▼ Journal of Research (Science), Bahauddin Zakariya University, Multan, Pakistan.
Vol.14, No.2, December 2003, pp. 147-152 ISSN 1021-1012

STORAGE STUDIES ON CARROT PRESERVATION BY CHEMICAL METHODS

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Abstract: In the present study, chemical preservatives were used to minimize carrot losses and to extend the shelf life. The mean value for acidity increased with a concomitant decrease in the pH values. The values for absorbance and salt percentage also decreased as the storage period advanced. On the basis of physico-chemical analysis it was observed that the carrots preserved with citric acid (1.5%) and potassium metabisulfite (1.0%) in maximum doses (T10) were ranked at the top and were found quite fit for use even after 120 days of storage period.

Keywords: Carrot, chemical preservatives, physico-chemical analysis, storage.

INTRODUCTION

Carrot is thought to be the most popular root vegetable [Kalra *et al.* 1987]. Its nutritional value in terms of vitamins and minerals is regarded as high among nutritionists, as it is a rich source of carotene. It contains appreciable quantities of thiamin, riboflavin and sugar. It losses freshness or quality very rapidly during transportation and storage. The deterioration in quality occurs in storage owing to slow losses of sugars in respiration. Its shelf life ranges between 3-4 days.

Vegetable processing plants use chemically preserved vegetables for further processing in to pickles and soup manufacturing. Vegetables can be preserved by pickling in weak brine [Woodroof 1989]. Benzoic and sorbic acids inhibit the growth of fungi and bacteria [Forenlof 1994]. Citric, malic, tartaric, lactic and acetic acids are generally used, while phosphoric and fumaric acids also find specific uses in acidification of foods [Anonymous 1990]. Sulfer dioxide and its salts are used in foods to prevent non-enzymatic browning and growth of undesirable micro-organisms [Tilbury 1980].

Keeping in view the above-cited factors there was a need to preserve this valuable vegetable as close to its fresh form as possible and also for a longer period of time. It has previously been preserved by canning, dehydration, pickling and freezing etc. Use of chemical additives for the preservation of fruits and vegetables is now getting popularity. It is not only cheap but the chemicals are also easily available. Moreover, it saves cost of labor and the investment on costly equipment.

MATERIALS AND METHODS

PROCUREMENT AND PACKAGING OF SAMPLE

Fresh carrots were purchased from local vegetable market in Faisalabad. They were washed with tap water, hand trimmed and peeled with the help

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of ordinary stainless steel knife. Afterwards they were cut in to 3.5 cm long strips manually. Those strips were divided into 200-g samples. All the possible combinations of chemical additives treatments were 22 in number (Table 1). However, 66 samples were prepared for triplicate readings. The samples were packed in plastic jars with chemical additives and placed on the laboratory shelf for further analysis.

Table 1: Possible combinations of chemical doses used during study period.

Treatments	SB %	CA %	SC %	KMS %
T0	-	-	-	-
T1 (Min)	0.15	0.5	-	-
T2 (Max)	0.25	1.5	-	-
T3 (Min)	0.15	-	14	-
T4 (Max)	0.25	-	25	-
T5 (Min)	0.15	-	-	0.5
T6 (Max)	0.25	-	-	1.0
T7 (Min)	-	0.5	14	-
T8 (Max)	-	1.5	25	-
T9 (Min)	-	0.5	-	0.5
T10 (Max)	-	1.5	-	1.0
T11 (Min)	-	-	14	0.5
T12 (Max)	-	-	25	1.0
T13 (Min)	0.15	0.5	14	-
T14 (Max)	0.25	1.5	25	-
T15 (Min)	0.15	0.5	-	0.5
T16 (Max)	0.25	1.5	-	1.0
T17 (Min)	0.15	-	14	0.5
T18 (Max)	0.25	-	25	1.0
T19 (Min)	-	0.5	14	0.5
T20 (Max)	-	1.5	25	1.0
T21 (Min)	0.15	0.5	14	0.5
T22 (Max)	0.25	1.5	25	1.0

SB = Sodium Benzoate, CA = Citric Acid, SC = Sodium Chloride, KMS = Potassium Metabisulfite.

CHEMICAL TREATMENTS

All samples were applied with four chemical additives including sodium benzoate (SB), Citric acid (CA), Sodium chloride (SC) and Potassium metabisulfite (KMS) as shown in Table 1.

The samples were kept in 200 ml tap water along with the above chemical additives and packed in plastic jars for further studies. All the 22 treatments were given specific marks of identification from T1 to T22. One control sample (T0) containing carrots along with tap water without any chemical additives was also kept for comparison.

Possible combinations of the above mentioned chemical additives were replicated three times with a storage interval of 40 days while study period extended up to 120 days. To keep the concentration of sodium benzoate, citric acid, sodium chloride and potassium metabisulfite constant in the brine, following formula [Bennett 1951] was applied and quantity of doses were calculated to avoid any complication:

$$x = \frac{A \cdot \ S}{100 - S}$$

x = Concentration of salt in pounds per hundred pounds of the vegetable.

A = Percentage of moisture in a specific vegetable.
S = Percentage of salt/chemical desired in the finished brine.

PHYSICO-CHEMICAL ANALYSIS

Chemical analyses were carried out after 0, 40, 80 and 120 days at an interval of 40 days. The first reading was taken after three days and was considered as zero day reading.

Acidity

Acidity of the brine was determined by method described by Ruck [1963].

The pH

The pH of the brine was estimated with the help of pH meter model HANNA b417.

Common Salt

Salt percentage in the brine was detected by salometer/brix hydrometer as described by Howard and Leonard [1982].

Absorbance

The absorbance of the brine filtrate [Fang *et al.* 1974] was measured at 560-580 nm with the help of Spectronic 20-D and interpreted as browning index [Mudahar and Bains 1982].

SENSORY EVALUATION

The samples of carrots were subjected to sensory evaluation after desalting and making into pickle according to the following formula [Nagi and Satinder 1978]:

Carrots (preserved)	1000g
Mustard oil	250g
Mustard seeds	100g
Common salt	100g
Capsicum powder	15 – 20 g
Aniseed	50g
Fenugreek seed	50g
Kalongi	50g

The pickle so prepared was offered for sensory evaluation for its quality criteria by a panel of semi-trained judges [Land and Shepherd 1988].

STATISTICAL ANALYSIS

The data obtained was subjected to statistical analysis [Faqir 1995].

RESULTS AND DISCUSSION

The results given in Table 2 show that an increase in acidity occurred gradually during the storage period. First reading was taken after three

days and was considered as zero day reading. The mean value for acidity in minimum dose level increased by 29% from 3.30 to 4.66 after 120 days of storage period. Minimum acidity recorded at zero day was 1.80 while maximum value was observed to be 6.14 at the end of storage period. Maximum mean acidity was observed in T11 (Sodium chloride and Potassium metablisulfite) while maximum mean acidity was exhibited by T5 (Sodium benzoate, Citric acid and Potassium metabisulfite).

Table 2: Data regarding acidity in minimum and maximum dose levels.

Treatments	0 day	40 days	80 days	120 days
T1	3.96	3.96	4.62	4.82
T2	3.96	4.09	4.73	4.92
T3	3.00	3.43	3.71	3.71
T4	3.07	3.71	3.77	3.84
T5	2.23	2.27	3.07	4.16
T6	2.43	2.94	3.20	4.22
T7	3.58	4.60	5.12	5.18
T8	3.84	4.86	5.24	5.50
T9	2.68	3.00	3.92	4.32
T10	3.20	3.45	4.60	4.48
T11	1.80	2.43	2.49	2.94
T12	2.0	2.49	2.68	3.20
T13	3.96	4.48	4.54	4.86
T14	4.22	4.60	4.92	5.12
T15	3.56	5.76	5.82	5.88
T16	5.88	5.95	6.01	6.08
T17	3.52	4.41	4.54	4.67
T18	3.71	4.48	4.84	4.86
T19	4.09	4.09	4.80	4.16
T20	4.35	4.35	4.60	4.73
T21	4.92	5.63	6.20	6.14
T22	5.84	5.95	6.27	6.52

The statistical analysis showed that the treatments were highly significant in influencing the acidity. In the maximum dose level the mean acidity increased by 24%. Minimum and maximum mean value for acidity was recorded in T11 and T22 at the end of storage period. The increase in percent acidity in the treatments during storage is attributed to chemical reactions, which occur during storage period [Iqbal 1993].

The pH of treatments decreased from 0-120 days gradually with an increase in acidity. In minimum dose level a 5.67 and in the maximum dose level a 2.4% decrease was observed. Minimum mean pH value was exhibited by T14 while T17 showed the maximum mean pH (Table 3).

In the maximum dose level, the lowest and the highest mean pH values were recorded in T8 and T14 respectively. A slight decrease in pH values has been reported in literature [Awan *et al.* 1994] for dehydrated carrots. The value for absorbance also showed a constant decrease. It is well known that highly colored solutions absorb more light. In the present study, the presence of salt and potassium metabisulfite have a bleaching effect and hence lowering the amount of light observed by the brine filtrate. Sodium chloride in the brine was taken up by the carrots, hence

exhibiting a decrease in the brine concentration. Minimum and maximum values for absorbance were exhibited in T15 and T2 respectively. In the minimum dose level 45.8% decrease in absorbance of brine occurred after 120 days of storage period. Statistical analysis showed that treatments were highly significant (Table 4).

Table 3: Data regarding pH, absorbance, sodium chloride and acidity in minimum and maximum doses.

Treatments	Treatment means of pH	Treatment means of absorbance	Treatment means of sodium chloride	Treatment means of acidity
T1	5.67c	0.253b	0.0a	4.336a
T2	5.87f	0.630b	0.0a	4.430a
T3	6.08e	0.265a	26.0b	3.472a
T4	5.90g	0.470b	52.0b	3.600a
T5	5.70d	0.253a	0.0a	2.935a
T6	5.48c	0.523b	0.0a	3.200a
T7	6.07e	0.160a	16.0b	4.625a
T8	6.15h	0.225a	30.5b	4.864a
T9	5.85d	0.075	0.0a	3.504a
T10	5.75e	0.060a	0.0a	3.824a
T11	5.95d	0.193a	20.5b	2.496a
T12	5.84f	0.245a	41.0b	2.640a
T13	5.51b	0.170a	12.0b	4.464a
T14	5.34a	0.143a	24.0b	4.720a
T15	5.36a	0.053a	0.0a	5.760b
T16	5.46b	0.057a	0.0a	5.974b
T17	6.11e	0.067a	20.0b	4.228a
T18	5.66d	0.237a	40.0b	4.474a
T19	5.78d	0.070a	23.9b	4.320a
T20	5.87f	0.080a	48.0b	4.412a
T21	5.97d	0.085a	23.0b	5.728b
T22	5.85f	0.103a	46.0b	6.000b

SENSORY EVALUATION

For sensory evaluation, the preserved carrots were made into pickle [Nagi and Satinder 1978]. Sample (T10) preserved with citric acid (1.5%) and potassium metabisulfite (1.0%) attained the highest score of 213 points from a panel of trained judges. In case of flavor evaluation, sample (T7) preserved with citric acid (0.5%) and sodium chloride (14%) got the highest score of 53 while sample (T2) preserved with sodium benzoate (0.25) and citric acid (1.5%) got the lowest score of 52, respectively. Regarding taste of pickle the sample T2 obtained the maximum score, while sample (T4) preserved with sodium benzoate (0.25%) and sodium chloride (25%) obtained minimum score of 40.

On the basis of overall sensory characteristics sample (T2) containing citric acid and potassium metabisulfite secured the highest points while sample T4 was ranked at the bottom.

CONCLUSION

From the results of present study, it was concluded that vegetables can be preserved with the help of chemical additives and their shelf life can considerably be extended. However, during present study sample number

T10 was ranked at the top which was preserved with citric acid (1.5%) and potassium metabisulfite (1%) in maximum doses and this sample was found fit for use even after 120 days of storage.

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