formula given below.

\[ N_1V_1 = N_2V_2 \]

Where \( V_1 \) was the Vol. of oxalic acid, \( N_1 \) was the oxalic acid Normality, \( V_2 \) was the Vol. of NaOH, \( N_2 \) was the NaOH Normality.

### 2.5.2 Samples Titration

10ml Turnip slurry was taken in a conical flask and 2-3 drops of phenolphthalein (indicator) were added. 0.1N NaOH solution was taken in a burette and titrated against turnip slurry. Three corresponding readings were taken and calculated the acidity with the help of the formula given below.

\[
\text{Acidity} \% = \frac{0.0067 \times T \times 100 \times 100}{L \times M}
\]

Where \( T \) was the ml of NaOH used, \( L \) was the sample taken for dilution, \( M \) was the ml of diluted sample taken for titration

### 2.5.3 pH

The pH meter was used to measure the pH according to the standard method of A.O.A.C (2000).

### 2.6 Total solid

The total solid content was calculated by the standard method of A.O.A.C (2000). A 20g sample of dehydrated turnip was placed in the dish and it was kept in the oven for 24 hours at 600C. After 24 hours it was allowed to cool in desiccators. Dished was weight along with dried weight. It was calculated by the following formula.

\[
\text{Total solid} \% = \frac{(X - Y) \times 100}{(Z - Y)}
\]

Where \( X \) was the dry sample weight add dish weight, \( Y \) was the dish weight, \( Z \) was the fresh sample weight add dish weight

### 2.7 Microbial count

General-purpose media (Nutrient Agar) was used in the dilution plate method to determent the total bacterial count of the sample as reported by Collins (1976). Ten-fold serial dilutions of the sample were prepared. Six test tubes were taken and each filled with 9ml saline solution and labeled from 1-6 numbers. Then 1ml of the sample was added to the first test tube and mixed gently. Then 1ml sample was taken from 1st
test tube and added to 2nd one. The process was repeated till the 6th test tube and 1ml from the last one was discarded. In each step of Ten-fold serial dilution, the sample was diluted by the number of six and we have shown it as 101, 102, 103, 104, and so on. We poured a 50µl sample into pre-incubated plates of nutrient agar from test tubes with the help of a micropipette. Plates were incubated in an incubator for 24 hours at 27-30oC. After incubation plate was selected with approximately 300-500 Cru and calculated the bacterial colonies were with help of the colony counter.

\[ \text{Cru/g} = \text{dilution factor} \times \text{spread volume factor} \times \text{no. of colonies} \]

2.8 Sensory evaluation

Sensory quality of Taste, color, texture, and overall acceptability of dehydrated turnip sample was accomplished by trained person panel through using 9 points hedonic scale of Lamond (1977).

2.9 Statistical Analysis

All Data were analyzed statistically by using 2 factorial (without any interaction) complete randomized designs (CRD) through using computer M-Stat-C program and LSD were used to separate their means as described by Steel and Torrie (1997).

3. RESULTS AND DISCUSSION

3.1 Physio-chemical analysis

3.1.1 Moisture Content

The dehydrated diced turnip was treated with different chemical preservatives and analyzed for moisture during 90 days storage at 15 days intervals. The result relating to the response of storage interval and the effect of different chemical preservatives on the moisture of dehydrated diced turnip is shown in Table 4.1 and Fig. 4.1.

The result indicated that the value of moisture content was decreased by storage interval. The minimum decrease was observed in T1 (9.3 to 9.17) 1.40% and the maximum decrease was detected in T0 (8.81 to 8.85) 3.52%. The upper limit of the mean value obtained in T1 (9.23%) and lower limit mean value was found in T0 (8.65%).

Similarly, these findings are in close conformity with the finding of Chaudhary et al. (1995), who reported that during storage a decrease in moisture content was noticed in packed solar-dried persimmon.
Table-4.1: Chemical preservatives effects on moisture content of dehydrated diced turnip.

| Tart · Storage intervals | Mean | % Dec. |
|------------------------|------|--------|
|                         | Initial | 15 | 30 | 45 | 60 | 75 | 90 |
| T₀                    | 8.81 | 8.76 | 8.71 | 8.65 | 8.61 | 8.54 | 8.5 | 8.65g | 3.52 |
| T₁                    | 9.3 | 9.28 | 9.25 | 9.23 | 9.22 | 9.19 | 9.17 | 9.23a | 1.40 |
| T₂                    | 8.87 | 8.82 | 8.78 | 8.75 | 8.7 | 8.66 | 8.64 | 8.75f | 2.59 |
| T₃                    | 8.98 | 8.94 | 8.9 | 8.86 | 8.83 | 8.79 | 8.75 | 8.86e | 2.56 |
| T₄                    | 9.17 | 9.13 | 9.09 | 9.04 | 9.01 | 8.97 | 8.95 | 9.05d | 2.40 |
| T₅                    | 8.86 | 8.81 | 8.78 | 8.76 | 8.71 | 8.67 | 8.63 | 8.75f | 2.60 |
| T₆                    | 9.28 | 9.25 | 9.22 | 9.19 | 9.15 | 9.12 | 9.1 | 9.19b | 1.94 |
| T₇                    | 9.22 | 9.19 | 9.16 | 9.13 | 9.1 | 9.07 | 9.04 | 9.13c | 1.95 |
| Mean · | 9.07a | 9.03b | 8.99c | 8.96d | 8.92e | 8.88f | 8.85g |

Statistical analysis (Appendix-I) shows that the moisture content results of the different treatments were highly significant (P<0.05). Results regarding the storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.05).

Figure-4.1: Effect of different chemical preservatives on the moisture content of dehydrated diced turnip.

3.1.2 pH

The dehydrated diced turnips were treated with different chemical preservatives (sodium benzoate, potassium metabisulphite, and potassium sorbate) and their different concentrations were analyzed for pH during the 90 days storage period at each 15 days interval. The result concerning pH is shown in Table 4.2 and also graphically in Fig. 4.2.
Results showed that pH value was decreased with storage interval. The maximum decrease occurred in T0 (5.84 to 4.9) while the minimum decrease was found in T1 (5.82 to 5.45). The minimum mean value was obtained by T0 (5.44) and the maximum mean value was recorded in T1 which was (5.64). These results are partially supported by the work of Akhtar and Jived (2013) and reported a significant decrease in pH during the storage study of apple slices.

Table-4.2: Different chemical preservatives effects on pH of dehydrated diced turnip.

| Tart. | Storage intervals | Mean | % Dec. |
|-------|-------------------|------|--------|
|       | Initial | 15   | 30   | 45   | 60   | 75   | 90   |
| T₀    | 5.84    | 5.74 | 5.65 | 5.42 | 5.35 | 5.2  | 4.9  | 5.44e |
| T₁    | 5.82    | 5.78 | 5.71 | 5.65 | 5.57 | 5.49 | 5.45 | 5.64a |
| T₂    | 5.85    | 5.6  | 5.55 | 5.48 | 5.39 | 5.31 | 5.13 | 5.47de|
| T₃    | 5.86    | 5.68 | 5.59 | 5.5  | 5.45 | 5.36 | 5.15 | 5.51cd|
| T₄    | 5.87    | 5.71 | 5.63 | 5.57 | 5.53 | 5.4  | 5.2  | 5.56bc|
| T₅    | 5.83    | 5.62 | 5.5  | 5.44 | 5.38 | 5.3  | 5.05 | 5.45e |
| T₆    | 5.9     | 5.76 | 5.7  | 5.62 | 5.54 | 5.45 | 5.32 | 5.61ab|
| T₇    | 5.89    | 5.74 | 5.68 | 5.59 | 5.5  | 5.42 | 5.25 | 5.58ab|
| Means  | 5.86a   | 5.70b| 5.63c| 5.53d| 5.46e| 5.37f| 5.18g|

Results of pH of dehydrated diced turnip showed a highly significant difference (P<0.05) in different treatment and storage periods (Appendix II).

Figure-4.2: Effect of different chemical preservatives on pH of dehydrated Diced turnip.

3.1.3 Titratable acidity
Dehydrated diced turnips which were treated with different chemical preservatives and their different concentrations were analyzed for titratable acidity at
each 15 days interval during the 90 days storage periods. Results data concerning titratable acidity of dehydrated diced turnip samples are presented in Table and Fig. 4.3.

Results pointed that titratable acidity was increased in all samples during 3-month storage period. The maximum increase was occurring in T0 (1.8 to 2.12) at 17.78% while the minimum increase was occurring in T1 (1.74 to 1.88) at 8.05%. During 3-month storage of dehydrated diced turnip, the highest mean value was obtained by T0 (1.96) while the lowest mean value was obtained by T1 (1.81).

Table-4.3: Different chemical preservatives effects on titratable Acidity of dehydrated diced turnip.

| Tar t | Storage intervals | Mean | % Inc. |
|-------|------------------|------|--------|
|       | Initial | 15   | 30   | 45   | 60   | 75   | 90   |
| **T0** | 1.8     | 1.87 | 1.91 | 1.96 | 2.01 | 2.06 | 2.12 |
| **T1** | 1.74    | 1.77 | 1.79 | 1.81 | 1.83 | 1.85 | 1.88 |
| **T2** | 1.79    | 1.85 | 1.89 | 1.93 | 1.98 | 2.02 | 2.09 |
| **T3** | 1.78    | 1.83 | 1.87 | 1.9  | 1.94 | 1.97 | 2.06 |
| **T4** | 1.77    | 1.81 | 1.84 | 1.87 | 1.9  | 1.94 | 2.03 |
| **T5** | 1.79    | 1.87 | 1.9  | 1.95 | 1.99 | 2.04 | 2.1  |
| **T6** | 1.76    | 1.78 | 1.81 | 1.83 | 1.86 | 1.89 | 1.92 |
| **T7** | 1.77    | 1.79 | 1.82 | 1.85 | 1.88 | 1.91 | 1.94 |
| **Means** | 1.78g | 1.82f | 1.85e | 1.89d | 1.92c | 1.96b | 2.02a |

Statistical analysis (Appendix-III) shows that the titratable acidity results of the different treatments were highly significant (P < 0.000). Results regarding storage period of dehydrated diced turnip at different intervals were also highly significant (P < 0.000).
Figure-4.3. Effect of different chemical preservatives on titratable acidity of dehydrated diced turnip.

3.1.4. Total Solid

During the three months of the storage period, dehydrated diced turnips which were treated with different chemical preservatives were examined for total solid content at each 15 days interval. Results related to storage interval and chemical preservatives of dehydrated diced turnip are demonstrated in Table and Fig. 4.4.

The result indicated that the total solid value was increased during the storage period. The maximum increase was found in T0 (91.19 to 91.5%) 0.34% and the minimum increase were found in T1 (90.7 to 90.83%) 0.14%. The highest mean value was observed in T0 which was 91.35% and the lowest mean value was found in T1 which was 90.77%.

Table-4.4: Different chemical preservatives effects on total solid of dehydrated diced turnip.

| Tart. | Storage intervals | Mean | % Inc |
|-------|-------------------|------|-------|
|       | Initial | 15  | 30   | 45   | 60   | 75   | 90   |       |
| T₀    | 91.19   | 91.24 | 91.29 | 91.35 | 91.39 | 91.46 | 91.5 | 91.35a | 0.34 |
| T₁    | 90.7    | 90.72 | 90.75 | 90.77 | 90.80 | 90.80 | 90.83 | 90.77g | 0.14 |
| T₂    | 91.13   | 91.18 | 91.22 | 91.25 | 91.3  | 91.34 | 91.36 | 91.25b | 0.25 |
| T₃    | 91.02   | 91.06 | 91.1  | 91.14 | 91.17 | 91.21 | 91.25 | 91.14c | 0.25 |
| T₄    | 90.83   | 90.87 | 90.91 | 90.96 | 90.99 | 91.03 | 91.05 | 90.95d | 0.24 |
| T₅    | 91.14   | 91.19 | 91.22 | 91.24 | 91.29 | 91.33 | 91.37 | 91.25b | 0.25 |
| T₆    | 90.72   | 90.75 | 90.78 | 90.81 | 90.85 | 90.88 | 90.9  | 90.81f | 0.20 |
| T₇    | 90.78   | 90.81 | 90.84 | 90.87 | 90.9  | 90.93 | 90.96 | 90.87e | 0.20 |
| Means | 90.94g  | 90.98f| 91.01e | 91.05d| 91.08c| 91.12b| 91.15a|

Statistical analysis (Appendix-IV) shows that the total solid results of the different treatments were highly significant (P<0.000). Results regarding storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.000).
3.1.5 Ash

The diced dehydrated turnips treated with different chemical preservatives were analyzed for ash content at each 15 days interval during three months of storage. Results considering the different chemical preservatives effect and storage interval of ash content of dehydrated diced turnip are presented in Table 4.5 and Fig. 4.5.

The result showed that the value of ash was increased with storage interval. The maximum increased occurs in T0 (6.49 to 6.64) 2.31% while the minimum increase occurs in T1 (6.06 to 6.12) 0.99%. Among all the dehydrated diced turnip treatments the maximum mean value was noticed in T0 (6.57%) and the lowest mean value found in T1 (6.08%).

The results obtained from this study were closely in agreement with Sounded and Rheba (2009) they reported that during the six-month storage of Yam (Dioscuri spa) ash content slightly increased while moisture content was reduced.

Similarly, these results are a partial agreement to the Melda et al. (2007). They reported during sun drying moisture content is decreased while increased protein, lipids, crude fiber, and total ash in leafy vegetables.

Table-4.5: Different chemical preservatives effects on ash of dehydrated diced turnip

| Tart. | Storage intervals | Mean | % Inc. |
|-------|-------------------|------|--------|
|       | Initial 15 30 45 60 75 90 |       |        |
| T0    | 6.49 6.53 6.55 6.59 6.61 6.61 6.64 | 6.57a | 2.31   |
| T1    | 6.06 6.06 6.07 6.08 6.08 6.1 6.12 | 6.08g | 0.99   |
| T2    | 6.38 6.4 6.41 6.43 6.45 6.45 6.47 | 6.43c | 1.41   |
Statistical analysis (Appendix-V) shows that the ash results of the different treatments were highly significant (P<0.05). Results regarding storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.05).

| T<sub>3</sub> | 6.25 | 6.26 | 6.28 | 6.3 | 6.3 | 6.32 | 6.36 | 6.30<sub>d</sub> | 1.76 |
| T<sub>4</sub> | 6.17 | 6.17 | 6.19 | 6.21 | 6.23 | 6.24 | 6.27 | 6.21<sub>e</sub> | 1.62 |
| T<sub>5</sub> | 6.47 | 6.49 | 6.51 | 6.52 | 6.54 | 6.56 | 6.59 | 6.53<sub>b</sub> | 1.85 |
| T<sub>6</sub> | 6.10 | 6.12 | 6.13 | 6.15 | 6.16 | 6.18 | 6.14<sub>f</sub> | 1.31 |
| T<sub>7</sub> | 6.08 | 6.09 | 6.11 | 6.13 | 6.15 | 6.16 | 6.19 | 6.13<sub>f</sub> | 1.81 |
| **Means** | 6.25<sub>f</sub> | 6.27<sub>e</sub> | 6.28<sub>d</sub> | 6.30<sub>c</sub> | 6.31<sub>b</sub> | 6.33<sub>b</sub> | 6.35<sub>a</sub> |

**Figure-4.5:** Effect of different chemical preservatives on Ash of dehydrated diced turnip.

### 3.1.6 Ascorbic Acid

The dehydrated diced turnip treated with different chemical preservatives and their different concentrations were analyzed for ascorbic acid content during three-month storage at each 15 days storage interval is shown in Table 4.6 and Fig. 4.6.

The result showed ascorbic acid value was decreased during three-month storage. Maximum decrease was found in T0 (10.5 to 2.05%) 80.48% while the minimum decrease was found in T1 (11.3 to 7.03%) 37.79%. The minimum mean value was found in T0 (6.15) while the maximum mean value was found in T1 (9.05). These results are partially supported by the work of Negi and Roy (2000). They reported that blanching, drying, and storage period reduced ascorbic acid content in carrot products. Similarly, Chawla et al. (2005) reported that ascorbic acid decreased in the dehydrated product may be due to light, temperature and oxidation occurred during storage.
Table-4.6: Different chemical preservatives effects on ascorbic acid of dehydrated diced turnip.

| Tart | Storage intervals | Mean | % Dec. |
|------|-------------------|------|--------|
|      | Initial 15 30 45 60 75 90 |      |        |
| T₀   | 10.5 8.9 6.8 6 5.35 3.45 2.05 | 6.15f | 80.48  |
| T₁   | 11.3 10.41 9.71 9.01 8.3 7.6 7.03 | 9.05a | 37.79  |
| T₂   | 10.2 9 7.4 6.8 6 5.2 4 | 6.94de | 60.78  |
| T₃   | 10.3 9.4 7.7 7.2 6.4 5.6 4.8 | 7.34cd | 53.40  |
| T₄   | 10.6 9.8 8.1 7.9 7.1 6.2 5.1 | 7.83bc | 51.89  |
| T₅   | 10.1 9 7.1 6.5 5.8 5 3.99 | 6.78e  | 60.50  |
| T₆   | 11.5 10.65 9.25 8.98 8.27 7.57 7 | 9.03a  | 39.13  |
| T₇   | 10.9 10 8.5 8.22 7.42 6.72 6.15 | 8.27b  | 43.58  |

Means 10.68a 9.65b 8.07c 7.58d 6.83e 5.92f 5.02g

Statistical analysis (Appendix-VI) shows that the ascorbic acid results of the different treatments were highly significant (P<0.05). Results regarding the storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.05).

Figure-4.6: Effect of different chemical preservatives on ascorbic acid of dehydrated turnip.

3.2 Sensory evaluation

Sensory evaluation of dehydrated diced turnips was evaluated for color, texture, taste and overall, all acceptability. Dehydrated samples were demonstrated to 10 well trained food science panelist and the judges had previous experience of foods. The color, taste, texture and overall acceptability of dehydrated diced turnip samples were evaluated at each 15 days interval of 90 days storage. They were called for rank all the
samples by using 9-point hedonic scale in which 1 disliked extremely and 9 liked extremely.

3.2.1 Color

All the dehydrated diced turnips samples were treated with different chemical preservatives (sodium benzoate, potassium metabisulphite, and potassium sorbate) and their different concentrations were analyzed for color for each storage interval of three-month storage presented in Table 4.7 and Fig. 4.7.

Color quality was decreased during three-month storage period of dehydrated diced turnip. The maximum decrease of color quality has occurred in T0 (6.2 to 3) 51.61%. While minimum decreases were found in T1 (8.6 to 7.0) 18.60%. The maximum mean score was noticed in treatment T1 which was 7.70. While treatment T0 (3.97) was obtained minimum mean score. These results are partially agreement to Sani et al. (2000). They reported that potassium metabisulphite helps to reduce browning in fruit pulp and they concluded from research, during storage the reduction of color might be due to milord reaction.

Table-4.7: Different chemical preservatives effects on color of dehydrated diced turnip

| Tart. | Storage intervals | Mean | %Dec. |
|-------|------------------|------|-------|
|       | Initial | 15 | 30 | 45 | 60 | 75 | 90 |       |
| T0    | 6.2     | 4.2 | 4  | 3.8 | 3.4 | 3.2 | 3 | 3.97f | 51.61 |
| T1    | 8.6     | 8.2 | 7.9 | 7.6 | 7.4 | 7.2 | 7 | 7.70a | 18.60 |
| T2    | 7       | 6.3 | 5.9 | 5.6 | 4.4 | 4  | 3.7 | 5.27df | 47.14 |
| T3    | 7.2     | 6   | 5.6 | 5.2 | 4.9 | 4.6 | 4.2 | 5.39d | 41.67 |
| T4    | 7.4     | 7   | 6.8 | 6.6 | 6.3 | 6  | 5.8 | 6.56c | 21.62 |
| T5    | 6.4     | 5.8 | 5.4 | 5   | 4.4 | 3.9 | 3.6 | 4.93e | 43.75 |
| T6    | 8       | 7.6 | 7.2 | 7   | 6.8 | 6.6 | 6.4 | 7.09b | 20.00 |
| T7    | 7.8     | 7.4 | 7.1 | 6.8 | 6.6 | 6.6 | 6.3 | 6.86bc | 23.08 |
| Mean  | 7.33a   | 6.56b | 6.24bc | 5.95c | 5.53d | 5.23de | 4.96e |

Statistical analysis (Appendix-VII) shows that results regarding to color of the different treatments of dehydrated turnip were highly significant (P<0.05). Results regarding storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.05).
Figure-4.7: Effect of different chemical preservatives on color of dehydrated diced turnip.

3.2.2 Texture

Dehydrated diced turnips treated with different chemical preservatives of different ratio were analyzed for sensory evaluation of texture during three-month storage of each 15 days interval. Data regarding to texture is shown in Table 4.8 and Fig. 4.8.

Textures quality of dehydrated diced turnip was decreased during 90 days storage. The maximum decreased was found in treatment $T_0$ (4.5 to 2) 55.56% while minimum decreased was found in $T_1$ (8.8 to 7.5) 14.77%. The highest mean score was found in $T_1$ (8.06) while lowest mean score found in $T_0$ (2.97).

Table-4.8: Different chemical preservatives effects on texture of dehydrated diced turnip

| Tart  | Storage intervals | Mean | %Dec. |
|-------|-------------------|------|-------|
|       | Initial | 15   | 30   | 45   | 60   | 75   | 90   |       |
| $T_0$ | 4.5     | 3.5  | 3.2  | 2.8  | 2.5  | 2.3  | 2    | 2.97f |
| $T_1$ | 8.8     | 8.5  | 8.2  | 8    | 7.8  | 7.6  | 7.5  | 8.06a |
| $T_2$ | 6       | 3.8  | 3.5  | 3.3  | 3.2  | 3    | 2.8  | 3.66e |
| $T_3$ | 6.6     | 5.5  | 4.6  | 4    | 3.7  | 3.3  | 3    | 4.39d |
| $T_4$ | 6.8     | 5.5  | 4.4  | 4.1  | 3.8  | 3.5  | 3.2  | 4.47d |
| $T_5$ | 5.5     | 4    | 3.7  | 3.3  | 3    | 2.7  | 2.5  | 3.53e |
| $T_6$ | 8.2     | 7.9  | 7.6  | 7.4  | 7    | 6.8  | 6.6  | 7.36b |
| $T_7$ | 8       | 7.7  | 7.4  | 7    | 6.3  | 6.1  | 5.6  | 6.87c |
| Means | 6.80a   | 5.80b | 5.33c | 4.99cd | 4.66de | 4.41ef | 4.15f |       |

Statistical analysis (Appendix-VIII) shows that results regarding the texture of the different treatments of dehydrated turnip were highly significant (P<0.05). Results
regarding the storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.05).

![Graph](image)

**Figure-4.8:** Effect of different chemical preservatives on Texture of dehydrated diced turnip.

### 3.2.3 Taste

Dehydrated diced turnips were treated to different chemical preservatives ratio and stored it in polythene bags for 90 days. The result regarding the sensory evaluation of taste through 9 points hedonic scale is shown in Fig. 4.9 and also in Table 4.9.

The result showed that the taste of dehydrated diced turnip decreased during 90 days of storage. The maximum decrease in score rate was occurred in T0 (5 to 2.2) 56% and while the minimum decrease occurred in T1 (8.2 to 7) 14.63%. From all the treatment the maximum mean score obtained by T1 which was (7.56). And minimum mean score was obtained by T0 (3.33).

**Table-4.9: Different chemical preservatives effects on taste of dehydrated diced turnip**

| Tart | Initial | 15 | 30 | 45 | 60 | 75 | 90  | Mean  | %Dec. |
|------|---------|----|----|----|----|----|-----|-------|-------|
| T0   | 5       | 3.8| 3.6| 3.3| 2.9| 2.5| 2.2 | 3.33g | 56.00 |
| T1   | 8.2     | 8  | 7.8| 7.5| 7.3| 7.1| 7   | 7.56a | 14.63 |
| T2   | 5       | 4.5| 4  | 3.6| 3.2| 2.9| 2.5 | 3.67f | 50.00 |
| T3   | 6       | 5  | 4.6| 4.2| 3.8| 3.5| 3   | 4.30e | 50.00 |
| T4   | 6.5     | 5  | 5  | 4.6| 4.2| 3.8| 3.3 | 4.70d | 49.23 |
| T5   | 5       | 4  | 3.8| 3.5| 3.2| 3  | 2.5 | 3.57fg| 50.00 |
| T6   | 7.8     | 7.6| 7.4| 7.1| 6.8| 6.5| 6.2 | 7.06b | 20.51 |
| T7   | 7       | 6.7| 6.6| 6.4| 6.1| 5.7| 5.5 | 6.29c | 21.43 |
Statistical analysis (Appendix-IX) shows that results regarding the taste of the different treatments of dehydrated turnip were highly significant (P<0.000). Results regarding the storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.000).

| Means  | 6.31a | 5.66b | 5.36c | 5.03d | 4.07e | 4.40f | 4.06g |

Figure-4.9: Effect of different chemical preservatives on Taste of dehydrated diced turnip.

3.2.4 Overall acceptability

The dehydrated diced turnips were treated with different chemical preservatives (potassium sorbate, potassium metabisulphite, and sodium benzoate) and their different concentrations were analyzed for overall acceptability during storage periods. Findings considering to overall acceptability of dehydrated diced turnip during 90 days storage are shown in Table 4.10 and Fig. 4.10.

The results of overall acceptability were showed a decreasing pattern with the storage period. The highest score rate decrease has occurred in T0 (5.23 to 2.4) 54.11%. While minimum decreases occur in T1 (8.53 to 7.17) 15.94%. The maximum mean score was obtained by T1 (7.77). While the minimum mean score got by T0 (3.42).

These findings are in close conformity with Jolson et al. (1998). They found that tomato paste preserved with potassium metabisulphite holds the best overall acceptability score and negligible microorganism.
Table-4.10: Different chemical preservatives effects on overall acceptability of dehydrated diced turnip

| Tart | Storage intervals | Mean | %Dec. |
|------|-------------------|------|-------|
|      | Initial 15 30 45 60 75 90 |      |       |
| T₀   | 5.23 3.83 3.6 3.3 2.93 2.67 2.4 | 3.42g | 54.11 |
| T₁   | 8.53 8.23 7.97 7.7 7.5 7.3 7.17 | 7.77a | 15.94 |
| T₂   | 6 4.87 4.47 4.17 3.6 3.3 3 | 4.20f | 50.00 |
| T₃   | 6.6 5.5 4.93 4.47 4.13 3.8 3.4 | 4.69e | 48.48 |
| T₄   | 6.9 6 5.4 5.1 4.77 4.43 4.1 | 5.24d | 40.58 |
| T₅   | 5.63 4.6 4.3 3.93 3.53 3.2 2.87 | 4.01f | 49.02 |
| T₆   | 8 7.7 7.4 7.17 6.87 6.63 6.4 | 7.17b | 20.00 |
| T₇   | 7.6 7.27 7.03 6.73 6.33 6.03 5.7 | 6.67c | 25.00 |
| Means| 6.81a 6.00b 5.64c 5.32d 4.96e 4.67f 4.38g |      |       |

Statistical analysis (Appendix-X) shows that results regarding to taste of the different treatments of dehydrated turnip were highly significant (P<0.05). Results regarding storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.05).

Figure-4.10: Effect of different chemical preservatives on overall acceptability of dehydrated diced turnip.

3.3 Total microbial count

The total microbial bacterial count was examined for different treatments of dehydrated diced turnip during 3-month storage period. Results regarding total bacterial count are shown in Table 4.11 and Fig. 4.11.

The total bacterial count was increased in dehydrated diced turnip samples with storage intervals. Maximum increase of bacterial count was observed in T0 (6 x10⁷ to 54 x 10⁷cfu/g) 800% While minimum percentage increase of bacterial count found in T1 (4 x 10⁷ to19 x 10⁷cfu/g) 375%. During 90 days storage period, the maximum
mean value obtained by treatment T0 (24.43 x 10^7 cfu/g) while the minimum mean value got by T1 (10.57 x 10^7 cfu/g).

These results are partially agreement with Hashmi et al (2007) they reported that bacterial count was increased during the six-month storage of dehydrated mango pickles.

Figure-4.11: Effect of different chemical preservatives on overall acceptability of dehydrated diced turnip.

Statistical analysis (Appendix-XI) shows that results regarding the bacterial count of different treatments of dehydrated turnip were highly significant (P<0.05). Results regarding the storage period of dehydrated diced turnip at different intervals were also highly significant (P<0.05).
Table-4.11: Different chemical preservatives effects on total bacterial count of dehydrated diced turnip.

| Tart. | Storage intervals | Mean  | %inc. |
|-------|-------------------|-------|-------|
| Initial | 15 | 30 | 45 | 60 | 75 | 90 |
| T<sub>0</sub> | 6x 10<sup>7</sup> | 8x10<sup>7</sup> | 15x10<sup>7</sup> | 23 x10<sup>7</sup> | 29 x10<sup>7</sup> | 36 x10<sup>7</sup> | 54 x10<sup>7</sup> | 24.43 x10<sup>7</sup>a | 800 |
| T<sub>1</sub> | 4 x10<sup>7</sup> | 5 x10<sup>7</sup> | 7 x10<sup>7</sup> | 10 x10<sup>7</sup> | 13 x10<sup>7</sup> | 16 x10<sup>7</sup> | 19 x10<sup>7</sup> | 10.57 x10<sup>7</sup>f | 375 |
| T<sub>2</sub> | 6 x10<sup>7</sup> | 8 x10<sup>7</sup> | 13 x10<sup>7</sup> | 18 x10<sup>7</sup> | 23 x10<sup>7</sup> | 29 x10<sup>7</sup> | 38 x10<sup>7</sup> | 19.29 x10<sup>7</sup>bc | 533.33 |
| T<sub>3</sub> | 5 x10<sup>7</sup> | 7 x10<sup>7</sup> | 11 x10<sup>7</sup> | 17 x10<sup>7</sup> | 22 x10<sup>7</sup> | 28 x10<sup>7</sup> | 34 x10<sup>7</sup> | 17.71 x10<sup>7</sup>bcd | 580 |
| T<sub>4</sub> | 5 x10<sup>7</sup> | 6 x10<sup>7</sup> | 10 x10<sup>7</sup> | 16 x10<sup>7</sup> | 20 x10<sup>7</sup> | 25 x10<sup>7</sup> | 30 x10<sup>7</sup> | 16.00 x10<sup>7</sup>cde | 500 |
| T<sub>5</sub> | 5 x10<sup>7</sup> | 9 x10<sup>7</sup> | 15 x10<sup>7</sup> | 21 x10<sup>7</sup> | 26 x10<sup>7</sup> | 32 x10<sup>7</sup> | 42 x10<sup>7</sup> | 21.43 x10<sup>7</sup>ab | 740 |
| T<sub>6</sub> | 5 x10<sup>7</sup> | 6 x10<sup>7</sup> | 9 x10<sup>7</sup> | 12 x10<sup>7</sup> | 16x10<sup>7</sup> | 20 x10<sup>7</sup> | 24 x10<sup>7</sup> | 13.14x10<sup>7</sup>ef | 380 |
| T<sub>7</sub> | 5 x10<sup>7</sup> | 5 x10<sup>7</sup> | 9 x10<sup>7</sup> | 14 x10<sup>7</sup> | 18x10<sup>7</sup> | 23 x10<sup>7</sup> | 28 x10<sup>7</sup> | 14.57x10<sup>7</sup>de | 460 |
| Mean | 5.13x10<sup>7</sup>f | 6.75x10<sup>7</sup>f | 11.13x10<sup>7</sup>e | 16.38x10<sup>7</sup>d | 20.88x10<sup>7</sup>e | 26.13x10<sup>7</sup>b | 33.63x10<sup>7</sup>a | | | |
Conclusions

Results on the storage life of dehydrated turnip treated with different preservative chemicals revealed a significant influence of both storage life and chemical preservative treatments. Although a decrease in organoleptic quality was observed for the storage intervals, this decrease varied according to the chemical preservative. Among all the samples the treatment with 0.1% potassium metabisulphite was observed to be the most acceptable pretreatment on the overall quality basis of dehydrated diced turnip. Similarly, other physic-chemical traits responded variably according to the chemical preservative at different storage intervals.

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