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Effect of chemical preservation on browning and keeping quality of fresh cut apple slices during cold storage

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Abstract : This experiment was carried out during 2013 and 2014 seasons to study the effect of ascorbic acid 2%, citric acid 2% and cysteine 0.5% on browning and keeping quality fresh cut of apple slices cv. 'Anna' during cold storage at 4°C. Weight loss, decay, titratable acidity, total soluble solids and total phenols content were determined. Results showed that slices were treated had lower significant of weight loss, decay and total soluble solids % while, titratable acidity % and total phenols contents decreased with prolonged cold storage periods in both seasons. Slices treated with ascorbic acid 2 % and citric acid 2 % recorded lowest weight loss and decay % while, total acidity % and phenols content were highest in compared with other treatments and control. No significant effect on total soluble solids % was observed in both seasons.

Key words: fresh cut, apples, ascorbic acid, citric acid and cysteine.

Introduction

In recent years, a rapid growth for fresh cut fruits and vegetables has been observed due to the consumers increased demand for convenience, fresh like quality and high nutritive value (Rico et al., [1]).fresh cut apple. In particular are desired as a convenience snack for catering services to salad – bars, schools, and company cafeterias (Saftnere etal,[2]). Mechanical damage during processing results in cellular delcolization of enzyme and their substrates, leading to biochemical deterioration such as enzymatic browning. Off – flavor and texture breakdown. Enzymatic browning is one of the most important reactions that occur in many fresh cut fruit and vegetables. This reaction, in which phenolic compounds are oxidized, is related to ppo activity, the amount of phenolic and the presence of oxygen (Koukounaras et al.,[3]). Antibrowning agents are compounds that act to prevent the browning reactions. such ascitic acid, ascorbic acid, oxalic acid and cysteine are retard enzymatic browning in fresh cut fruits, Weerayuth[4]. The aim of the present work was to study the effect of chemical preservation on browning and keeping quality of fresh cut apple slices during cold storage.

Materials and Methods

The present experiment was carried out during two successive seasons (2013and 2014) on fresh cut apple cv."Anna". The experimental mature apple fruits were harvested from private orchard to study the effect of chemical preservation on browning and keeping quality of fresh cut apple slices during cold storage. Fruits were sorted for size uniformity and absence of defects. Sound fruits (slices homogenized) were divided into four groups (each treatment content 20 slices). The first group were treated with ascorbic acid 2% ,the second group were treated citric acid 2%, the group third cysteine 0.5% and fourth group un treated (control). And stored all treatments at 4℃ and 90-95% relative humidity (RH). The changes in physical and chemical properties of slices were followed through the experimental period as follows:

Physical characteristics:

Weight loss%:

It was calculated according to the following equation:

Weight loss % = [(Initial weight – weight at sampling date) / Initial weight] x 100

4 slices were labeled in every replicate and initially weighed to calculate the slices weight loss percent during the cold storage in relation to its original weight.

Decay Percentage:

Incidence and external fruit appearance was estimated according to the following equation:

Decay % = (Number of decayed slices / Number of initial slices**)** x 100

Chemical properties

Soluble solids content (SSC):

The obtained juice was used to determine the percentage of soluble solids content (SSC) by the use of a hand refractometer according to Chen. and Mellenthin [5]

Titratable acidity (%):

Total acidity was determined by titrating 5 ml of the extracted juice against 0.1 N of NaOH using phenolphthalein indicator, titratable acidity was expressed as percentage of malic acid (g malic acid/100ml juice) according to (AOAC, [6]).

Total phenols content:

To determined phenolic compounds each parts frozen to -25c^0 before being ground up .For HPLC analysis , 10 g of ground up apples were homogenized for one minute with 70% aqueous methanol , the filtrate was stored at -18c^0 prior analysis. Samples of clear juices were diluted before injection. Before HPLC, all samples were diluted 1:3(v/v) with sodium acetate buffer (solvent A). HPLC was carried out using an Agilent 1100 series HPLC system .polyphenolics were separated with a guard column. The mobile phase consisted of 10.2% acitic acid in 2mM sodium acetate (solvent A) and acetonitrile (solvent B). The flow rate was kept constant at 0.5 ml/min for a total run time of 72min at 25℃. the injection volume was 25UL Jaroslaw and Witold [7] .

Statistical Analysis

The experimental design was RCBD with three replicates, and all the obtained data were statistically analyzed according to Snedecor and Cochran[8]. The individual comparisons were carried out by using the least significant difference (LSD) according to SAS [9].

Results

Physical properties:

Weight loss %:

Data in Table (1) showed that, the effect of ascorbic acid 2%,citiric acid 2% and cysteine 0.5% on weight loss percentage of fresh cut of apple slices 'Anna 'cv. during storage at 4℃ 2013 and 2014 seasons. Weight loss percentage was gradually increased toward the storage periods with significant differences among all storage period in both seasons of study. The weight loss attributed mainly to water loss from the fruit tissues and partially for the respiration. The later result agree with those reported by Farooq etal., [10] on apple.

Fresh cut of apple slices were treated with ascorbic acid 2% has recorded that the lowest weight loss % compared with all other treatments in both seasons by Eleni and Theodoros[11], reported the loss in moisture results in a reduction of fresh weight accompanied by the loss of freshness, appearance and texture .

Decay Percentage

Data in table (2) illustrated that the effect of ascorbic acid 2%,citiric acid 2% and cysteine 0.5% on decay percentage of fresh cut of apple slices 'Anna 'cv. during 2013 and 2014 seasons. Decay percentage was gradually increased toward the storage periods with significant differences among all storage period in both seasons of study Liu *et al.,* [12] on apricots and plums.

Fresh cut fruits of apple were treated with ascorbic acid and citric acid were lower decay % compared with all other treatments in both seasons this result agreed with Charles, et al, [13].

Chemical characteristics:

Soluble solids content (SSC %)**:**

Data in Table (3) cleared that soluble solid content (SSC %) of fruits gradually increasing with the advanced in cold storage Significant differences between the treatments were obtained during storage periods at the most cases in the two seasons. These results agreed with Dilawar *et al* [14] on persimmon.

Increasing in TSS % during storage might be associated with the transformation of pectic substances, starch, hemicelluloses or other polysaccharides in soluble sugar also with dehydration of fruits Nath et al., [15] on mandarin.

Fresh cut of apple fruits were treated ascorbic acid2%, citric acid2% and cysteine 0.5% had higher and no significant on TSS % in both seasons by Eleni and Theodoros[11].

reported an appreciable increase in fructose and glucose in fresh cut mango treated with antibrowning agents and stored at 10℃.

Titratable acidity%:

Data in Table (4) revealed that titratable acidity (TA%) decreased with the progress in storage periods. All treatments decreased TA% than the control, with significant differences between the treatments were obtained during storage periods at the most cases in the two seasons.

Decrease in TA percentage with advanced of storage periods which could be due to the increase of its consumption in respiration activities as an organic substrate. This result agreed with those reported by Wahba [16] on costata persimmon

Fresh cut of apple were treated with ascorbic acid 2% had higher acidity% in first season while in the second season fresh cut were treated by ascorbic acid 2% and citric acid 2% had higher acidity compared with all treatments. Were line in Siyuan , *et al* [17] reported that the decrease ph and increased TA% .citric acid is usually used as an acidity regulator to add an acidic or sour taste to foods and soft drinks.

Total phenols:

Data tabulated in table (5) reported that on Gallic acid mg/100g content decreased with the progress in storage periods. All treatments decreased total phenols mg/100g content than the control, with significant differences between the treatments were obtained during storage periods at the most cases in the two seasons. Francisco and Juan [18] on fruits reported that ethylene accumulation in pant tissue also promotes PPO and POD activity and decrease total phenols.

Fresh cut of apple were treated with ascorbic acid 2% were higher Gallic acid mg/100gcontent compared with all treatments were in line with Maria et al.,[19].

Table (1): The effect of chemical preservation on weight loss% and keeping quality of fresh cut apple slices during cold storage at $0c^0$ during 2013&2014 seasons.

Storage periods days 2013					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic 2%	0.00	7.1	11.93	17.77	9.20b
Citric acid 2%	0.00	8.78	10.60	14.23	8.40b
Cysteine 0.5%	0.00	8.08	11.52	15.44	8.76b
Control	0.00	9.83	13.76	18.66	10.56a
Means B	0.00d	8.65c	13.22b	18.30a	
Storage periods days 2014					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic 2%	0.00	6.76	11.77	17.64	9.04b
Citric acid2%	0.00	7.83	9.83	17.50	8.79b
Cysteine 0.5%	0.00	9.16	12.94	16.94	9.76b
Control	0.00	10.86	18.34	21.11	12.58a
Means B	0.00d	8.65c	13.22b	18.30a	

L.S.D2013, A= 0.888 B=0.938
L.S.D2014, A= 1.238 B=0.823

Table (2): The effect of chemical preservation on decay % and keeping quality of fresh cut apple slices during cold storage at $0c^0$ during 2013&2014 seasons

Storage periods days 2013					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic2%	0.00	1.00	2.30	3.66	1.75c
Citric acid 2%	0.00	0.66	1.66	2.66	1.25c
Cysteine 0.5%	0.00	2.66	3.66	5.00	2.83b
Control	0.00	2.33	4.33	7.00	3.41a
Means B	0.00	1.66c	3.00b	4.58a	
Storage periods days 2014					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic 2%	0.00	0.66	1.66	2.33	1.16c
Citric acid2%	0.00	1.00	2.00	3.33	1.58cb
Cysteine 0.5%	0.00	1.66	2.66	4.00	2.08b
Control	0.00	2.33	3.33	6.33	3.00a
Means B	0.00	1.4c	2.41b	4.00a	

L.S.D2013, A=0.55 B=0.506
L.S.D2014, A= 0.67 B= 0.546

Table (3): The effect of chemical preservation on titratable acidity % and keeping quality of fresh cut apple slices during cold storage at $0c^0$ during 2013&2014 seasons.

Storage periods days 2013					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic 2%	0.80	0.85	0.68	0.53	0.71a
Citric acid2 %	0.80	0.70	0.62	0.51	0.66b
Cysteine 0.5%	0.80	0.63	0.52	0.44	0.59c
Control	0.80	0.58	0.51	0.40	0.57c
Means B	0.80a	0.69 b	0.58c	0.47d	
Storage periods days 2014					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic2%	0.85	0.74	0.58	0.50	0.66a
Citric acid2%	0.85	0.67	0.53	0.51	0.64a
Cysteine 0.5%	0.85	0.61	0.49	0.43	0.59b
Control	0.85	0.69	0.56	0.43	0.53c
Means B	0.85a	0.67b	0.54c	0.46d	

L.S.D2013, A= 0.048 B=0.033
L.S.D2014, A= 0.027 B= 0.019

Table (4): The effect of chemical preservation on TSS % and keeping quality of fresh cut apple slices during cold storage at $0c^0$ during 2013&2014 seasons.

Storage periods days 2013					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic 2%	12.00	13.16	14.16	15.00	13.58a
Citric acid2%	12.00	13.6	14.16	15.00	13.58a
Cysteine 0.5%	12.00	13.33	14.33	14.38	13.62a
Control	12.00	12.83	13.50	14.66	13.25a
Means B	12.00d	13.12c	14.04b	14.87a	
Storage periods days 2014					
Treatments	**0**	**2**	**4**	**6**	**Means A**
Ascorbic 2%	13.00	13.50	14.66	16.66	14.45a
Citric acid2%	13.00	13.66	14.16	15.83	14.16a
Cysteine 0.5%	13.00	14.00	14.66	15.16	14.20a
Control	13.00	13.50	14.83	15.66	14.25a
Means B	13.00d	13.66c	14.58b	15.83a	

L.S.D2013, A= 0.564 B=0.30
L.S.D2014, A= 0.627 B= 0.31

Table (5): The effect of chemical preservation on total phenols mg/100g and keeping quality of fresh cut apple slices during cold storage at $0c^0$ during 2013&2014 seasons.

Storage periods days 2013					
Treatments	**0**	**2**	**4**	**6**	**Means**
Ascorbic 2%	55.20	51.16	28.40	5.91	35.16
Citric acid 2%	55.20	38.94	9.30	2.20	26.41
Cysteine 0.5%	55.20	26.20	18.50	3.82	25.93
Control	55.20	30.15	9.43	0.033	23.70
Means	55.20	36.61	16.41	2.99	
Storage periods days 2014					
Treatments	**0**	**2**	**4**	**6**	**Means**
Ascorbic2%	54.00	50.49	27.45	5.89	34.45
Citric acid 2%	54.00	39.78	17.23	2.54	28.38
Cysteine 0.5%	54.00	25.99	16.34	4.10	25.11
Control	54.00	31.14	10.00	0.035	23.79
Means	54.00	36.85	17.80	3.14	

References

1. Rico D,M,Diana,AB,Barat. And JM.Barry Ryan C.(2007).Extending and measuring the quality of fresh cut fruit and vegetables. Food science and technology 18:373-386
2. Saftner RA, A.R,Abbott,J.Bhabwat,AA,VinyardB.(2005).Quality measurement of intact and fresh cut slices of Fuji,apple slices by natural and Gold rush apples. Food science 70:317-324
3. Koukounaras A, Diamantidis G, Sfakiotkakis E (2008). The effect of heat treatment on quality retention of fresh cut peach. Postharvest biology and technology 48:30-36
4. Weerayuth S, S.Manurakchinakorn .(2010). Pontential application of ascorbic acid, citric acid and oxalic acid for browning inhibition in fresh cut fruits and vegetables.walailak j.sci.&tech. 7(1):5-14
5. Chen, P.M. and W.M. Mellenthin (1981). Effects of harvest date on ripening capacity and post-harvest Life of d'Anjou pears. J. Amer .Soc. Hort. Sci., 106 (1): 38– 42
6. A.O.A.C. (2005). Official Methods of Analysis. 18th ed. Association of Official Analysis Chemists. Washington, D.C., USA
7. Jaroslaw M.W.Plocharski (2006). Determination of phenolic compounds in apples and processed apple products. Journal of fruit and ornamental plant research vol 14. (suppl. 2)
8. Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods. 7th ed., 4th printing, the Iowa state Univ. Press Ames., Iowa U.S.A
9. SAS (1985). SAS uses'guide statistics for personal computers version 5th Ed. SAS Inst. Cary N Co.
10. Farooq,A.Rab,N.Khan and I.Iqbual.(2012).Physico-chemical quality of apple cv. Gala must fruits stored at low temperature. Fuuast j.biol.,2(1):103-107.
11. Eleni M. and T.Varzakas (2011). Effect of storage conditions on the sensory quality, color and texture of fresh –cut minimally processed cabbage with the addition of ascorbic acid, citric acid and calcium choloride . Food and Nutrition science 956-963
12. Liu, W.T., Chul C.L. and zhou T. (2002).Thymol and acetic acid vapors Reduce postharvest Brown Rot of Apricots and plums. Hort science vol 37 no (1) page 151- 156.
13. Charles.T.,J.Orchard .A.Beezer.J.Teetteh.(2007). enzymatic browning of apple cylinders using different solution. Journal of food science & technology 42(12) 1475-1481
14. Dilawar K.,A.R.Khan, S.B.S.Ali and I.A.Khalil 2007 . Storage stability of persimmon fruits (Diosyros Kaki) stored in different packaging materials. Journal of agricultural and biological science vol2. No 2
15. Nath.A.K.Barman.S.Chandra,P.Baiswar (2012).Effect of plant extracts on quality of Khasi mandarin (Citrus reticulate Blanco) fruits during ambient storage. Food and bioprocess technology vol.6,issue 2 pp 470-474
16. Wahba, M.M. (2007). Physiological studies on the response of 'Costata' persimmon trees to biofertilization. Ph. Thesis Fac.of Agric. Al-Azhar Univ.

17. Siyuan.W.T.Lin,Guowei.,Man,H.LiL.Zhao.J.Wu and X.Liao (2013). Effects of anti- browning combinations of ascorbic acid , citric acid ,nitrogen and carbon dioxide on the quality of banana smoothies . Food and bioprocess technology vol 7 no1 pp:161-173
18. Francisco A,T,B, Juan .C.E (2001).Phenolic compound and related enzymes as determinants of quality in fruits and vegetables. Journal of the science of food and agriculture. 81, no9 pp:853-876
19. Maria ,I.Gill.J.R.Gorny and A.A,Kader.(1998). Responses of 'Fuji' apple slices to ascorbic acid treatments and low oxygen atmospheres. Hortscience 33(2)-305-309

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