EFFECT OF TEMPERATURE AND EDIBLE COATING ON THE SHELF-LIFE OF CARROT

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Abstract- Carrot is a cool-season vegetable, its botanical name is *Daucus carota*, and it belongs to the family Umbelliferae. Carrots(*Daucus carota*) are the most common and popular vegetable in the world. The aim of present study is designed to evaluate the effectiveness of edible coating (gelatin 2 %, 4 %), packaging (LDPE, HDPE) and temperature 5 ºC on the physical and chemical changes, overall quality, and shelf life of fresh cut carrots, were investigated for the period of 2021-22 at Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam. The carrots were purchased from market, carrots were washed, peeled and sliced in to homogeneous pieces, sliced carrots divided into of top, middle and bottom part of carrot, control sample dipped in distilled water and air dry, remaining slices were dipped in gelatin solution of 2 % and 4 %, after coating air dried them at ambient temperature 22 ºC, after drying packed in LDPE and HDPE bags and stored in refrigerator 5º C and coded as T_0L (control without coating, LDPE), T_0H (control without coating, HDPE), T_1L (2% gelatin coating, LDPE), T_1H (2% gelatin coating, HDPE), T_2L (4% gelatin coating, LDPE), T_2H (4% gelatin coating, HDPE). The samples were analyzed for physico-chemical and sensory characteristics.

The maximum values of pH (6.6), TSS (12.1ºBrix), fiber (6.6%), total sugar (49.6) was recorded in T2L, and the maximum moisture (79.9%) recorded in T1H. While the maximum value of vitamin C (9.1 mg/100g) and ash (7.6) was recorded in T1L and T0H respectively. Samples which had the highest color score in T_2L (8.0), aroma score 7.3, texture score (8), overall acceptance (7.66). During the period of 12 days of storage in refrigeration of 5ºC , the sample which was stored in LDPE with 4 % of gelatin coating gives leading results in all the physicochemical and sensory parameters

Index Terms- Carrot, Shelf life, gelatin, temperature.

I. INTRODUCTION

The main sources of postharvest loss in carrots are bulk loss and the occurrence of disease in the root during storage and commercialization (Oliveira et al., 2001). This is due to high rates of transpiration, which wrinkles and changes the texture of the carrot skin, among other things (Caron et al., 2003). Carrot roots have a water content ranging from 85 to 90%, with a major portion of it lost by transpiration. Transpiration is caused by a vapor pressure deficit (VPD), which occurs when the humidity at the carrot surface differs from the humidity in the surrounding air (Costa et al., 2015).

Carrot quality has a shelf life of 3 to 6 months when stored at a temperature of -0 ± 5°C (Kopec & Valsikova, 2002). Due to microbial degradation, the high respiration rate and product loses firmness and acquires smells typical of anaerobic catabolism (Barry Ryan et al., 2000). Without refrigeration, it does not last for more than 3 to 4 days at ambient temperature. The carrot becomes very soft and susceptible to microbial attack.

Bio-degradable packing made from productive materials has been extensively researched as a potential replacement for synthetic plastics, which are known to have detrimental environmental consequences. The major elements used to make edible films and coatings are proteins, lipids, and polysaccharides, which can be utilized singly or in combination (Davis & Song, 2006).

Gelatin, protein produced by hydrolysis of collagen found in animal skin, tissues, bones, and has several properties that contribute to its film-forming capabilities, including biodegradability, biocompatibility, and plasticity (Estaca et al., 2009; Martucci et al., 2015). The nutraceutical industry, gelatin is primarily utilized as an encapsulating medium to deliver bioactive ingredients with active principles, noteworthy supplier of this biopolymer. Because this substance is mostly made up of water, gelatin, and glycerin, it might be used to create biodegradable films. To avoid food contamination, gelatin films have been applied to food surfaces, producing a thin coating of edible film on the meal surface or between layers of components (Khaliq et al., 2015).

Packaging commonly used for packaging vegetables and fruits is PE plastic. Polyethylene is a soft, transparent, and flexible film, has good impact strength and tear strength, good mechanical properties, polyethylene is widely used as food packaging, because it is thermoplastic, polyethylene is easily made with a good degree of density (Dwi et al., 2013).

The cool chamber, low-cost storage structure that uses evaporative cooling to maintain a greater humidity and lower temperature than the surrounding environment (Roy et al., 2012).

High humidity and low temperature are significant for regulating water loss from carrot roots, addition to managing the pace of biochemical changes, physiological and microorganism invasion (Tronsmo et al., 2015). Other quality criteria such as ascorbic acid, electrolyte leakage and b-carotene have been shown to improve when water loss is reduced (Ezell et al., 2017). Carrots storage capacity can also be improved by drying them and then storing them.

II. MATERIALS AND METHODS

3.1 Sample/materials collection

The research was conducted on effect of temperature and edible coating on the shelf life of carrot. The red carrots (*Daucus Carota* L.) were obtained from the local vegetable market. Carrots were selected randomly regarding uniform color, shape, size and without any kind of defects were purchased on the physical attributes and packaging material (low-density polyethylene and high-density polyethylene) were also purchased. The edible coating material gelatin (bovine, food grade, Merck) was obtained from the laboratory the University. Carrots were brought to the lab, as soon as it was purchased. The research was carried out in the research labs of the IFST, Sindh Agriculture University Tandojam, in 2022.

3.2 Preparation of Carrot samples

Rinse the fresh carrots with running tap water to remove the dirt, dust, and sediments. After washing, peeled them with a manual peeler and make 1 cm thick slices of upper, middle, and lower part of carrots. The slices were sub-divided and treated with different concentrations of 2%, 4% gelatin coating and then kept in low-density polyethylene and high-density polyethylene and stored in refrigeration 5 ^{o}C

3.3 Preparation of gelatin coating

2% Gelatin coating was made by dissolving grams of 2 g of gelatin per 100 ml of distilled water, heated at 70 ^{o}C for 2 minutes.

4% Gelatin coating was made by dissolving grams of 4 g of gelatin per 100 ml of distilled water, heated at 70 ^{o}C for 2 minutes.

Table 3.1 Experimental design

Sample	Treatments
T_0L	Control without coating, LDPE, refrigerator temperature, 5 °C
T_0H	Control without coating, HDPE, refrigerator temperature, 5 °C
T_1L	2% gelatin coating, LDPE, refrigerator temperature, 5 °C
T_1H	2% gelatin coating, HDPE, refrigerator temperature, 5 °C
T_2L	4% gelatin coating, LDPE, refrigerator temperature, 5 °C
T_2H	4% gelatin coating, HDPE, refrigerator temperature, 5 °C

3.4 Physico-chemical analysis of carrot slices

The proximate composition analysis of samples was determined using (AACC, 2000).

The Physico-chemical analysis is following

1. Moisture %
2. pH value
3. TSS (^{o}Brix)
4. Ash (%)
5. Fiber %
6. Ascorbic Acid (mg/100g)
7. Total sugar %

3.4.1. Determination of moisture (%) of carrots

The amount of moisture was measured by using the (AACC, 2000) method. The 5 g carrot sample was placed in a pre-weighed empty petri plate and kept in the hot air oven for 3 to 4 hrs. at 70 °C. After that, the dish was put in a desiccator to cool. The weight of the sample was determined. The equation was used to determine the values of sample.

The following formula was used to determine values:

$$\text{Moisture content (\%)} = \frac{\text{Fresh sample weight} - \text{Dried sample weight}}{\text{Fresh sample weight}} \times 100$$

3.4.2. Determination of pH value for carrots/juice

pH value of the carrot sample was determined according to the method of (AACC, 2000) by using a InoLab (pH 7110) digital pH meter. 10 ml of sample was taken and shaken firmly. The pH value was measured using buffer at pH 4, 7, and 10 before inserting the electrodes directly into to the solution. After initial reading, the electrode was cleaned with distilled water and then cleaned the electrode with tissue paper.

3.4.3. Determination of Total soluble solids (°Brix) of carrots

Total soluble solids of carrot samples were determined by using of Atago (RX-5000) refractometer. First, refractometer's prism was washed, cleaned, and dried the with distilled water and calibrated to 0. The carrot samples were put on the refractometer's prism and, then the refractometer's lid was closed and note the readings. The same procedure was used for each sample.

3.4.4. Determination of ash (%) of carrots

The ash contents of carrot samples were analyzed by using the (AACC, 2000). In a hot air oven, washed and cleaned crucible cups were dried. Weighed an empty crucible cup (W1). 5 g samples were placed in the weighed crucible cup (W2). For 24 hrs., electrical muffle furnace set at 550 °C, Crucible cups were put in and left until white ash is obtained. The crucible cups were weighted after cooling in the desiccator. The crucible cups were weighted after cooling in a desiccator (W3).

The following formula was used to determine values:

$$\text{Ash (\%)} = \frac{\text{W3} - \text{W1}}{\text{W2}} \times 100$$

3.4.5 Determination of crude fiber (%) of carrots

Crude fiber of carrot sample was determined by using method (AACC, 2000). 10 ml of extracted juice samples were dried in the hot air oven. Added 200 ml sulfuric acid (H_2SO_4) mixture in the test tube. Place the test tube on the crude fiber extractor device for 30 minutes of boiling, at the same time, place the condenser on the conical flask. Filtered the material through Whatman filter paper. Buckner Funnels is used for air suction. Wash the residues with distilled water to make it free from acid. After filtrating it is transferred the sample to the digestion flask through Whatman filter paper, added 200 ml sodium hydroxide (NaOH) mixture, connect the flask with condenser and allowed to boil for 30 minutes. Wash the juice sample with water one more to remove any Alkali. Placed the sample to the crucible cup and let it to dry. Before putting the sample into the Muffle Furnace, weighted it (W1). Sample was placed in the Muffle furnace for 4 hrs. at 600 °C. Take the sample from of the muffle and placed it in the Desiccator for 2 hrs. to cool. Ignited the contents of the crucible in muffle furnace and weighted, denoted this as (W2).

Calculate the crude fiber % following formulas was used

$$\text{Crude Fiber \%} = \frac{\text{W2} - \text{W1}}{\text{Sample weight}} \times 100$$

3.4.6. Determination of ascorbic acid mg/100g^{-1} of carrots

Mazumdar and Majumder developed a titration method to quantify the amount of Ascorbic acid in a carrot sample (2003). In a beaker, 10 ml of filtered carrot juice was added to 15 ml of oxalic acid, which was then titrated against dichlorophenol solution until pink color showed.

Calculate the ascorbic acid % following formulas was used

titer x dye equivalent x dilution = ascorbic acid (mg/100g^{-1})

3.4.9 Determination of total sugar of carrots

To determine the total sugar of the carrot sample, 100 ml of filtered sample was placed in a conical flask from a solution prepared for reducing sugar. The solution (100 ml) was placed in a flask, and 10 ml of 8.6% HCl (8.6 ml HCl was taken and mixed into a small volume of water, and then distilled water was added up to the final volume of 100 ml) was added. The solution was heated for 5 minutes and then allowed to cool before being neutralized with NaOH and 3-4 drops of phenolphthalein indicator, which was added drop by drop until a pink color developed. With distilled water, the solution was placed into a volumetric flask and produced up to 250 ml. The solution was placed in a burette and titrated against 10 ml Fehling's solution with 4-5 drops of methylene blue indicator until a brick red color developed. The amount of solution used was recorded, and the following formula was used to calculate it.

$$\text{Total sugar (\%)} = \frac{\text{Factor (4.95) X dilution (250)}}{\text{Titer X W of sample}} \times 100$$

3.5. Sensory evaluation

A panel of judges will assess the sensory features of the Larmond (1997) approach and a 9-point hedonic scale. The panelists in coded form on disposable plates at random. Each panelist, however, was given a questionnaire summarizing the quality features of the carrot samples (color, taste, aroma, and overall acceptance). Each parameter received a score from the panelists, with a maximum score of 9. Each sensory quality was scored on a 9-point hedonic scale, with 1 being the most disliked and 9 being the most liked.

3.6. Statistical analysis

The data collected from research were statistically analyzed according to statistical procedure of analysis of variance one way (ANOVA), by using Statistix 8.1 software (Analytical Software, 2005).

III. RESULTS

4.1 Physico-chemical parameters

Chemical parameters were investigated: moisture %, Ascorbic acid mg/100g^{-1}, pH value, total soluble solids °Brix, total sugar %, ash % , and fiber %.

4.1.1 Moisture % of carrot slices

The result regarding moisture % at interval of 0-12 days was observed statistically not significant at ($P \leq 0.05$).

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed moisture % of carrot sample kept at refrigeration temperature in LDPE bags, 68.8, 72.1, 77.4, 73.8. The results obtained for T_0H

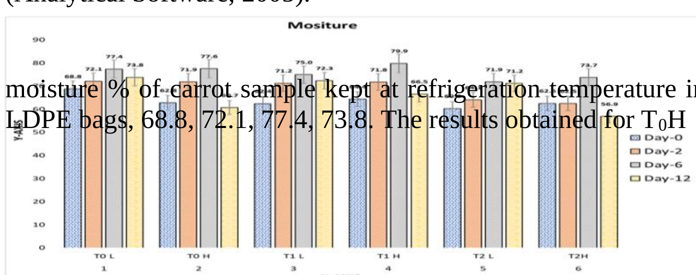

Figure 4.1Effects of packaging material and gelatin coating on moisture % of carrot at refrigeration temperature 5 °C.

control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed moisture % of carrot sample kept at refrigeration temperature in HDPE bags, 62.8, 71.9, 77.6, 60.7. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed moisture % of carrot sample kept at refrigeration temperature in LDPE bags, 62.4, 71.2, 75.0, 72.3. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed moisture % of carrot sample kept at refrigeration temperature in HDPE bags, 64.4, 71.8, 79.9, 66.5. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed moisture % of carrot sample kept at refrigeration temperature in LDPE bags, 60.3, 64.1, 71.9, 71.2. The results obtained for T_0H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed moisture % of carrot sample kept at refrigeration temperature in HDPE bags, 62.5, 62.5, 73.7, 56.9.

4.1.2 pH value of carrots/juice

Effects of edible coating and packaging material on pH value of carrot are presented in Figure 4.2. The result regarding pH value at interval of 0, 2, 6, 12 days was observed statistically not significant at ($P \leq 0.05$).

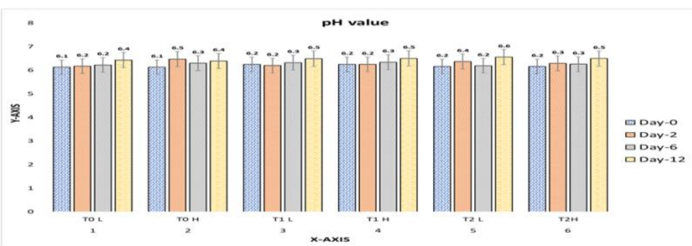

Figure 4.2 Effects of packaging material and gelatin coating on pH value of carrot at refrigeration temperature 5 ^{o}C.

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed pH value of carrot sample kept at refrigeration temperature in LDPE bags, 6.1, 6.2, 6.2, 6.4. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed pH value of carrot sample kept at refrigeration temperature in HDPE bags, 6.1, 6.5, 6.3, 6.4. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed pH value of carrot sample kept at refrigeration temperature in LDPE bags, 6.2, 6.2, 6.3, 6.5. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed pH value of carrot sample kept at refrigeration temperature in HDPE bags, 6.2, 6.2, 6.3, 6.5. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed pH value of carrot sample kept at refrigeration temperature in LDPE bags, 6.2, 6.4, 6.2, 6.6. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed pH value of carrot sample kept at refrigeration temperature in HDPE bags, 6.2, 6.3, 6.3, 6.5.

4.1.3 Total soluble solids (°Brix) of carrot slices

Effects of edible coating and packaging material on TSS of carrot are presented in Figure 4.3. The result regarding TSS at interval of 0-12 days was observed statistically not significant at ($P \leq 0.05$). The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed TSS of carrot sample kept at refrigeration temperature in LDPE bags, 8.7, 9.4, 9.5, 8.9. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed TSS of carrot sample kept at refrigeration temperature in HDPE bags, 8.7, 8.2, 8.7, 8.2. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed TSS of carrot sample kept at refrigeration temperature in LDPE bags, 9.9, 9.4, 9.6, 9.2. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed TSS of carrot sample kept at refrigeration temperature in HDPE bags, 9.7, 9.3, 9.1, 8.7. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed TSS of carrot sample kept at refrigeration temperature in LDPE bags, 11.7, 11.8, 11.7, 11.6. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed TSS of carrot sample kept at refrigeration temperature in HDPE bags, 11.5, 12.1, 11.6, 11.3.

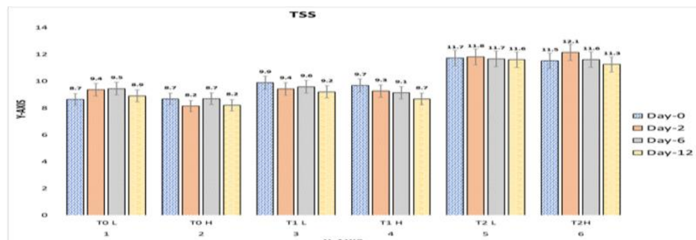

Figure 4.3 Effects of packaging material and gelatin coating on total soluble solid (°Brix) of carrot at refrigeration temperature 5 ^{o}C

4.1.4 Ash % of carrot slices

Effects of edible coating and packaging material on ash % of carrot are presented in Figure 4.4. The result regarding ash% at interval of 0-12 days was observed statistically not significant at ($P \leq 0.05$).

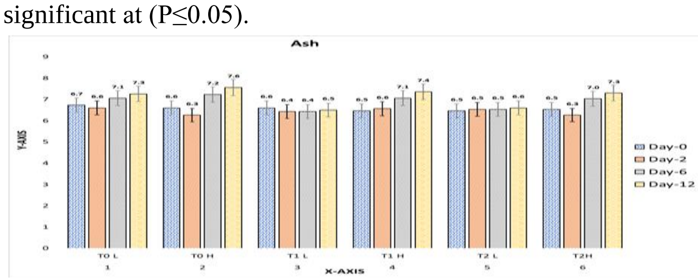

Figure 4.4 Effects of packaging material and gelatin coating on ash % of carrot at refrigeration temperature 5 ^{o}C.

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed ash % of carrot sample kept at refrigeration temperature in LDPE bags, 6.7, 6.6, 7.1,7.3. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ash % of carrot sample kept at refrigeration temperature in HDPE bags, 6.6, 6.3, 7.2, 7.6. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed ash % of carrot sample kept at refrigeration temperature in LDPE bags, 6.6, 6.4, 6.4, 6.5. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ash % of carrot sample kept at refrigeration temperature in HDPE bags, 6.5, 6.6, 7.1, 7.4. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ash % of carrot sample kept at refrigeration temperature in LDPE bags, 6.5, 6.5 ,6.5, 6.6. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ash % of carrot sample kept at refrigeration temperature in HDPE bags, 6.5, 6.3, 7.0, 7.3.

4.1.5 Crude fiber % of carrot slices

Effects of edible coating and packaging material on crude fiber % of carrot are presented in Figure 4.5. The result regarding crude fiber % at interval of 0-12 days was observed statistically not significant at (P≤0.05).

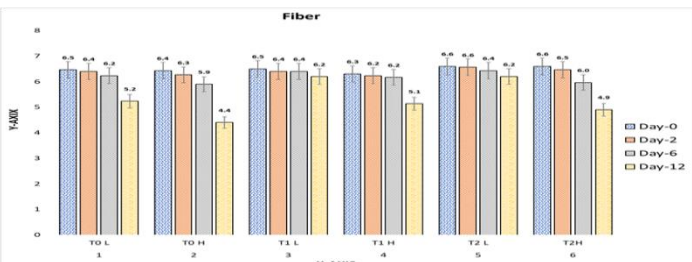

Figure 4.5 Effects of packaging material and gelatin coating on crude fiber % of carrot at refrigeration temperature 5 °C

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed crude fiber % of carrot sample kept at refrigeration temperature in LDPE bags, 6.5, 6.4, 6.2, 5.2. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed crude fiber % of carrot sample kept at refrigeration temperature in HDPE bags, 6.4, 6.3, 5.9, 4.4. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed crude fiber % of carrot sample kept at refrigeration temperature in LDPE bags, 6.5, 6.4, 6.4, 6.2. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed crude fiber % of carrot sample kept at refrigeration temperature in HDPE bags, 6.3, 6.2, 6.2, 5.1. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed crude fiber % of carrot sample kept at refrigeration temperature in LDPE bags, 6.6, 6.6, 6.4, 6.2. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed crude fiber % of carrot sample kept at refrigeration temperature in HDPE bags, 6.6, 6.5, 6.0, 4.9.

4.1.6 Ascorbic acid mg/100g-1 of carrot slices

Effects of edible coating and packaging material on ascorbic acid of carrot are presented in Figure 4.6. The result regarding ascorbic acid at interval of 0-12 days was observed statistically not significant at (P≤0.05).

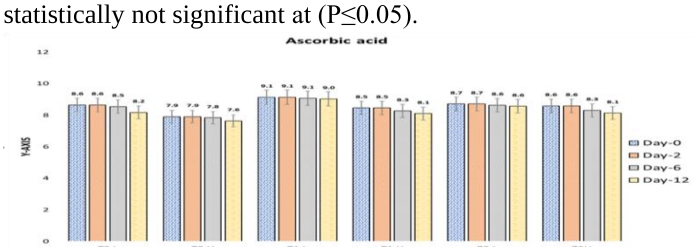

Figure 4.6 Effects of packaging material and gelatin coating on ascorbic acid of carrot at refrigeration temperature 5 °C

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed ascorbic acid of carrot sample kept at refrigeration temperature in LDPE bags, 8.6, 8.6, 8.5, 8.2. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ascorbic acid of carrot sample kept at refrigeration temperature in HDPE bags, 7.9, 7.9, 7.8, 7.6. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed ascorbic acid of carrot sample kept at refrigeration temperature in LDPE bags, 9.1, 9.1, 9.1, 9.0. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ascorbic acid of carrot sample kept at refrigeration temperature in HDPE bags, 8.5, 8.5, 8.3, 8.1. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ascorbic acid of carrot sample kept at refrigeration temperature in LDPE bags, 8.7, 8.7, 8.6, 8.6. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed ascorbic acid of carrot sample kept at refrigeration temperature in HDPE bags, 8.6, 8.6, 8.3, 8.1.

4.1.9 Total sugar % of carrot slices

Effects of edible coating and packaging material on total sugar % of carrot are presented in Figure 4.9. The result regarding total sugar % at interval of 0-12 days was observed statistically not significant at (P≤0.05).

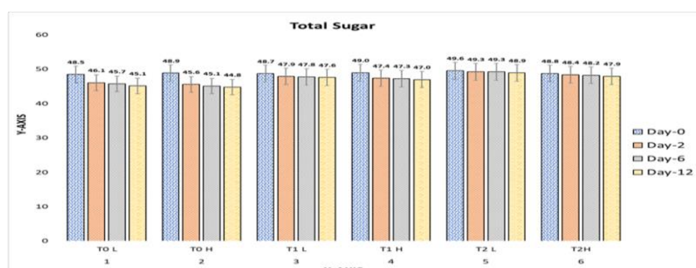

Figure 4.9Effects of packaging material and gelatin coating on total sugar % of carrot at refrigeration temperature 5 °C

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed total sugar % of carrot sample kept at refrigeration temperature in LDPE bags, 48.5, 46.1, 45.7, 45.1. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed total sugar % of carrot sample kept at refrigeration temperature in HDPE bags, 48.9, 45.6, 45.1, 44.8. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed total sugar % of carrot sample kept at refrigeration temperature in LDPE bags,48.7, 47.9, 47.8, 47.6 . The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed total sugar % of carrot sample kept at refrigeration temperature in HDPE bags,49.0, 47.4, 47.3, 47.0. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed total sugar % of carrot sample kept at refrigeration temperature in LDPE bags, 49.6, 49.3, 49.3, 48.9. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed total sugar % of carrot sample kept at refrigeration temperature in HDPE bags, 48.8, 48.4, 48.2, 47.9

4.2 Sensory evaluation

The sensory evaluation of gelatin coated carrot slices was incorporated by faculty of Institute of Food Sciences and Technology, Sindh Agricultural University Tandojam. The sensory attributes like texture, aroma, color, and overall acceptability were evaluated by judges using 9-point hedonic score system.

4.2.1 Color score

Effects of edible coating and packaging material on color score of carrot are presented in Figure 4.16. The result regarding color score at interval of 0-12 days was observed statistically not significant at (P≤0.05).

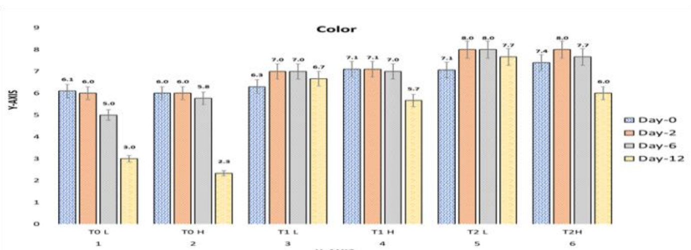

Figure 4.16Effects of packaging material and gelatin coating on color score of carrot at refrigeration temperature 5 °C

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed color score of carrot sample kept at refrigeration temperature in LDPE bags, 6.1, 6.0, 5.0, 3.0. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed color score of carrot sample kept at refrigeration temperature in HDPE bags, 6.0, 6.0, 5.8, 2.3. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed color score of carrot sample kept at refrigeration temperature in LDPE bags, 6.3, 7.0, 7.0, 6.7 The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed color score of carrot sample kept at refrigeration temperature in HDPE bags, 7.1, 7.1, 7.0, 5.7. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed color score of carrot sample kept at refrigeration temperature in LDPE bags, 7.1, 8.0, 8.0, 7.7. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed color score of carrot sample kept at refrigeration temperature in HDPE bags, 7.4, 8.0, 7.7, 6.0

1. **Texture score**

Effects of edible coating and packaging material on texture score of carrot are presented in Figure 4.17. The result regarding texture score at interval of 0-12 days was observed statistically not significant at (P≤0.05).

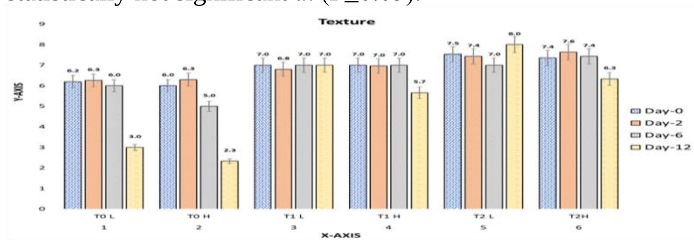

Figure 4.17 Effects of packaging material and gelatin coating on texture of carrot at refrigeration temperature 5 °C

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed texture score of carrot sample kept at refrigeration temperature in LDPE bags, 6.2, 6.3, 6.0, 3.0. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed texture score of carrot sample kept at refrigeration temperature in HDPE bags, 6.0, 6.3, 5.0, 2.3. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed texture score of carrot sample kept at refrigeration temperature in LDPE bags, 7.0, 6.8, 7.0, 7.0. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed texture score of carrot sample kept at refrigeration temperature in HDPE bags, 7.0, 7.0, 7.0, 5.7. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed texture score of carrot sample kept at refrigeration temperature in LDPE bags, 7.5, 7.4, 7.0, 8.0. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed diameter mm of carrot sample kept at refrigeration temperature in HDPE bags, 7.4, 7.6, 7.4, 6.3.

4.2.2 Aroma Score

Effects of edible coating and packaging material on aroma score of carrot are presented in Figure 4.18. The result regarding aroma score at interval of 0-12 days was observed statistically not significant at (P≤0.05).

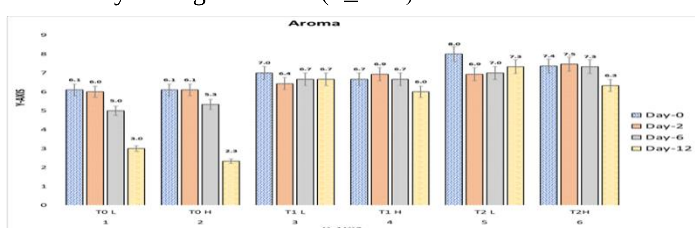

Figure 4.18 Effects of packaging material and gelatin coating on aroma score of carrot at refrigeration temperature 5 °C

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed aroma score of carrot sample kept at refrigeration temperature in LDPE bags, 6.1, 6.0, 5.0, 3.0. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed aroma score of carrot sample kept at refrigeration temperature in HDPE bags, 6.1, 6.1, 5.3, 2.3 The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed diameter mm of aroma score kept at refrigeration temperature in LDPE bags, 7.0, 6.4, 6.7, 6.7. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed aroma score of carrot sample kept at refrigeration temperature in HDPE bags, 6.7, 6.9, 6.7, 6.0. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed aroma score of carrot sample kept at refrigeration temperature in LDPE bags, 8.0, 6.9, 7.0,7.3. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed aroma score of carrot sample kept at refrigeration temperature in HDPE bags, 7.4, 7.5, 7.3, 6.3.

4.2.3 Overall Acceptability

Effects of edible coating and packaging material on acceptability score of carrot are presented in Figure 4.19. The result regarding acceptability score at interval of 0-12 days was observed statistically not significant at ($P \leq 0.05$)

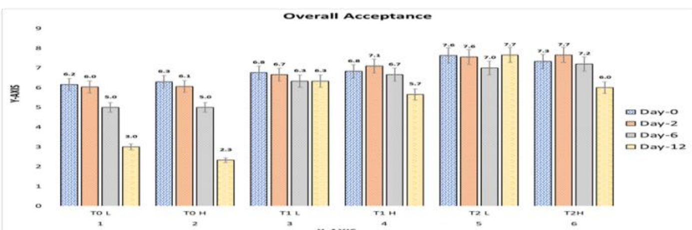

Figure 4.19 Effects of packaging material and gelatin coating on overall acceptability of carrot at refrigeration temperature 5 °C

The results obtained for T_0L control sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed acceptability score of carrot sample kept at refrigeration temperature in LDPE bags, 6.2, 6.0, 5.0, 3.0. The results obtained for T_0H control sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed acceptability score of carrot sample kept at refrigeration temperature in HDPE bags, 6.3, 6.1, 5.0, 2.3. The results obtained for T_1L sample presented in graph observed at the interval of 0, 2, 6, 12 days, result showed acceptability score of carrot sample kept at refrigeration temperature in LDPE bags, 6.8, 6.7, 6.3, 6.3. The results obtained for T_1H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed acceptability score of carrot sample kept at refrigeration temperature in HDPE bags, 6.8, 7.1, 6.7, 5.7. The results obtained for T_2L sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed acceptability score of carrot sample kept at refrigeration temperature in LDPE bags, 7.6, 7.6, 7.0, 7.7. The results obtained for T_2H sample presented in graph observed at the interval of 0, 2, 6, 12 days result showed acceptability score of carrot sample kept at refrigeration temperature in HDPE bags, 7.3, 7.7, 7.2, 6.0.

IV. DISCUSSION

5.1 Moisture % of carrot slices

The maximum moisture was noted under the T1H (79.9%), however minimum moisture (56.9 %) was observed in T2H. The results was further confirmed with (becerra-moreno, 2015) who reported that the moisture content of carrots stored under control conditions decrease during storage, The average moisture was determined as 43 to 86 % during the storage(Togrul, 2006). (Asgar, 2020) reported, the moisture content dropped to 90.28 percent. The drop in water content in carrots is caused by transpiration, he further reported carrot that are packed in Polyethylene and stored at 5°C contain up to 67.83 moisture content.

5.2 pH value of carrot slices

The maximum pH 6.6 was observed under the T2L, while minimum pH 6.1 was observed in T0L. The results were further conformed with (Ayub et al., 2013) pH value of cut carrots exhibited decrease when compared to fresh carrots. The pH value of fresh carrot around 6.0. The reducing of pH value with storage time was attributed to increasing acidity. The acidity of vegetables is inversely proportional to the pH level, which indicates their flavour. Because of the buffering capacity of the same fluids, substantial changes in acidity can occur with no noticeable change in pH (Chitarra, 2005).

5.3 Total soluble solids (°Brix) of carrot slices

The maximum TSS (11.8°Brix) was noted under the T2L, however minimum TSS (8.2°Brix) was observed in T0H. The results was compared with (Ayub et al., 2013) who reported that only soluble solids did not indicated difference between fresh carrots and stored, parameter are sensitive to the minimal processing and storage conditions. The total soluble solids found (12.0°Brix) were numerically close to the value to the value of pumpkin (12.2°Brix) (Ayub et al., 2013). (Aguila et al., 2006) reported that stored minimal processed and whole crimson giant radishes at a temperature of 5°C found 0.43% increase in the content of total soluble solids after storge of 10 days. The results corroborated the greater water loss result in high TSS. The total soluble solids could be attributed to the breakdown of starch or the hydrolysis of cell wall polysaccharides.

5.4 Ash % of carrot slices

The maximum ash value was 7.6 % was noted under the T0H, however minimum ash 6.3% was observed in T2H. the results are similar to (karmoker et al 2011). They showed the nutritive value of Carrot per 100 g edible portion as 0.70%. the dry basis calculation showed that carrot have high amount of Ash (4.91). Ramamoorthy stated that the ash content of a sample shows the mineral composition. As a result, a low ash content suggests a low metals content (Ramamoorthy,2010). (Silva, 2016) reported that the variation in nutrient might be due to variety difference, maturity, harvesting storage and processing conditions. The result for ashes in the present study did not show a significant difference (>0.05) the ash content during storage , treated sample showed better nutritive value the control samples. (kasale et al., 2019) reported 7.47% ash content in carrots.

5.5 Crude fiber % of carrot slices

The maximum crude fiber (6.6%) was noted under the T2L, however minimum crude fiber 4.4% was observed in T0H. The results was further confirmed with (Boadi et al 2021) who reported that the fiber content ranged from 7.18% to 8.87% . The crude fibre content of carrots was much lower than the 24.66 percent stated in the literature. (kasale et al 2019) reported that high crude fiber found carrot is 10.48g/100g.

5.6 Ascorbic acid (mg/100g^{-1}) of carrot slices

The maximum ascorbic acid (9.1mg/100g) was noted under the T1L, while minimum ascorbic acid (7.6mg/100g) was observed in T0H. The results was compared with (Silva et al., 2016) who reported that the ascorbic acid in fresh carrots was same as that found in stored carrot slices although there was a tendency of decrease of this with 18.3 mg/100g compare to fresh carrot slices 21.30 mg/100g (Silva et al., 2016). Alves found 10 mg/100 g of vitamin c in fresh cut carrots. The findings showed that packaging carrots in LDPE bags and storing them in a cool environment extends their shelf life and reduces ascorbic acid loss (Negi & Roy, 2000).

5.9 Total sugar % of carrot slices

The maximum total sugar (49.6) was observed under the T2L, however minimum total sugar (44.8) was noted in T0H. The results compared with the study of (Mastromatteo et al., 2012) who reported stated that during storage general decrease of sugar was observed for the packed sample in LDPE. Carrots' total sugar content has been shown to range between 40 and 70 g

5.12 Sensory evaluation

(Mastromatteo et al., 2012) reported the evaluation during storage of fresh carrots, uncoated sample losses their texture color aroma as compared to coated sample. Respiratory activity and sensory degradation were both lowered by coating. Fresh carrot shelf life appeared to be substantially influenced by sensory quality. In reality, no microbiological threshold was crossed, and no visible moulds formed on the surface to indicate that the product was unacceptably contaminated. It's probable that the combination of active Map and coating treatment resulted in enhanced fresh carrot preservation. (Marquez et al., 2017) claimed that because sensory factors are linked to food mechanical qualities, they cause color, fragrance, and texture alterations. No significant changes in color, texture, or scent were found in coated carrot samples.

CONCLUSION

It is concluded that freshly cut carrots were kept at 5 ^{o}C for the interval of 2, 6, 12, days. Carrots were randomly cut in 1 cm thick slices and coated with gelatin %. During the storage period, the result showed, water loss, decreases texture, and reduction of color in the control sample as compared to the coated samples. The samples coated with gelatin better retained the physio-chemical and sensory characteristics. It also provides a good moisture barrier, oxygen barrier, which helps to promoted maintenance of a good exterior quality of fresh cut carrots and extend shelf life. Packaging affected on water content, vitamin C, respiration rate, and weight loss in the period storage of 12 days. The temperature of 5 °C was the storage temperature that could maintain changes in the characteristics of the coated carrot. Low density Polyethylene plastic type was an excellent package in maintaining changes in the characteristics of carrots during the storage process.

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