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Effect of Postharvest Treatments on Storage and Quality of Carrot cv. New Kuroda at Ambient Temperature

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A B S T R A C T

An investigation was carried out at Floriculture Research Station, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Mulugu (V & M), Siddipet Dist., Telangana State during the period of 2017-18 and 2018-19 to determine the effect of postharvest treatments on storage and quality of carrot at ambient temperature. The study was conducted with Hot water at 50^0C dipping for one minute, H_2O_2 1 per cent for one minute dipping, $NaOCl_2$ 150 ppm dipping for one minute, $CaOCl_2$ 150 ppm dipping for one minute, $CaCl_2$ 3 per cent dipping for five minutes. The experiment was laid out in CRD with three replications. All the parameters in terms of vitamin C, TSS, Carotene, reducing sugars, total sugars were significantly differed among storage and quality of carrot. The minimum per cent of physiological loss in weight (10.37 %), firmness (9.48 kg/cm^2) and maximum shelf life (8.70) was recorded in T_5 ($CaCl_2$). minimum per cent of decay (27.43 %) and maximum β-carotene content (2.62 mg/100g), ascorbic acid content (2.65 mg/100g), TSS content (12.69 °Brix), reducing sugars (1.25 mg/100g), total sugars (4.58 mg/100g) was recorded in T_1 (hot water treatment).

Introduction

Carrot is an important vegetable throughout the world as human food and now under cultivation in many countries. Carrot (*Daucus carota* L.) is one of the vegetable crops which belongs to the family Umbelliferae. Carrot is indigenous to Asia and is a popular salad

vegetable. It is a rich source of carotene, a precursor of vitamin A. It consists of nutrients such as proteins, vitamins, carbohydrates, fiber, potassium, sodium, thiamin and riboflavin and also high in sugar. Its use increases resistance against the blood and eye diseases.

The quality of carrot is influenced by both biotic and abiotic parameters, and after harvest, the critical operations are handling, storage and processing (Seljasen *et al.,* 2013). Carrots are vulnerable to water loss and proper packaging will prevent desiccation, hence prolong the shelf life. Low temperatures and absence of ethylene and sufficient oxygen in the packaging headspace atmosphere are important to avoid quality deterioration (Seljasen *et al.,* 2013).

According to Holden *et al.,* (1999) raw carrot roots contain, on average, 12% of dry matter, 4.5% of sugars, 2.0% of dietary fibre, 5.7mg/100g of vitamin C. The high biological value of this vegetable relates mainly to carotenoid compounds and dietary fibre, which are components of carrot roots tissue (Alasalvar *et al.,* 2001). Carotenoids are red, orange or yellow fat soluble plant pigments. In human organism, some carotenoids are converted into vitamin A (Handelman, 2001). The main carotenoid compounds found in carrot roots are α-carotene and β-carotene (Simon and Wolff 1987, Mayer-Miebach and Spiess 2003). Other data show that carotenoid content is highly differentiated among carrot cultivars and ranges from 4 to 25mg/100g or even more (Rubatzky *et al.,* 1999). Skrede *et al.,* (1997) found that high carotenoid content in carrot results in a more reddish and darker color of the roots. Carotenoid content increases with the age and size of storage root (Lee 1986, Rosenfeld 1998).

Soluble sugars are the dominant storage compounds in carrot roots. They account for 34-70% of dry weight of the root and are stored in vacuoles of the parenchyma (Daie 1984, Nilsson 1987). Most of the produced carrots are stored for several months before consumption. Carrot roots can be stored successfully for 6-8 months in cold store conditions, depending upon the cultivar and quality of the roots. Recommended storage conditions are: temperature of 0-1°C and 95-98% RH (Stoll and Weichmann 1987). Storage conditions are among the main factors influencing changes of carrot roots quality during postharvest period (Seljasen *et al.,* 2001). However it is believed that carotenoid content in the roots is little affected by postharvest storage (Koca and Karadeniz, 2008). Sometimes an increase of carotenoid content is observed (Le Dily *et al.,* 1993, Kopas-Lane and Warthesen 1995, Kidmose *et al.,* 2004).

Sugar compounds are the substrates used during storage for the respiration process in the plant tissue. Increasing hexoses and decreasing sucrose content was observed during storage of carrot roots (Suojala, 2000).

The objective of the study was to determine the influence of long-term storage of carrot, at ambient temperature conditions, on quality traits, related to their physical and chemical parameters.

Materials and Methods

The present investigation was carried out entitled "Effect of postharvest treatments on storage and quality of carrot cv. New kuroda at ambient temperature" was carried out during *Rabi* and Summer (2017-18 and 2018-19), the experiment was carried out at Floriculture Research Station, Rajendranagar, SKLTSHU, Hyderabad.

The experiment was conducted to study the effect of chemicals on postharvest treatments

such as with Hot water at 50^0C dipping for one minute, H_2O_2 1 per cent for one minute dipping, $NaOCl_2$ 150 ppm dipping for one minute, $CaOCl_2$ 150 ppm dipping for one minute, $CaCl_2$ 3 per cent dipping for five minutes. The experiment was laid out in CRD with three replications.

Mature carrot roots were harvested and transported on the same day to the Laboratory. The fruits were grouped according to replication and treatment. They were then trimmed and washed with clean tap water to remove any dirt. Each treatment included one kg of roots with three replications and stored at ambient conditions.

Per cent of Physiological loss in weight (PLW)

Physiological loss in weight was calculated by subtracting the final weight from the initial weight. The results were then expressed in percentage using following formula.

$$\% \text{ PLW} = \frac{\text{Initial weight - Final weight}}{\text{Initial weight}} \times 100$$

Firmness (kg/cm^2)

Regression Model: A typical linear regression model is agreement between the FIR values measured by shown in equation 1:

$$Y = k_0 + k_1 X_1$$

Where:
Y = Dependent variable, for example FIR of carrot X = Independent variable, for example TSS of carrot
k , k = Regression coefficients

In order to predict carrot FIR based on TSS of carrot the linear regression model FIR = k + k TSS was 0 1 suggested.

Percentage of decay (%)

The number of decayed roots was expressed as a percentage of the total number of roots in the treatment at start of storage.

TSS (^{0}Brix)

Total soluble solids content was determined by using ERMA Hand Refractometer. Five observations from each treatment were recorded and average was calculated. The total soluble solids content was expressed in $^\circ$Brix.

Ascorbic acid (mg/100g)

$$\text{Dye factor} = \frac{0.5}{\text{Titer}}$$

Ascorbic acid was determined by using the formula given by Ranganna (1986):

Calculation

Ascorbic acid =

$$\frac{\text{Titre value x Dye factor x Volume made up x 100}}{\text{Aliquot of extraction taken for estimation x volume of sample taken for estimation}}$$

β-carotene (mg/100g)

β-carotene was determined by using the formula given by Srivastava and Sanjeev Kumar (2002).

$$\beta\text{- Carotene (mg / 100g)} = \frac{\text{O.D. of sample x 13.9x } 10^4 \text{ x 100}}{\text{Weight of sample x 560 x 1000}}$$

Reducing sugar

Reducing sugars content in root was determined at root maturity by using Lane and Eyon method (AOAC, 1965).

Results and Discussion

Physiological loss in weight (%)

The different postharvest treatments were found to be significant with respect to per cent of physiological loss in weight during storage at ambient temperature (Table-1). Significantly minimum per cent of physiological loss in weight (10.37 %) was recorded in T_5 ($CaCl_2$) which was on par with T_2 (H_2O_2) (10.57 %), and maximum physiological loss in weight (17.28 %) was recorded in T_6 (control).

Firmness (kg/cm^2)

The significant difference was found with respect to firmness during storage at ambient temperature (Table-1). Significantly maximum firmness (9.48 kg/cm^2) was recorded in T_5 ($CaCl_2$) which was on par with T_2 (H_2O_2) (9.41 kg/cm^2), and minimum per cent of firmness (5.48 kg/cm^2) was recorded in T_6 (Control).

Decay percentage

The different postharvest treatments were found to be non significant with respect to decay during storage at ambient temperature (Table-1). Significantly minimum per cent of decay (27.43 %) was recorded in T_2 (H_2O_2) followed by T_5 ($CaCl_2$) (31.90 %), and maximum decay (54.20 %) was recorded in T_6 (control).

β-carotene (mg/100g)

The significant difference was found with respect to β-carotene content during storage at ambient temperature (Table-1). Significantly maximum β-carotene content (2.62 mg/100g) was recorded in T_1 (hot water treatment) followed by T_5 ($CaCl_2$) (2.50 mg/100g). Minimum β-carotene content (2.38 mg/100g) was recorded in T_6 (control).

Ascorbic acid (mg/100 g)

The different postharvest treatments were found to be significant with respect to ascorbic acid content during storage at ambient temperature (Table-2). Significantly maximum ascorbic acid content (2.65 mg/100g) was recorded in T_1 (hot water treatment) which was on par with T_2 (H_2O_2) and T_5 ($CaCl_2$) (2.58 mg/100g). Minimum ascorbic acid content (2.50 mg/100g) was recorded in T_6 (control).

TSS (°Brix)

The different postharvest treatments were found to be significant with respect to TSS content during storage at ambient temperature (Table-2). Significantly maximum TSS content (12.69 °Brix) was recorded in T_1 (hot water treatment) followed by T_2 (H_2O_2) (12.04 °Brix). Minimum TSS content (11.85 °Brix) was recorded in T_6 (control) which was on par with T_4 ($CaOCl_2$) (11.91 °Brix) and T_4 ($CaOCl_2$) (11.91 °Brix)

Reducing sugars (mg/100g)

The significant difference was found with respect to reducing sugars during storage at ambient temperature (Table-2).

Significantly maximum reducing sugars (1.25 mg/100g) was recorded in T_1 (hot water treatment) which was on par with T_2 (H_2O_2) (1.23 mg/100g) and T_5 ($CaCl_2$) (1.19 mg/100g). Minimum reducing sugars (1.17 mg/100g) was recorded in control which was on par with T_3 ($NaOCl_2$) (1.19 mg/100g).

Table.1 Effect of postharvest treatments on physiological loss in weight, content, decay percentage and β-carotene of carrot stored at ambient temperature

Treatments	Physiological loss in weight (%)	Firmness (kg/cm^2)	Decay percentage	β-carotene (mg/100g)
T_1	12.80	7.73	43.27	2.62
T_2	10.57	9.41	27.43	2.45
T_3	10.61	7.83	43.93	2.42
T_4	14.17	8.33	51.20	2.38
T_5	10.37	9.48	31.90	2.50
T_6	17.28	5.48	54.20	2.40
SE(m)±	0.18	0.09	0.54	0.02
C.D. at 5%	0.55	0.27	1.68	0.08

T_1-Hot water at 50^0C dipping for one minute; T_2- H_2O_2 1 per cent for one minute dipping; T_3- $NaOCl_2$ 150 ppm dipping for one minute; T_4- $CaOCl_2$ 150 ppm dipping for one minute; T_5- $CaCl_2$ 3 per cent dipping for five minutes; T_6- Control (No treatment)

Table.2 Effect of postharvest treatments on ascorbic acid, TSS, reducing sugars, total sugars and shelf life of carrot stored at ambient temperature

Treatments	Ascorbic acid (mg/100 g)	TSS (^{0}Brix)	Reducing sugars (mg/100g)	Total sugars (mg/100g)	Shelf life (days)
T_1	2.65	12.69	1.25	4.58	7.00
T_2	2.59	12.04	1.23	4.56	8.00
T_3	2.58	11.91	1.19	4.53	7.50
T_4	2.56	11.91	1.21	4.51	7.80
T_5	2.59	11.97	1.19	4.53	8.70
T_6	2.50	11.85	1.17	4.51	6.00
SE(m)±	0.02	0.02	0.02	0.01	0.44
C.D. at 5%	0.07	0.07	0.05	0.04	1.37

T_1-Hot water at 50^0C dipping for one minute; T_2- H_2O_2 1 per cent for one minute dipping; T_3- $NaOCl_2$ 150 ppm dipping for one minute; T_4- $CaOCl_2$ 150 ppm dipping for one minute; T_5- $CaCl_2$ 3 per cent dipping for five minutes; T_6- Control (No treatment)

Total sugars (mg/100g)

The different postharvest treatments were found to be significant with respect to total sugars during storage at ambient temperature (Table-2). Significantly maximum total sugars (4.58 mg/100g) was recorded in T_1 (hot water treatment) which was on par with T_2 (H_2O_2) (4.56 mg/100g). Minimum total sugars were recorded in both T_6 (control) (4.51 mg/100g) and T_4 ($CaOCl_2$) (4.51 mg/100g).

Shelf life

The maximum shelf life (8.70) was recorded in T_5 ($CaCl_2$) which was on par with T_2 (H_2O_2) (8.00), T_4 ($CaOCl_2$) (7.80) and T_3 ($NaOCl_2$) (7.50). Minimum shelf life (6.00) was recorded in control which was on par with T_1 (hot water treatment) (7.00).

From this investigation, it can be concluded that the minimum per cent of physiological

loss in weight (10.37 %), firmness (9.48 kg/cm^2) and maximum shelf life (8.70) was recorded in T_5 ($CaCl_2$). minimum per cent of decay (27.43 %) and maximum β-carotene content (2.62 mg/100g), ascorbic acid content (2.65 mg/100g), TSS content (12.69 °Brix), reducing sugars (1.25 mg/100g), total sugars (4.58 mg/100g) was recorded in T_1 (hot water treatment).

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