Effect of Minimal Processing and Decontamination on Apple Fruits to Maintain Quality and Prolong Shelf-Life

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ABSTRACT

This experiment was performed during 2009 seasons on (Anna) apple fruits. The fruits were obtained from farm near El-Sadat city .Fruits were harvested with similar size at its ripe stage , stored in a refrigerator for 6 hours at 4 C RH (90%-85%) as a precooling , and subdivided in to different 8 groups. One group was packed without washing or any treatment (control treatment). Another groups was washed two times and immersed in cold water at 4 C for 15 minutes and then left in one layer to drain in a refrigerator for 3-4 hours to remove the excessive water .Having drained, and simply packed in high density polyethylene (washing treatment) .The another six groups were treatet as the follows: Washed and treated with Chlorine solution conc. 50 ppm (C50) ,washed and treated with Chlorine solution conc. 100 ppm (C100) ,washed and treated with Chlorine solution conc. 150 ppm (C150) ,washed and treated with Lactic acid buffer system (LABS) solution 0.25% conc. (L0.25%) ,washed and treated with (LABS) solution 0.50% conc. (L0.50%) and washed and treated with (LABS) solution 1.00% conc. (L1.00%), the fruits were putting in fume dishes(1/4 K.G) and packed by Low density polyethylene stretch (LDPE) . Effect, of these treatments on the quality during storage at 4□ C were studies. The results indicated that, in all samples treated or not the total psychotropic aerobic bacteria count, Yeasts and molds count, Lactic acid bacteria count and Enterobactriaceae count were increased on storage time but with in the safe limits .Total soluble solids , total sugars and PH were increased, however the titratable acidity, ascorbic acid were decreased because of ripping .The best treatment was washing and treated with Chlorine solution conc. 50 ppm then 100 ppm then 150 ppm then washing and treated with (LABS) solution 0.50% conc.

Key words: Apple fruits ; minimal processing ; storage and quality.

INTRODUCTION

Apples (*Malus domestica Bork)* is considered to be one of the most important fruits in the word . The world production of apples reached about 56, 97 Million ton *(FAO,2010).*In Egypt the acreage of apples attained about 65, 110 Fed; which produced about 468, 269 ton. for all introduced oultivars, " Anna" apples was found to be the most important. Since the it has been spreading quickly in Egypt, specially in newly reclaimed areas because of the availability of its low chilling requirements and its good yield

and quality compared to locally grown cultivars one as recommended by*(Anon.2009)*.

Apple fruits, like most of other perishable fruits are containing a large amount of water which caused a number of physiological and pathological disorders, and consequently caused a reduction in storage and shelf life (Gemma, 2010).

The fresh produce is very important for public health but there are changes in life styles and major shifts in consumption trends. These changes have produced a demand for a wider range of products, and have led people to spend less time at home so they eat out more often. Such trends have been reflected in an increase in the popularity of salad bars and have prompted the appearance of minimally-processed convenience foods that are ready-to-eat. Among them, the consumption of fresh cut or minimally-processed fruit and vegetables has undergone a sharp increase. Sales of fresh-cut product continue to grow through consumers' increasing willingness to pay for prepared, ready-to-eat or ready to- use fresh produce *(Rico et al., 2007)*.

However, mechanical operations during minimal processing damages fruit tissues, which in turn limits the shelf-life of products. Much research is still to be done in order to develop safe fresh fruit products with high sensory quality and nutritional value. The development of new processing techniques for preserving fresh cut fruit needs to overcome some of the hurdles to successful commercial distribution of such products *(Gemma et al ., 2010)*.

Fresh produce can be a vehicle for the transmission of bacterial, parasitic and viral pathogens capable of causing human illness and a number of reports refer to raw vegetables harbouring potential foodborne pathogens. Listeria monocytogenes, Salmonella and Escherichia coli have been isolated from raw fruit and vegetables, which can become contaminated while growing or during harvesting, postharvest handling, or distribution. The incidence of foodborne outbreaks caused by contaminated fresh fruit and vegetables has increased in recent years *(Varela et al., 2007)*

A range of treatments have been applied to extend the shelf life of fresh-cut apples including use of natural browning inhibitors, salt and chemical treatments, coating agents and reduced oxygen atmospheres *(Pérez-Gago et al., 2006)* and antimicrobial reagents .

A key approach used to avoid browning and microbial contamination in apples has been the use of reducing agents, often with the addition of calcium chloride (CaCl2), in combination with packaging and low

temperature storage. *(Tortoe et al., 2007)* observed moderate browning on 'Golden Delicious' apple slices using ascorbic acid (AA, 0.5M with or without sodium chloride) stored at 4 ◦C up to 14d. *(Son et al., 2001)* also reported the effect of AA on browning of fresh-cut apples. Selected combinations of treatments have been shown to be effective in the prevention of browning of apple slices for up to eight weeks at 0.2 ◦C While flesh browning may be minimised during extended storage, other organoleptic factors such as texture and flavour may not be acceptable. An understanding of the physiology behind such changes and the development of mechanisms to prevent them is required to improve the shelf life of fresh-cut products. *(*Encarna Aguayo, *et al. 2010)*. The aim of this study was to investigate the effect of minimal processing and decontamination treatment on apple fruits to maintain its quality and prolong shelf-life.

MATERIALS AND METHODS

This study was carried out in one successive season of 2009, on (Anna) apple these fruits were harvested in the early morning from private farm near El-Sadat city. Hand-harvest fresh fruits (Anna) apple 100 Kg with uniform size and color were selected and stored in a refrigerator for 6 hours at 4±1□ C , RH 90% - 85% as precooling , then subdivided into different 8 groups . One group was packed without washing or any treatment and was considered as a control treatment. Another groups was washing and immersed two times in cold tap water at 4□ C for 15 minutes and then left in one layer to drain in a refrigerator for 3-4 hours in order to remove the excessive water .Having drained, and simply packed in high density polyethylene this group consider the washing treatment .the another six groups were treatment as washed and treated with Chlorine solution (Calcium hypochlorite) concentration (50 ppm,100 ppm and150 ppm) .Others washed and treated with Lactic acid buffer system (LABS) solution(food grade add to cool water in 4□C and adjusted with sodium hydroxide to pH 3to make 0.25% conc. solution,0.50% conc. solution and 1.00% conc. Solution). All dipping treatments were at 4□ C for 4 minutes and then left in one layer to drain in a refrigerator for 3-4 hours in order to remove the excessive water .Having drained, the fruits were putting in fume dishes(1/4 K.G) and packed by Low density polyethylene stretch (LDPE) . Then study the effect of these treatments on fruits quality during storage at 4□ C.

Quality attributes evaluation:

1 .Sensory evaluation of color, taste and texture.

The Sensory evaluation was used to evaluate quality of the fruits .The end of shelf-life was reached when the average value of the samples was judged as an unacceptable for consumption by the sensory panel. Sensorial quality was evaluated by a10-member to score quality attributes of fruits prior to the other tests. Samples were scored for overall visual quality by using an interval hedonic scale, where the extremes and center of the interval were represented as follows: zero dislike extremely, no characteristic of the product, 5nither like nor dislike, limit of acceptance from the consumer's point of view, and 9 like extremely, very characteristic of the product. The attributes such as texture, taste and color were evaluated. According to (Allende et al. , 2007).

2 .Microbiological analysis:

All untreated (control) and treated samples which sensorially accepted were subjected to microbiological analyses during the storage time starting at zero day at interval of storage time of apple fruits. Ten gram of fruits were taken and mixed with 90 ml of sterile physiological saline (8.5 g sodium chloride in 1 litter of distilled water). Several dilutions were prepared to be used for counting total psychotrophic aerobic bacteria by using plat count agar (PCA Oxoid C.M. 325) and incubated for 48 h at 37 C (Van der Steen et al., 2002), total yeasts and molds by using Rose Bengal Chloramphenicol agar (Oxoid C.M. 549) with supplement Chloramphenicol antibiotic (Oxoid S.R. 78) and incubated for 48-72 h at 30 C (Allende et al., 2007), total lactic acid bacteria by using MRS agar medium (bio-life C.M. 361) and incubated for 48 h at 37 C (Allende et al., 2007), total Enterobacteriaceae count by using Violet Red Bile Glucose agar (VRBG Oxoid C.M. 485) and incubated for 24 h at 37 C. (Van der Steen et al., 2002). Microbial counts were expressed as log CFU/g sample.

3 .Chemical analysis:

Determination of Total titratable acidity (TTA%) Titratable acidity as malice acid for (Anna) apple, malice acid for (Florida) peach and tartaric acid for (Flame seedless) grapes was determined according to the method of (Spayd and Morris , 1981) as the following: fruits was cut into small pieces and homogenized in a blender. Fruits (10 g) was diluted to 100 ml with distilled water and then filtered. 10 ml of the extract were titrated with 0.1 NaOH in the presence of phenol phthaline as indicator.

Determination of pH meter (model #59003-25, Chicago, USA)that had Filtrate was assessed using a pH 4 and 7 (A.O.A.C, 1995).

Determination of Total soluble solids (T.S.S.%) Three replicates from each treatment were wrapped each in cheese cloth and squeezed with a-hand press and one drop from collected juice was analyzed for determination of total soluble solids(TSS%) using refractometer (ATAGO N1 Brix 0-32%, made in jaban) (A.O.A.C 1995).Average of the three reading was recorded.

Determination of total sugars: A sample of 10 gram was extracted with water in the presence of calcium carbonate to prevent inversion. The extraction was undertaken in water bath at 100 c for 30 min . the extract clarified with lead acetate and finally deleaded by potassium oxalate prior to completion to known volume (250 ml)in a volumetric flask. According to the method of (Plummer, 1978). Total sugars were determined by phenol – sulphoric acid method (A.O.A.C., 1995). In this method aqueous of carbohydrates is pipette into a small tube. A blank of water also is prepared. A solution of phenol is added and the contents are mixed. Concentrated sulfuric acid is added rapidly to the tube and the contents are mixed. The intense yellow – orange color result is measured at 490 nm with a spectrophotometer (Model # 2380, Perking Elmer, England) and total sugars present were calculated by comparison with standard curve.

Determination of ascorbic acid: Ascorbic acid was determined according to (Ozden and Bayindirli, 2002). ascorbic acid was extracted from 10 grams of fruit which blended with 1% oxalic acid and then completed to 100 ml in a blender. The extract was filtered through filter paper. A volume of 5 ml was titrated with 2, 6 dichlorophenol indophenols solution. The results were calculated as mg ascorbic acid /100 g sample. A standard ascorbic acid titrated with the dye as a blank.

4 .Statistical analysis:

Split plot design with three replications according to (Gomez and Gomez, 1984) using SAS(Statistical Analysis Systems) software Ver. 9.0, 2000.

RESULTS AND DISCUSSION

Sensory evaluation of color, taste and texture.

Color, taste and texture visual defects determined the sensorial shelf-life. both microbiological and physiological processes will have an effect on the quality evaluation of fruits such as color, taste and texture therefore treatment with (C50), (C100), (C150), (L0.25%), (L0.50%) and (L1.00%)

will affect positively on the color, taste and texture as it will reduce the microbiological load on fruits. The changing of color, taste and texture can be explained by faster rate of ripening processes due to a higher respiration rate caused by the occurrence of more damaged spots on late – season fruits. These damaged spots also provide more optimal conditions for mould growth. Color, taste and texture change during ripening of fruits is associated with decreasing brightness and increasing redness intensity. Color, taste and texture changes were affected by treatments and storage time. Table (1) show the effect of all treatments on color, taste and texture of apples stored at 4°C.

The data revealed that, the color, taste and texture of control sample was acceptable at day 35 where its changed and become unacceptable at day 50 . Meanwhile color, taste and texture of washed two times with cold tap water 4□ C sample (W) was accepted up to day 95.That could be due to washing process which reduced the contaminate material. As well as the color, taste and texture of (C50), (C100) and (C150) samples was prolonged the accepted period to 120 days. This may due to the effect of Chlorine solution as antimicrobial agent which dramatically reduced the microbial load. (L0.25%) and (L0.50%) sample was accepted to 95 days. However the (L1.00%) sample was accepted just only to 80 Days. This may due to the effect of lactic acid buffer system (LABS) solution 1.00% conc. which fast rate of ripening process . These results are in good agreement with data presented by (Walking-*Ribeiro*, 2010). who stated that, the color, taste and texture changes were affected by treatments and storage time. At the same time the data represented a significant difference between the means of the sampling dates in all stages in apples. Meanwhile the data represented a significant difference between the means of the all treatment in deferent stages of storage time.

Microbiological evaluation: total psychotropic aerobic bacteria, Yeasts and molds, Lactic acid bacteria and Enterobactriaceae bacteria.

Total bacterial count, total yeasts and molds count and total lactic acid bacteria count of any food products is correlated directly with the sanitary condition of processing, handing and storage conditions. Also the assessment of Enterobacteriaceae commonly forms part of the microbiological quality monitoring of food processed for safety, and their presence in numbers of CFU exceeding carefully established levels is traditionally related to hygiene and safety. Table (2) shows the changes in

total psychotrophic aerobic bacteria count (TBC), total yeasts and molds count (TYMC) , total lactic acid bacteria count (TLABC) and total Enterobacteriaceae count (TEC) of all treatments on apples stored at 4°C .
The initial number of (TBC) was 2.37 Log 10 CFU/g and (TLABC) was 2.55 Log 10 CFU/g on fresh apples (day zero) .A reduction of 1.98, 1.26, 1.1, 1.2, 1.51, 1.47 and 1.26 Log 10 CFU/g (TBC) units and of 1.96, 1.21, 1.09, 1.08, 1.72, 1.68 and 1.67 Log 10 CFU/g units were obtained by treatment with (W) , (C50), (C100) , (C150) , (L0.25%) , (L0.50%) and (L1.00%) respectively .It seems that (TBC) and (TLABC) of apples were sensitive to lactic acid buffer system and more sensitive to chlorine solution and the apples witch washed two times with cold tap water 4□ C was effected too.
At day 35(end day) of the untreated sample the Log 10 CFU/g of (TBC) and (TLABC) was 2.84 and 2.89 respectively, however, the end day of the treatments of (W) , (C50), (C100) , (C150) , (L0.25%) , (L0.50%) and (L1.00%) was 2.48, 1.85, 1.80, 1.87, 2.40, 2.53 and 2.51 Log 10 CFU/g for the (TBC) respectively, it was 2.40, 1.81, 1.77, 1.79, 2.38, 2.57 and 2.56 Log 10 CFU/g for the (TLABC) respectively.
Such reduction would enhance safety of apples fruits .At day 35 in stage 1 Log 10 CFU/g of (TBC) and (TLABC) untreated was significantly lower ($P < 0.05$) than apples treated with (W) ,than apples treated with (C50), (C100) and (C150) and than apples treated with (L0.25%) , (L0.50%) and (L1.00%) . The Log 10 CFU/g of (TBC) and (TLABC) of treatment apples was not significant on day 50 and day 65 In stage 2 or the day 90 and 95 in stage 3 but it was significant with day 80 In stage 2 and between the day 105,115 and 120 in stage 4 also it was significant between treatment with (C50), (C100) and (C150) in this stage .This can only be explained by that different concentration have a different effect . It is clear that after 80, 95 and 120 days storage at 4□ C the Log 10 CFU/g number of (TBC) and (TLABC) of treatment apples with (L1.00%) , (L0.25%) ,(W) (L0.50%) , (C50), (C100) and (C150) respectively was still similar to the initial number . That could be due to the antimicrobial activity of lactic acid buffer system , chlorine solution and washed with cold water at 4□ C and synergistic effect between treatments and packaging in high density polyethylene. This result in agreement with (Walking-Ribeiro,2010) who found this too.
There was no growth of Enterobacteriaceae and yeasts and molds were detected for all samples , except for control and washing samples , the developed of (TYMC) and (TEC) at day zero was 0.0 and 0.33 Log 10 CFU/g for control and washing samples respectively, the (TEC) was 1.46 and 0.77 Log 10 CFU/g and the (TYMC) was 1.08 and 0.0 Log 10 CFU/g

for control and washing samples on day 35 respectively, however, the end day of the treatments of (W) , (C50), (C100) , (C150) , (L0.25%) , (L0.50%) and (L1.00%) was 1.57, 1.27, 1.29, 1.33, 0.33, 1.38 and 1.36 Log 10 CFU/g for the (TEC) respectively, it was 1.73, 1.42, 1.27, 1.26, 1.31, 1.31 and 1.46 Log 10 CFU/g for the (TYMC) respectively. These results are in good agreement with data presented by (Gemma, 2010) who stated that too.

The growth of Enterobacteriaceae and yeasts and molds were clear in the end day of any treatments At the same time the data represented a significant difference between the means of the sampling dates in all stages in apples. Meanwhile the data represented a significant difference between the means of the all treatment in deferent stages in apples.

3.Chemical composition.

Chemical composition of fruits represented an important role on the quality parameters and shelf-life of fresh fruits. Total soluble solids , total sugars, PH, titratable acidity, ascorbic acid were determined for all treated and untreated samples of fruits during the storage period at 4C.

Total soluble solids.(T.S.S), Total titratable acidity and PH-value.

Table (3) show the effect of all treatments on total soluble solids.(T.S.S), total titratable acidity and PH-value of apples , stored at 4°C .The data revealed that, the effect of all treatments on zero time was between 10.77% to 10.70% for the total soluble solids.(T.S.S) , between 0.66% to 0.62% for the total titratable acidity and between 3.7 to 3.57 for PH-value of apples. The control sample was 13.63%,0.38% and 3.98 at day 35 for the total soluble solids.(T.S.S), total titratable acidity and PH-value of apples where its changed respectively. Meanwhile that changed on washing water sample (W) to be 13.9%, 0.26% and 4.13 respectively up to day 95.That could be due to washing process which reduced the contaminate material. As well as the total soluble solids.(T.S.S), total titratable acidity and PH-value of (C50), (C100) and (C150) samples was prolonged the accepted period to 120 days to be from 14.08%13.91% for total soluble solids.(T.S.S), from 0.26% to 0.29% for total titratable acidity and from 4.27 to 4.28 for PH-value. This may due to the effect of chlorine solution as antimicrobial agent which dramatically reduced the microbial load. (L0.50%) sample was accepted to 95 days and the total soluble solids.(T.S.S), total titratable acidity and PH-value was 13.65%, 0.36% and 4.11 respectively . However the (L0.25%) and (L1.00%) sample was accepted just only to 80 Days. This may due to the effect of lactic acid buffer system (LABS) solution 1.00% conc. which fast rate of ripening

process and low conc. (L0.25%) was not effect very will and the total soluble solids (T.S.S), total titratable acidity and PH-value was 13.65%, 0.39% and 4.13 for (L1.00%) samples respectively and was 12.93%, 0.37% and 4.02 for (L0.25%) samples respectively. These results are in good agreement with data presented by (Encarna Aguayo, *et al. 2010)* who stated that, total soluble solids.(T.S.S), total titratable acidity and PH-value changes were affected by treatments and storage time. At the same time the data represented a significant difference between the means of the sampling dates in all stages in apples. Meanwhile the data represented a significant difference between the means of the all treatment in deferent stages in apples.

Total sugars content and ascorbic acid content.

Table (4) show the effect of all treatments on total sugars content and ascorbic acid content which has been considered an important notional component in fruits of apples stored at 4C .The data revealed that, the effect of all treatments on zero time was between 5.38% to 5.64% for the total sugars content and between 15.96 to 16.01 (mg/100g) for ascorbic acid content of apples. The control sample was 7.75% and 15.65 (mg/100g) at day 35 where its changed for the total sugars content and ascorbic acid content of apples respectively. Meanwhile that changed on washing water sample (W) to 8.02% and 15.28 (mg/100g) respectively up to day 95.That could be due to washing process which reduced the contaminate material. As well as the total sugars content and ascorbic acid content of (C50), (C100) and (C150) samples was prolonged the accepted period to 120 days to be from 8.25% to8.33% for total sugars content and from 15.01 to15.10 (mg/100g) for ascorbic acid content. This may due to the effect of Chlorine solution as antimicrobial agent which dramatically reduced the microbial load. (L0.50%) sample was accepted to 95 days. total sugars content and ascorbic acid content was 8.00% and 15.12 (mg/100g) respectively. However the (L0.25%) and (L1.00%) sample was accepted just only to 80 days and the total sugars content and ascorbic acid content was 7.8% and 15.39 (mg/100g) for (L0.25%) respectively. and was 8.04% and 14.91 (mg/100g) for (L1.00%) respectively. This may due to the effect of lactic acid buffer system (LABS) solution 1.00% conc. which fast rate of ripening process and low conc. (L0.25%) was not effect very will . These results are in good agreement with data presented by (Gemma, 2010) who stated that, total sugars content and ascorbic acid content changes were affected by treatments and storage time. At the same time the data represented a significant difference between the means of the sampling dates in all stages in apples. Meanwhile the data

represented a significant difference between the means of the all treatment in deferent stages in apples.

CONCLUSION

(Anna) apple fruits were harvested at its ripe stage then having precooling then having washing and dipping treatment and packed by (LDPE) then stored in a refrigerator at 4° C, RH (90%-85%) that was help us to maintain quality and prolong shelf-life .And it could be recommended that the best treatment was washing and treated with Chlorine solution conc. 50 ppm then 100 ppm then 150 ppm then washing and treated with (LABS) solution 0.50% conc.

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Table (1). Means of sensory score values of apple fruits as influenced by washing with cold water, chlorine solution and lactic acid buffer system during storage at 4° C.

Treatment	storage time	Stage 1				Stage 2				Stage 3			Stage 4			
		0	15	35	Mean	50	65	80	Mean	90	95	Mean	105	115	120	Mean
Control	Taste	8.41	7.75	5.92	7.36 c	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Color	8.76	8.46	7.18	8.14 c	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Texture	8.66	8.06	6.18	7.63 e	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Washing	Taste	8.63	8.73	8.1	8.48 a	7.83	6.95	6.18	6.33 f	5.57	5.27	5.42 d	n.d	n.d	n.d	n.d
	Color	8.94	8.85	8.69	8.83 a	8.87	8.25	7.89	8.24 b	7.69	7.5	7.60 d	n.d	n.d	n.d	n.d
	Texture	8.74	8.6	8.53	8.63 abc	8.42	8.08	7.3	7.93 a	6.63	5.57	6.10 c	n.d	n.d	n.d	n.d
C50	Taste	8.46	8.75	8.24	8.48 a	7.8	7.47	7.05	7.44 b	6.54	6.5	6.52 b	6.64	6.24	5.86	6.21 a
	Color	8.83	8.71	8.56	8.70 b	8.44	8.18	8.19	8.27 b	8.01	7.88	7.95 b	7.65	7.47	7.36	7.49 b
	Texture	8.86	8.7	8.53	8.69 ab	8.31	7.89	7.65	7.95 a	6.8	6.68	6.74 b	6.64	6.33	6.2	6.39 b
C100	Taste	8.39	8.74	8.51	8.55 a	7.89	7.43	7.13	7.49 b	6.89	6.53	6.71 a	6.39	6.23	5.82	6.15 b
	Color	8.85	8.78	8.71	8.78 ab	8.67	8.59	8.41	8.56 a	8.14	7.97	8.06 a	7.89	7.6	7.4	7.63 a
	Texture	8.91	8.78	8.62	8.77 a	8.3	7.93	7.71	7.98 a	7.42	7.11	7.27 a	6.73	6.54	6.37	6.55 a
C150	Taste	8.17	8.78	8.66	8.54 a	8.27	7.63	7.26	7.72 a	6.77	6.45	6.61 b	5.95	5.66	5.28	5.63 c
	Color	8.86	8.75	8.66	8.76 ab	8.42	8.21	8.12	8.25 b	8	7.85	7.93 b	7.77	7.49	7.35	7.54 b
	Texture	8.82	8.72	8.65	8.73 a	8.16	7.82	7.59	7.86 a	7.16	6.72	6.94 b	6.43	6.26	6.16	6.28 c
L 0.25%	Taste	8.52	8.7	8.3	8.51 a	7.77	7.15	6.48	7.13 d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Color	8.85	8.79	8.64	8.76 ab	8.49	8.21	7.84	8.18 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Texture	8.83	8.54	8.19	8.52 c	7.73	7.14	6.45	7.11 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
L 0.50%	Taste	8.44	8.72	8.51	8.56 a	8.12	7.3	6.48	7.30 c	6.06	5.84	5.95 c	n.d	n.d	n.d	n.d
	Color	8.84	8.79	8.68	8.78 ab	8.6	8.33	7.87	8.27 b	7.7	7.6	7.65 c	n.d	n.d	n.d	n.d
	Texture	8.81	8.61	8.18	8.53 bc	7.74	7.12	6.45	7.10 b	5.83	5.63	5.73 d	n.d	n.d	n.d	n.d
L 1.0%	Taste	8.34	8.43	7.85	8.14 b	6.94	6.35	5.71	6.33 f	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Color	8.82	8.71	8.52	8.69 b	7.92	6.82	5.59	6.78 c	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Texture	8.74	8.22	7.58	8.18 d	7.03	6.7	5.48	6.40 c	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Means	Taste	8.42 a	8.66 a	7.99 a		7.80 a	7.18 b	6.61 c		6.37 a	6.12 b		6.29 a	6.04 b	5.65 c	
	Color	8.84 a	8.73 b	8.45 c		8.44 a	8.08 b	7.70 c		7.91 a	7.76 b		7.77 a	7.52 b	7.37 c	
	Texture	8.79 a	8.53 b	8.06 c		7.95 a	7.5 b	6.95 c		6.77 a	6.34 b		6.60 a	6.38 b	6.24 c	
LSD (a*b)	Taste			0.24				0.11			0.09				0.06	
	Color			0.1				0.14			0.02				0.06	
	Texture			0.16				0.15			0.26				0.03	

Values with the same letters in the same horizontal row or vertical column are not significantly different (P ≤ 0.05).

n.d = not determined because of spoilage.

(Control) = Selected and simply packed in high density polyethylene

(Washing) = Washed two times with cold tap water 4 C and simply packed in high density polyethylene

(C50) = Washed and treated with Chlorine solution conc. 50 ppm and simply packed in high density polyethylene

(C100) = Washed and treated with Chlorine solution conc. 100 ppm and simply packed in high density polyethylene

(C150) = Washed and treated with Chlorine solution conc. 150 ppm and simply packed in high density polyethylene

(L0.25%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.25% conc. and simply packed in high density polyethylene

(L0.50%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.50% conc. and simply packed in high density polyethylene

(L1.00%) = Washed and treated with Lactic acid buffer system (LABS) solution 1.00% conc. and simply packed in high density polyethylene

Table (2). Effects of washing with cold water, chlorine solution and lactic acid buffer system on total count of psychotropic aerobic bacteria, Enterobactriaceae, lactic acid bacteria and yeasts and molds growth

Treatment	storage time	Stage 1				Stage 2				Stage 3			Stage 4			
		0	15	35	Mean	50	65	80	Mean	90	95	Mean	105	115	120	Mean
Control	PCA	2.37	2.53	2.84	2.62 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Entero	0.33	0.43	1.46	0.74 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	LAB	2.56	2.69	2.89	2.71 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Y&M	0	0	1.08	0.36 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Washing	PCA	1.98	1.81	1.85	1.91 b	2.06	2.11	2.25	2.14 c	2.35	2.48	2.42 b	n.d	n.d	n.d	n.d
	Entero	0.33	0.33	0.77	0.48 a	0.92	0.77	0.92	0.87 b	1.66	1.57	1.66 a	n.d	n.d	n.d	n.d
	LAB	1.96	1.76	1.86	1.86 c	1.97	2.06	2.15	2.06 d	2.25	2.4	2.32 b	n.d	n.d	n.d	n.d
	Y&M	0	0	0	0.0 b	0	1.02	1.33	0.78 b	1.51	1.73	1.62 a	n.d	n.d	n.d	n.d
C50	PCA	1.26	1.1	1.37	1.24 e	1.41	1.38	1.64	1.44 d	1.58	1.62	1.60 c	1.68	1.76	1.85	1.77 b
	Entero	0	0	0	0.0 b	0	0	0	0.0 c	0	0	0.0 c	1	1.21	1.27	1.16 b
	LAB	1.21	1.03	1.24	1.16 f	1.31	1.27	1.45	1.34 e	1.5	1.66	1.64 a	1.8	1.71	1.81	1.70 a
	Y&M	0	0	0	0.0 b	0	0	0	0.0 c	0	0	0.0 c	0.88	1.18	1.42	1.16 a
C100	PCA	1.1	1.1	1.35	1.18 e	1.44	1.41	1.64	1.49 d	1.56	1.61	1.59 c	1.66	1.76	1.8	1.75 c
	Entero	0	0	0	0.0 b	0	0	0	0.0 c	0	0	0.0 c	1	1.21	1.29	1.17 b
	LAB	1.09	1.02	1.21	1.10 g	1.28	1.24	1.42	1.31 f	1.48	1.65	1.52 d	1.58	1.68	1.77	1.68 b
	Y&M	0	0	0	0.0 b	0	0	0	0.0 c	0	0	0.0 c	0	1.11	1.27	0.79 b
C150	PCA	1.2	1	1.31	1.17 e	1.47	1.42	1.63	1.47 d	1.58	1.63	1.61 c	1.71	1.77	1.87	1.78 a
	Entero	0	0	0	0.0 b	0	0	0	0.0 c	0	0.67	0.33 b	1.13	1.25	1.33	1.24 a
	LAB	1.08	1	1.21	1.09 g	1.25	1.23	1.38	1.29 g	1.44	1.54	1.49 e	1.57	1.68	1.79	1.68 b
	Y&M	0	0	0	0.0 b	0	0	0	0.0 c	0	0	0.0 c	0	1.08	1.26	0.78 b
L 0.25%	PCA	1.51	1.69	2	1.73 c	2.07	2.26	2.4	2.24 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Entero	0	0	0	0.0 b	0	0	0.33	0.11 c	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	LAB	1.72	1.58	2.03	1.81 d	2.18	2.26	2.38	2.28 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Y&M	0	0	0	0.0 b	0	1.12	1.31	0.81 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
L 0.50%	PCA	1.47	1.62	1.92	1.67 dc	2.04	2.13	2.37	2.18 c	2.49	2.53	2.51 a	n.d	n.d	n.d	n.d
	Entero	0	0	0	0.0 b	1.2	1.32	1.37	1.29 e	1.42	1.38	1.40 a	n.d	n.d	n.d	n.d
	LAB	1.68	1.67	1.97	1.77 e	2.07	2.21	2.36	2.21 c	2.48	2.87	2.63 a	n.d	n.d	n.d	n.d
	Y&M	0	0	0	0.0 b	0	0	0	0.0 c	1.14	1.31	1.23 b	n.d	n.d	n.d	n.d
L 1.0%	PCA	1.26	1.42	2.02	1.57 d	2.22	2.38	2.51	2.37 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Entero	0	0	0	0.0 b	0	0.92	1.38	0.76 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	LAB	1.67	1.64	2.07	2.09 b	2.18	2.26	2.48	2.32 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Y&M	0	0	0	0.0 b	0	1.24	1.46	0.9 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Means	PCA	1.62 b	1.68 b	1.84 a		1.81 b	1.97 b	2.02 a		1.91 a	1.97 a		1.69 c	1.76 b	1.84 a	
	Entero	0.083 a	0.096 a	0.28a		0.30 b	0.43 ab	0.57 a		0.60 a	0.72 a		1.04 c	1.22 b	1.30 a	
	LAB	1.62 b	1.56 c	1.92 a		1.74 c	1.79 b	1.94 a		1.83 b	1.93 a		1.68 c	1.69 b	1.79 a	
	Y&M	0.0 b	0.0 b	0.13 a		0.0 c	0.48 b	0.59 a		0.83 b	0.61 a		0.28 c	1.13 b	1.32 a	
LSD (a*b)	PCA	0.11				0.63				0.03			0.01			
	Entero	0.26				0.36				0.26			0.02			
	LAB	0.01				0.02				0.02			0.01			
	Y&M	0.25				0.24				0.21			0.02			

Values with the same letters in the same horizontal row or vertical column are not significantly different (P ≤ 0.05).
(PCA) = total count of psychotropic aerobic bacteria, (Entero) = total count of Enterobactriaceae, (LAB) total count of lactic acid bacteria ,(Y&M) = total count of yeasts and molds and (n.d)= not determined
(Control) = Selected and simply packed in high density polyethylene
(Washing) = Washed two times with cold tap water 4 C and simply packed in high density polyethylene
(C50) = Washed and treated with Chlorine solution conc. 50 ppm and simply packed in high density polyethylene
(C100) = Washed and treated with Chlorine solution conc. 100 ppm and simply packed in high density polyethylene
(C150) = Washed and treated with Chlorine solution conc. 150 ppm and simply packed in high density polyethylene
(L0.25%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.25% conc. and simply packed in high density polyethylene
(L0.50%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.50% conc. and simply packed in high density polyethylene
(L1.00%) = Washed and treated with Lactic acid buffer system (LABS) solution 1.00% conc. and simply packed in high density polyethylene

Table (3). Effects of washing with cold water, chlorine solution and lactic acid buffer system on % of total soluble solids (%TSS), % titratable acidity (as malice acid) and

Treatment	storage time	Stage 1				Stage 2				Stage 3			Stage 4			
		0	15	35	Mean	50	65	80	Mean	90	95	Mean	105	115	120	Mean
Control	TSS.	10.77	12.16	13.63	12.19 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Acidity	0.623	0.523	0.383	0.510 d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	PH	3.64	3.94	4.37	3.98 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Washing	TSS.	10.73	11.03	11.38	11.05 b	11.86	12.45	12.97	12.42 b	13.68	13.9	13.79 a	n.d	n.d	n.d	n.d
	Acidity	0.633	0.566	0.49	0.563 c	0.427	0.393	0.34	0.387 d	0.29	0.263	0.277 c	n.d	n.d	n.d	n.d
	PH	3.57	3.71	3.79	3.69 b	3.85	3.9	3.98	3.91 c	4.12	4.13	4.12 a	n.d	n.d	n.d	n.d
C50	TSS.	10.78	11.17	11.48	11.14 b	11.92	12.39	12.88	12.39 bc	13.45	13.73	13.59 b	13.81	14.13	14.31	14.08 ab
	Acidity	0.656	0.613	0.576	0.615 ab	0.487	0.427	0.376	0.430 bc	0.353	0.347	0.35 b	0.32	0.28	0.26	0.287 a
	PH	3.63	3.7	3.75	3.69 b	3.81	3.84	3.92	3.86 d	4	4.07	4.03 b	4.22	4.26	4.28	4.25 a
C100	TSS.	10.65	11.08	11.51	11.08 b	11.75	12.03	12.51	12.09 d	13.08	13.24	13.16 c	13.5	13.95	14.29	13.91 b
	Acidity	0.643	0.613	0.566	0.604 abc	0.513	0.423	0.357	0.431 bc	0.36	0.323	0.337 b	0.303	0.277	0.257	0.279 a
	PH	3.67	3.71	3.77	3.72 b	3.81	3.84	3.92	3.86 d	4	4.07	4.04 b	4.17	4.21	4.27	4.22 a
C150	TSS.	10.73	11.2	11.53	11.16 b	11.87	12.36	12.91	12.38 bc	13.42	13.64	13.53 b	13.72	14.15	14.42	14.09 a
	Acidity	0.646	0.62	0.586	0.618 a	0.57	0.483	0.41	0.488 a	0.35	0.32	0.335 b	0.28	0.26	0.23	0.257 b
	PH	3.7	3.8	3.82	3.78 b	3.83	3.87	3.93	3.88 cd	3.97	4	3.99 b	4.13	4.25	4.27	4.22 a
L 0.25%	TSS.	10.72	11.1	11.42	11.08 b	11.78	12.34	12.93	12.35 bc	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Acidity	0.633	0.56	0.5	0.564 c	0.463	0.407	0.367	0.412 cd	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	PH	3.62	3.75	3.83	3.74 b	3.88	3.96	4.02	3.96 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
L 0.50%	TSS.	10.7	11.06	11.34	11.03 b	11.74	12.27	12.83	12.28 c	13.48	13.65	13.56 b	n.d	n.d	n.d	n.d
	Acidity	0.643	0.603	0.546	0.598 abc	0.5	0.453	0.413	0.456 ab	0.39	0.363	0.377 a	n.d	n.d	n.d	n.d
	PH	3.66	3.75	3.83	3.74 b	3.89	3.96	4.03	3.97 b	4.09	4.11	4.10 a	n.d	n.d	n.d	n.d
L 1.0%	TSS.	10.76	11.3	12.03	11.36 b	12.57	13.01	13.65	13.07 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	Acidity	0.656	0.626	0.573	0.619 a	0.563	0.503	0.393	0.487 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	PH	3.66	3.77	3.87	3.76 b	3.92	4.04	4.13	4.03 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Mean	TSS.	10.37 c	11.27 b	11.79 a		11.93 c	12.41 b	12.95 a		13.42 b	13.63 a		13.68 c	14.08 b	14.34 a	
	Acidity	0.64 a	0.58 b	0.53 c		0.503 a	0.441 b	0.38 c		0.347 a	0.323 b		0.301 a	0.272 b	0.249 c	
	PH	3.64 c	3.77 b	3.88 a		3.86 c	3.92 b	4.0 a		4.04 b	4.08 a		4.17 b	4.24 a	4.27 a	
LSD (a*b)	TSS.		0.67				0.13				0.1			0.17		
	Acidity		0.06				0.02				0.02			0.01		
	PH		0.18				0.04				0.06			0.06		

Values with the samesletters in the same horizontal row or vertical column are not significantly different (P ≤ 0.05).

TSS. = % total soluble solids , Acidity = % titratable acidity (as malice acid) , pH = pH value and (n.d) = not determined because of spoilage.

(Control) = Selected and simply packed in high density polyethylene

(Washing) = Washed two times with cold tap water 4 C and simply packed in high density polyethylene

(C50) = Washed and treated with Chlorine solution conc. 50 ppm and simply packed in high density polyethylene

(C100) = Washed and treated with Chlorine solution conc. 100 ppm and simply packed in high density polyethylene

(C150) = Washed and treated with Chlorine solution conc. 150 ppm and simply packed in high density polyethylene

(L0.25%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.25% conc. and simply packed in high density polyethylene

(L0.50%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.50% conc. and simply packed in high density polyethylene

(L1.00%) = Washed and treated with Lactic acid buffer system (LABS) solution 1.00% conc. and simply packed in high density polyethylene

Table (4). Effects of washing with cold water,chlorine solution and lactic acid buffer system on total sugars content % and ascorbic acid content V.C (mg/ 100 g) in apple fruits stored at 4° C.

Treatment	storage time	Stage 1				Stage 2				Stage 3			Stage 4			
		0	15	35	Mean	50	65	80	Mean	90	95	Mean	105	115	120	Mean
Control	T. sugar	5.61	6.4	7.76	6.59 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	V.C	16.01	15.84	15.95	15.94 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Washing	T. sugar	5.6	6.19	6.39	6.06 b	6.8	7.48	7.88	7.38 b	7.98	8.02	7.99 a	n.d	n.d	n.d	n.d
	V.C	16	15.85	15.58	15.81 ab	15.63	15.49	16.32	15.48 a	15.33	15.28	15.30 a	n.d	n.d	n.d	n.d
C50	T. sugar	5.52	6.2	6.47	6.07 b	6.66	7	7.88	7.11 d	7.96	7.96	7.95 a	8.02	8.13	8.26	8.13 b
	V.C	15.99	15.85	15.97	15.93 a	15.56	15.53	15.48	15.52 a	15.33	15.28	15.30 a	15.2	15.11	14.97	15.09 a
C100	T. sugar	5.38	6.18	6.39	5.98 b	6.7	7.08	7.86	7.11 d	7.87	7.75	7.71 b	7.97	8.09	8.27	8.11 b
	V.C	15.98	15.81	16.02	15.80 ab	15.57	15.64	15.45	15.52 a	15.3	15.23	15.27 b	15.21	15.1	14.98	15.10 a
C150	T. sugar	5.53	6.25	6.42	6.07 b	6.73	7.21	7.78	7.24 cd	7.95	8	7.98 a	8.15	8.23	8.33	8.24 a
	V.C	15.98	15.79	15.62	15.80 ab	15.58	15.53	15.42	15.51 a	15.17	15.13	15.15 c	15.1	14.99	14.84	15.01 b
L 0.25%	T. sugar	5.58	6.21	6.35	6.05 b	6.74	7.36	7.8	7.30 bc	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	V.C	15.97	15.78	15.64	15.80 b	15.57	15.52	15.39	15.49 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
L 0.50%	T. sugar	5.64	6.27	6.42	6.11 b	6.74	7.26	7.75	7.25 bcd	7.94	8	7.97 a	n.d	n.d	n.d	n.d
	V.C	15.96	15.82	15.65	15.81 ab	15.59	15.51	15.4	15.50 a	15.15	15.09	15.12 d	n.d	n.d	n.d	n.d
L 1.0%	T. sugar	5.57	6.26	6.5	6.11 b	7.14	7.74	8.04	7.64 a	n.d	n.d	n.d	n.d	n.d	n.d	n.d
	V.C	15.97	15.85	15.66	15.82 ab	15.55	15.15	14.91	15.20 b	n.d	n.d	n.d	n.d	n.d	n.d	n.d
Means	T. sugar	5.65 c	6.24 b	6.59 a		6.79 c	7.30 b	7.78 a		7.90 b	7.96 a		8.04 c	8.15 b	8.28 a	
	V.C	15.98 a	15.82 b	15.83 c		15.60 a	15.50 a	15.34 b		15.26 a	15.20 b		15.17 a	15.07 b	14.96 c	
LSD (a*b)	T. sugar			0.44				0.14			0.05				0.08	
	V.C			0.04				0.18			0.02				0.06	

Values with the same letters in the same horizontal row or vertical column are not significantly different (P ≤ 0.05).
T.sugar = Total sugar , V.C = Vitamin C ascorbic acid content (mg/ 100 g) and (n.d) = not determined because of spoilage.
(Control) = Selected and simply packed in high density polyethylene
(Washing) = Washed two times with cold tap water 4 C and simply packed in high density polyethylene
(C50) = Washed and treated with Chlorine solution conc. 50 ppm and simply packed in high density polyethylene
(C100) = Washed and treated with Chlorine solution conc. 100 ppm and simply packed in high density polyethylene
(C150) = Washed and treated with Chlorine solution conc. 150 ppm and simply packed in high density polyethylene
(L0.25%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.25% conc. and simply packed in high density polyethylene
(L0.50%) = Washed and treated with Lactic acid buffer system (LABS) solution 0.50% conc. and simply packed in high density polyethylene
(L1.00%) = Washed and treated with Lactic acid buffer system (LABS) solution 1.00% conc. and simply packed in high density polyethylene

الملخص العربى

" تأثير المعاملات الجزئية على ثمار التفاح مع ازالة الملوثات للحفاظ على الجودة و اطالة فترة الصلاحية "

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أجريت هذه الدراسة خلال موسم 2009 على ثمار التفاح المصرى (الانا Anna) حيث تم الحصاد بمجرد اكتمال النضج فى الصباح الباكر و تم وضع الثمار بالثلاجة على حرارة $4^{O}C$ لعمل تبريد مبدئى للثمار و تمت المعاملات بغسيل الثمار بماء مبرد على $4^{O}C$ ماعدا عينة الكنترول ثم نقع الثمار فى المعاملات الاتية : ماء بارد $4^{O}C$ ، محلول كلورين بتركيز (50 جزء فى المليون و 100 جزء فى المليون و 150 جزء فى المليون) و معاملات بالماء البارد $4^{O}C$ + محلول منظم من حمض الاكتيك بتركيزات(0.25% و 0.50% و 1.00%) و عينة اخرى تم اعادة غسلها بالماء البارد $4^{O}C$ فقط و بعد النقع تم فرد الثمار كطبقة واحدة على ارفف الثلاجة لمدة 3 ساعات للتخلص من الرطوبة فى الثمار ثم تعبأتها فى اطباق من الفوم ولفها بالبولى ايثيلين و حفظها فى الثلاجة على درجة حرارة لا تزيد عن$4^{O}C$ تم عمل سحبات من الثمار المعيئة و المخزنة بالثلاجة $4^{O}C$ على فترات متباعدة و تم عمل قياسات للحمل الميكروبى عن طريق عد البكتريا المحبة للبرودة psychotropic aerobic bacteria و عد الخمائر و الفطريات و عد بكتريا Enterobactriaceae و عد بكتريا حامض الاكتيك و تم عمل تقييم حسى للون و الطعم و القوام لمعرفة فترة انتهاء المنتج و تأثير طول مدة الحفظ على مدى جودته ، و تم عمل اختبارات كيميائية للمحتوى الثمار من كلا من المواد الصلبة الذائبة و الحموضة (مقدرة كحامض الماليك) و pH و محتوى الثمار من السكريات الكلية و محتواه من فيتامين سى . و قد اظهرت النتائج ان افضل المعاملات من حيث الجودة و طول فترة الحفظ و مستوى الامان هى المعاملة بمحلول الكلورين بتركيزاته المختلفة و على الترتيب (50 جزء فى المليون و 100 جزء فى المليون و 150 جزء فى المليون) ثم المعاملة بالمحلول المنظم لحامض الاكتيك بتركيز 0.50% ، و عموما اظهرت النتائج زيادة كلا من البكتريا المحبة للبرودة psychotropic aerobic bacteria و

الخمائر و الفطريات و بكتريا Enterobactriaceae و بكتريا حامض الاكتيك ولكن فى الحدود المسموح بها على طول فترات التخزين ، و زيادة كلا من المواد الصلبة الذائبة و pH و محتوى الثمار من السكريات الكلية زيادة معنوية على طوال فترة التخزين وذلك لكون ثمار التفاح من الثمار الكلايمكتيرية و التى تمر بمراحل النضج أثناء التخزين و اظهرت النتائج نقص محتوى الثمار لكلا من فيتامين سى و الحموضة (مقدرة كحامض الماليك) ، و مجملا فان المعاملات السابق ذكرها و الحفظ المبرد و التعبئة قد ادت لزيادة فترة تخزين الثمار (فترة التسويق) و الحفاظ على جودتها و سلامتها