

Journal of Food and Dairy Sciences

Journal homepage: www.jfds.mans.edu.eg
Available online at: www.jfds.journals.ekb.eg

Quality and Shelf Life Enhancement of Minimally Processed Refrigerated (MPR) Peaches

Rokaia R. Abdelsalam*; Sanaa M. Abdel-Hameed ; Asmaa M. Sh. Mohamed and H. M. A. Mohamed



Food Science Department, Faculty of Agriculture, Minia University, El-Minia, Egypt.

ABSTRACT

Peaches are climacteric stone fruits and they establish an interesting alternative as a minimally processed (MP) product due to their characteristics like flavor, color, smell, and also because of its handling resistance. However, they have a short shelf life after a fresh cut due to enzymatic browning as well as the stone cavity collapse. The present investigation aimed to determine the combined effect of blanching, osmotic dehydration and preservatives on the quality and stability of minimally processed refrigerated (MPR) peaches. Fruits were cut into halves and subjected to osmotic dehydration using sucrose solution (40%) at ambient temperature (25-30°C) for 4 hours. The pH of the syrup was adjusted with citric acid to 3.60. Potassium sorbate (0.75%), sodium bisulphite (0.45%) and ascorbic acid (0.50%) were then added to the syrup. Afterward, peaches were drained, packed under vacuum and stored at 4±1°C. Physicochemical analysis (total soluble solids, pH, total acidity, color parameters total, phenols, total sugars, and ascorbic acid) and microbial quality along with a sensory analysis were measured at regular intervals throughout the storage period. During 60 days of storage, a decrease in pH, ascorbic acid (mg/100g), color (L* value) and sensory characteristics were observed. From the results obtained it was revealed that the MPR peach-halves showed good overall acceptability up to 30 days of storage at refrigerated temperature (4±1°C).

Keywords: Fruit processing, peach quality, hurdle technology, osmotic dehydration.

INTRODUCTION

Fruits are a perishable food because their metabolic activity continues after harvest. Fruits are of great importance due to the presence of natural compounds such as vitamins (C and E), carotenoids and phenolic compounds, which can act as natural antioxidants (Robles-Sánchez *et al.*, 2007). Natural phenols have been reported to have excellent properties as a food preservative and play an important role in protecting against many pathological disorders (Haminiuk *et al.*, 2012).

Peaches (*Prunus persica L.*) belongs to the Rosaceae family, are economically and nutritionally important, although the total amplitude of antioxidants is lower than that of other fruits (Remorini *et al.*, 2008 and Wolfe *et al.*, 2008). They have many anti-disease properties such as cancer, anti-allergic, anti-tumor, anti-bacterial, anti-microbial and anti-inflammatory. Shelf life is limited by weight loss and physiological disorders in addition to browning and changes in texture (Kant *et al.*, 2018). Therefore, these fruits are generally commercialized shortly after being harvested. World production of peaches in 2018 is estimated at 18 million tons (Nanaki and Koroneos, 2018).

Minimally processed fruit (MPF) are products that undergo moderate processing processes that allow them to maintain their quality characteristics similar to those of fresh ones (Bolin and Huxsoll, 1989 and Alzamora *et al.*, 2000). The increasing popularity of MPF is due to the health benefits of fresh produce, combined with the continuous consumption trend of consuming ready-to-eat foods with a higher convenience value. The increasing

demand for these products presents researchers and processors with the challenge of making them more stable and safer (Martins *et al.*, 2011 and Nogales-Delgado *et al.*, 2015). The shelf-life of minimally processed fruit is generally more limited by changes in their sensory properties rather than by microbial growth (Ares *et al.*, 2008 and Lima and Vianello 2011). Browning is a special problem with fruits such as apples, pears, and peaches, which occur as a result of the action of polyphenol oxidase (PPO) on phenolic compounds to form quinones, which are responsible for browning (Barbagallo *et al.*, 2012 and Ghidelli *et al.*, 2013).

The expansion of MPF concepts has been reflected in new, renewable and improved products and processes that have been formulated and developed to create a greater variety of MPFs. There is also great interest in using new or emerging technologies to get the MPF using non-thermal processes in the framework of the "hurdle" concept (Alzamora *et al.*, 2000). The key requirements in minimal processing of fresh products are high quality of raw materials and good manufacturing practices including strict hygiene, cleaning with or without washing before and after peeling, gentle peeling and cutting before treatment, correct temperature, humidity and packaging materials (Varoquaux and Mazollier, 2002).

Minimally processed refrigerated (MPR) fruits are an important and rapidly developing class of MPF. The purpose of MPR fruits is to deliver to the consumer a like-fresh fruit product with an extended shelf-life and at the same time ensure food safety and maintain sound nutritional and sensory quality (Carter *et al.*, 2010).

* Corresponding author.

E-mail address: rokaia.guaid@minia.edu.eg

DOI: 10.21608/jfds.2020.102743

Minimally processed refrigerated fruits are defined as those performed by one unit or any number of suitable unit operations such as peeling, slicing, shredding, juicing, etc., when performing partial preservation but without an end point, including the use of a minimal heat, a preservative or radiation (Sandhya, 2010). Preserving or hurdle treatment can include pH control, antioxidants, chlorinated water entry, or a combination of these or other treatments. Initial preparation and preservation treatments usually follow by some type of controlled, modified atmosphere and vacuum packaging that is subjected to low temperatures above freezing point during storage, distribution, and marketing, and immediately prior to preparation for consumption.

The purpose of this study was to extend the shelf-life and maintain fresh-like quality of MPR peaches by using the "hurdle concept" based on mild heat treatment (blanching), osmotic dehydration, the used of preservatives and refrigerated storage at $4\pm 1^{\circ}\text{C}$.

MATERIALS AND METHODS

Fruit materials

Fresh quality peaches (*Prunus persica L*) at commercial maturity were chosen from a local market at El Minia Governorate (May 30, 2018). Fruits were transported to our laboratory, sorted to eliminate damaged or defective fruit, and stored at $4\pm 1^{\circ}\text{C}$ until use, within 24 hours. All reagents used were of analytical grade (Sigma Chemical, Co).

Minimal processing of peach fruits

Fruits were washed with water containing 200 ppm of active chlorine to remove dirt and surface microflora for prevent contamination. They were cut into halves of equal sizes using a sharp stainless steel knife and the stones were removed manually. Samples were then blanched with steam for 5 min. Osmotic solution was prepared using commercial grade sucrose and distilled water at concentration of (40% w/v) keeping a weight ratio of 1:2 (fruits : syrup). A magnetic stirrer provided gentle circulation of the syrup. Fruits pieces were held submerged in the syrup by a plastic screen and allowed for osmosis 4 hours at ambient temperature ($25\text{-}30^{\circ}\text{C}$) according to Tapia *et al.*, (1998). The pH of the solution was adjusted to 3.60 with citric acid. Potassium sorbate (0.75%), sodium bisulphite (0.45%), and ascorbic acid (0.50%), were added to the syrup. After that the samples were removed from the syrup and put to rest to drain off any excess liquids. The peach-halves were then packed in laminated polyester nylon (250 g capacity) under vacuum and thermo sealed. Samples were stored at refrigerated temperature ($4\pm 1^{\circ}\text{C}$) and relative humidity ($85\pm 5\%$). Relative humidity was estimated by hygrometer.

Chemical analysis

Moisture, Ash, fiber, total soluble sugars, and crude protein contents were determined according to the methods of the AOAC (2000).

Determination of physicochemical properties of MPR peaches

Total soluble solids, titratable acidity and pH determination of MPR peaches.

Samples (5 halves) were removed each 5 days, homogenized in a blender and subjected to physicochemical analyses.

Total soluble solids (TSS) was determined by using Abbe refractometer (model 1T). Results are expressed as $^{\circ}\text{Brix}$ according to AOAC (2000).

Titratable acidity (TA) was detected by titration against 0.1N NaOH with phenolphthalein indicator as described in AOAC (2000). TA was expressed as % citric acid. PH was measured using a Digital pH meter glass electrode (model 41250, ICM.OR, USA) as described in AOAC (2000).

Total Phenolics (TP)

The spectrophotometric measurement of TP was carried out at 765nm using T80 UV/VIS spectrometer. Results were expressed as mg of gallic acid equivalents per 100 g samples according to Lima *et al.*, (2005).

Ascorbic acid (AA)

Ascorbic acid was estimated by the AOAC (2000) titrimetric method of analysis using 2, 6 -dichlorophenol-indophenol dye. The results were expressed in mg ascorbic acid per 100 g of fruit homogenates.

Total soluble sugars (TS).

The phenol-sulfuric acid method described by Dubois *et al.*, (1956) was used in the determination of total soluble sugars.

Color characteristics.

Color parameters used to estimate changes in appearance of MP peaches during storage were L^* is a measure of lightness, a^* represents the chromatic scale from green to red and b^* represents the chromatic scale from blue to yellow. Color characteristics were measured by a color difference meter (model color Tec-PCM, USA). Ten measurements were performed at the surface points of the peach-halves according to Francis (1983).

Determination of microbiological properties

For microbiological assessments, samples were examined for total plate count (TPC), Yeasts and Molds count (Y&M), and total coliforms according to the procedure described by Vanderzant and Splittstoesser (1992). All the counts were done in triplicate and the results were reported as \log_{10} cfu/g.

Assessment of sensory properties

Samples were subjected to sensory evaluation on day 0, 30 and 60. Ten panelists from the staff members and post graduate students of Food Science Department, Faculty of Agriculture, Minia University evaluated the MPR peaches for appearance (10), color (10), texture (10), taste (10) and overall acceptability (10) according to the procedure described by EL-Samahy *et al.*, (2007).

Statistical analyses

Physico-chemical evaluations underwent variance analysis and mean comparison was performed by Tukey's test of a 5% significance level using Statistica 7.0 (StatSoft Inc., Tulsa, UK).

RESULTS AND DISCUSSION

Physicochemical characteristics of fresh peaches

The Physicochemical analysis of fresh peach-halves is illustrated in (Table1). The average weight of the fruit was 50.56 ± 3.49 g. The moisture content was of $88.33\pm 0.17\%$, ash content was of $0.33\pm 0.12\%$, and protein content was of $1.18\pm 0.36\%$. Furthermore, total soluble sugars and fiber contents were $8.09\pm 0.17\%$ and $1.12\pm 0.23\%$ respectively. Sugars represent 60-80% of soluble solids in peaches (Gorny *et al.*, 1998). The results also indicated that TSS of raw peach fruit was 8.90°Brix . Results are in accordance with date published by Ashraf *et al.*, (2010).

Table 1. Physicochemical parameters* of fresh peach fruits (expressed as fresh weight).

Weight of fruit (g)	Length (cm)	Width (cm)	Pulp: stone ratio	Moisture %	Protein %	Ash %	Fibers %	Total sugars%	TSS (Brix)
50.56±3.49	5.79±0.06	5.92±0.07	20.14±0.61	88.33±0.17	1.18±0.36	0.33±0.12	1.12±0.23	8.09±0.17	8.90±0.05

*Results are presented as means ±SD (n=3)

Effect of storage of MP peach-halves at ambient temperature

A preliminary experiment was designed to study the shelf-life of halved MP peaches stored under room temperature (Table 2). The data of sensory analysis and objective quality evaluation within the periods evaluated after 2 and 4 days at 25°C revealed that peach-halves underwent severe surface browning during the initial days of storage. Therefore, the most alterations were observed in the surface color coordinates (L*, a* and b*). Storage time had a significant effect (p≤0.05) on the colorimetric parameters occurring an increasing in a* values which tend toward red and a reduction of L* and b* values which tend toward blue. Moreover, the samples received a low score of acceptability because of high shrinkage, less color and low quality indicating that all additives don't seem to promote better results concerning to the maintenance of the quality. Therefore the shelf-life of MP peaches was very limited to 2-4 days maximum. Consequently, a longer shelf-life is important when considering the high perishability of MP fruits.

Table 2. Quality parameters* of MP peach-halves stored at ambient temperature

Parameters	Zero time	2 days of storage	4 days of storage
TSS (° Brix)	24.00 ^a	23.00 ^b	22.00 ^c
pH	4.23 ^a	3.98 ^b	3.09 ^c
TA (% as citric acid)	0.28 ^c	0.57 ^b	1.29 ^a
TP(mg /100g)	73.97 ^c	127.34 ^b	154.98 ^a
AA(mg /100g)	41.32 ^a	36.50 ^b	22.85 ^c
TS%	18.22 ^b	21.43 ^a	20.58 ^a
Color			
L*	43.57 ^a	38.57 ^b	22.15 ^c
a*	8.95 ^c	9.34 ^b	17.29 ^a
b*	22.08 ^a	21.72 ^a	18.08 ^b
TPC (log ₁₀ cfu/g)	3.5 ^c	3.9 ^b	4.3 ^a
Y&M (log ₁₀ cfu/g)	0	2.3 ^b	2.6 ^a
Overall acceptability	9.50 ^a	4.87 ^b	4.08 ^c

* Values within each raw followed by different letters (a-c) (expressed as superscripts) were significantly different at level of p≤ 0.05

Total soluble solids (TSS), titratable acidity (TA) and pH determinations.

The data in Table 3 shows the values of TSS (°Brix) of MPR peach-halves, when stored at 4 ±1°C for 60 days. No significant differences (p≤ 0.05) were observed in the TSS content (° Brix) during the storage of MPR peach-halves until 30 days. Thereafter there was a significant (p≤ 0.05) decrease in TSS upon storage for 60 days at 4±1°C. On the other hand, Martins (2010) noted that the soluble solids content (°Brix) remained constant during MP peach storage, with no significant difference (p ≤ 0.05) in the values between all the different treatments with ascorbic acid and calcium chloride. Nevertheless, when different packages were evaluated. Chagas et al. (2008) also note that there were no differences in the soluble solids content when treating MP peach with 1% and 2% citric acid and stored at 5 °C for a period of nine days.

As shown in Table 3, the pH of the MPR peach-halves was 4.23 at the beginning of the experiment (day zero). No significant (p≤ 0.05) changes were found until 20 days of storage. Thereafter, the pH values were gradually decreased and reached 3.63 on the 60 days of storage. Low pH is preferred in fresh-cut fruits because it provides better protection against microbial growth (O' Connor –Shaw *et al.*, 1994).

The titratable acidity (TA % as citric acid) of freshly prepared MPR peach-halves packed under vacuum was 0.28% (Table 3). This value, however, increased to 0.57% and 1.29% after 30 days and 60 days of cold storage respectively. Higher TA values are preferred during storage because they correlate with low pH values, thereby preventing the early growth of micro-organisms in fresh-cut fruits. Generally, the results showed a linear increasing trend in TA % with the advancement of the storage period. This may be due to subsequent accumulation of organic acids which were oxidized at a slow rate because of decreased respiration. Cortez *et al.*, (2014) and Geetha (2015) also reported an increase in TA of MP carrots and pumpkin cubes during storage. On the other hand, in some MP fruits, TA can decrease during storage (Perez *et al.*, 2014 and Totad *et al.*, 2018).

Table 3. Total soluble solids (TSS), pH, and titratable acidity (TA) in MPR peach-halves during the 60 days of storage

Time of storage (Days)	TSS (°Brix)	pH	TA (% as citric acid)
0	24.00 ^a	4.23 ^a	0.28 ^g
5	24.00 ^a	4.09 ^a	0.28 ^g
10	24.00 ^a	4.05 ^a	0.43 ^f
15	23.00 ^{ab}	4.03 ^{ab}	0.43 ^f
20	23.00 ^{ab}	4.03 ^{ab}	0.57 ^e
25	23.00 ^{ab}	3.98 ^b	0.57 ^e
30	23.00 ^{ab}	3.96 ^b	0.57 ^e
35	22.00 ^b	3.89 ^b	0.72 ^d
40	22.00 ^b	3.81 ^{bc}	0.86 ^d
45	22.00 ^b	3.78 ^{bc}	1.00 ^c
50	21.00 ^c	3.72 ^{bc}	1.00 ^c
55	21.00 ^c	3.69 ^c	1.15 ^b
60	21.00 ^c	3.63 ^c	1.29 ^a

*Values within each column followed by different letters (a-g) expressed as superscripts were significantly different at level of p≤ 0.05

Total phenolic (TP), Ascorbic acid (AA) and Total sugar (TS)

Results in Table 4 showed increases in TP during 60 days of storage. These increases could be the response of the reaction plant tissues to stress during processing (Haminiuk *et al.*, 2012), because mechanical damage provokes the de novo synthesis of the phenylalanine ammonialyase enzyme, which it is the key in phenolic biosynthesis (Tomás-Barberán and Espín, 2001).

According to Dalla-Valle *et al.*, (2007) post-harvest increases polyphenols content because of enzymatic hydrolysis of bound polyphenols, thus enhancing the total phenol amount. In literature, different values of total bound

phenols present in peach are (Vinson *et al.*, 2001). They reported a variation in the pattern of free and conjugated phenol distributions in fruits. In addition, it could be also explained by the different rates of phenolic synthesis due to stress and degradation due to PPO activity and surface healing. Imeh and Khokhar (2002) reported that in peaches the 80% of phenols are conjugated phenols and then it is surmised that some conjugated polyphenolics were degraded to extractable single phenolic acids during cold storage.

Table 4. Change in TPC, AA and TS* in MPR peach-halves the during 60 days storage period at 4°C.

Time of storage (Days)	TPC (mg/100g)	AA (mg/100g)	TS (%)
0	73.97 ^h	41.32 ^a	18.22 ^b
5	95.89 ^g	39.10 ^{ab}	24.00 ^a
10	123.30 ^{ef}	37.18 ^{ab}	20.09 ^b
15	145.20 ^e	36.36 ^{ab}	19.08 ^b
20	200.32 ^c	34.93 ^b	18.72 ^b
25	112.39 ^f	31.86 ^b	18.20 ^b
30	123.37 ^{cf}	30.24 ^b	16.26 ^c
35	183.68 ^d	27.45 ^c	17.87 ^{bc}
40	205.53 ^c	24.12 ^c	17.79 ^{bc}
45	211.23 ^{cd}	22.13 ^{cd}	18.87 ^b
50	243.87 ^b	20.33 ^d	16.77 ^c
55	260.31 ^b	19.45 ^d	17.85 ^{bc}
60	287.72 ^a	17.15 ^e	18.72 ^b

*Values within each column followed by different letters (a-h) expressed as superscripts were significantly different at level of $p \leq 0.05$, TPC: total phenol content, AA: ascorbic acid and TS: total sugar

As shown in Table 4, AA gradually declined during storage. AA decreased by about 58.5% after 60 days of storage. Major AA loss in MPR peach-halves occurs during processing. Losses were not only due to degradation reaction but also diffusion in syrup. These findings were similar to those of Alzamora *et al.*, (1989).

The data in Table 4, TS content had significantly ($p \leq 0.05$) an increase trend in the initial stage of the storage period (at the day 5 of storage). The increased level of total reducing sugars occurs due to water loss during processing and it could be attributed to the acid hydrolysis of polysaccharides during storage which resulted in increase in soluble sugars content. A similar trend was also seen in osmo-dehydrated and hurdle processed pineapple slices by Michael (2012), Rao and Roy (1980) in mango pulp dehydration, Mehta *et al.*, (1982) in dehydration of pineapple and Tomar *et al.*, (1990) in osmotic dehydration of pear.

Color analysis

Figure 1 shows the values of lightness (L^*) of MPR Peach halves stored at $4 \pm 1^\circ\text{C}$ for 60 days. There was a reduction in L^* suggesting browning of MP peaches due to the reduction of quinones to phenols (Torales *et al.*, 2008). It is interesting to note that the reduction in L^* values was only 4.24% after 30 days whereas, it reached 42.11% after 60 days of refrigerated storage. Similar to this study, other studies show that even when using antioxidants, the MP peach color is partially changed. Chagas *et al.* (2008) observed a decrease in L^* values while storing MP treated peaches with different concentrations of citric acid. A study by Martins (2010) also observed a decrease in L^*

values within 12 days after the storage of MP peaches treated with ascorbic acid, calcium chloride, and various packing materials. Costa (2010) observed a decrease in L^* values in MP peach samples treated with L-cysteine hydrochloride, ascorbic acid and calcium chloride. However, the decrease of L^* values could also be attributed to the shrinkage of plant tissue, which leads to an increased in sample opacity.

Figure 1 shows the values of MPR peach halves stored at $4 \pm 1^\circ\text{C}$ for 60 days. The values of a^* were fluctuated during the evaluated period and trend to increase at the end of the storage period. This increment indicates a high intensity of the red color. Different results had reported inclusive Chagas *et al.* (2008), who founded that the values of a^* did not differ significantly within nine days after storage between MP peaches treated with citric acid (1% and 2%).

In general, the parameters of L^* and a^* are well associated with a browning reaction. Enzymatic and non-enzymatic reactions are the main reason for developing a brown color. The changes in redness and yellowness are clear and appear to be related to changes in fruit pigments and solids uptake (Falade and Igbeka, 2007).

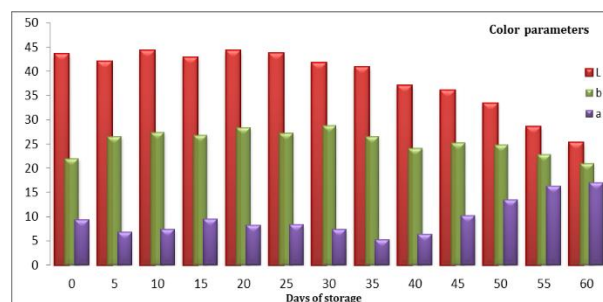


Figure 1. changes in color parameters in MPR peach-halves during 60 days of storage at $4 \pm 1^\circ\text{C}$.

Figure 1 shows values of b^* of the MPR peach halves stored at $4 \pm 1^\circ\text{C}$ for 60 days. There were also fluctuations in the values of b^* during storage; However, at the end of storage, there was a downward trend, indicating an increment of the blue color intensity. Increased a^* values and lower b^* values may indicate oxidized browning. Chagas *et al.*, (2008), have described similar behavior for MP peaches treated with citric acid.

Microbial analysis

Total plate count (TPC) of micro-organisms

Results in Figure 2 demonstrated that TPC of freshly prepared MPR peach-halves was $3.5 \log_{10}$ cfu/g. This value decreased to $3.2 \log_{10}$ cfu/g after 5 days of storage at $4 \pm 1^\circ\text{C}$. Generally, microbial count increased with storage time up to 60 days of storage and reached $4.3 \log_{10}$ cfu/g after 60 days of storage. According to HACCP guidelines, foods with less than $4 \log_{10}$ cfu/g are classified as a good food, and foods with more than $8 \log_{10}$ cfu/g are spoiled food, which is higher of the values in the study by (Jacxsens *et al.*, 2002). Martínez Ferrer and Harper (2005) stated that, the fruits of MP carry natural micro-flora and may contain approximately 2.01 - $2.02 \log_{10}$ cfu/ g.

Yeasts and molds (Y and M)

Figure 2 showed the growth curve of yeast and molds for MPR peach-halves. No occurrence of yeasts and molds up to 10 days of cold storage was observed, but they

increased thereafter. However, all counts were lower than the critical limit for Y and M (10^5 CFUg⁻¹) on all days of storage. On the other hand, Chauhan et al. (2006) found that pre-treated papaya slices, which were stored in different packaging conditions in a modified atmosphere, had zero counts of Y and M. Pinheiro *et al.*, (2005), reported that population of yeast and mold M were ranged from 2.7×10^2 to 1.9×10^7 CFU g⁻¹ in MP pineapple samples from supermarkets in Fortaleza, Brazil.

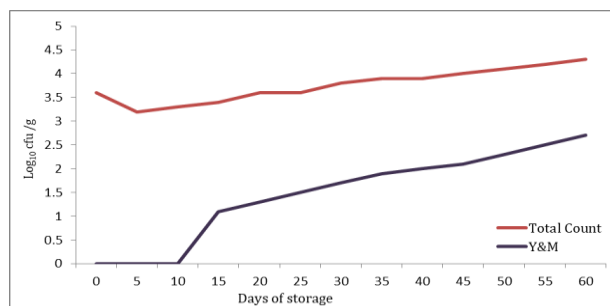


Figure 2. Total plate count (TPC), Yeasts and Molds (Y and M) of MPR peach-halves ($4 \pm 1^\circ\text{C}$ and 85%RH) for 60 days of storage.

Faecal coliform

Although O'Connor-Shaw et al. (1994) found that coliforms are part of the natural microflora of the fruits and the results of the current study did not reflect this, as careful preparation and purification of the sample were followed, which revealed good manufacturing practices. Meanwhile, Chauhan et al. (2006) reported that pretreated papaya slices with sorbates and benzoates as antimicrobial additives and packaged in a modified atmosphere registered zero coliform counts up to 60 day. The results obtained were also comparable with the results reported by Lopez-Malo *et al.*, (1994) and Ankita *et al.*, (2014). It was indicated that the selected condition was capable of assuring the microbial stability of the product. The main problem of MPR peach-halves is not microbiological decay as they are not harmful for consumption.

Sensory evaluations

Changes in sensory attributes such as appearance, color, texture, taste and overall acceptability of MPR peach halves were assessed during a 60-day cold storage. Results in Table (5) showed that color scores for MPR peach-halves decreased significantly ($p \leq 0.05$) during storage. The color loss was due to the development of browning. This can be confirmed by a decrease in L* value. The decrement of appearance and texture score was observed during 60 days of storage.

Table 5. Mean scores* of sensorial attributes of MPR peach-halves during cold storage.**

	zero time	after 30 days	after 60 days
Appearance	9.47 ^a	8.80 ^b	5.42 ^c
Color	9.75 ^a	7.96 ^b	5.35 ^c
Texture	8.36 ^a	7.44 ^b	6.20 ^c
Taste	9.51 ^a	8.89 ^a	6.13 ^b
Overall acceptability	9.50 ^a	8.61 ^b	5.15 ^c

* Means of 10 panelists

** Values within each column followed by different letters (a-c) expressed as superscripts were significantly different at level of $p \leq 0.05$

MPR peach halves stored at low temperature ($4 \pm 1^\circ\text{C}$). We maintained a good overall quality until 30 days of storage (Paul 1999). It could be also observed that the overall acceptability of the sample was found to be acceptable, but during the subsequent storage period, there was a reduction in overall sensory score. Similar finding has been reported by Rashmi *et al.*, (2005) in pineapple, Shobana (2003) in banana, Jose *et al.*, (2008) in mango slices.

CONCLUSION

In the current research, physical, chemical, microbiological and sensory changes were evaluated to determine the keeping quality of MP peach-halves. The result revealed that the shelf-life of halved MP peach was limited to 2-4 days maximum at ambient temperature. In the contrary, it is possible to obtain shelf-stable, high moisture MPR products by applying hurdle technology. This could be achieved by the combined effect of blanching, osmotic dehydration and the use of preservatives that act synergistically when packed under vacuum and stored at refrigerated temperature ($4 \pm 1^\circ\text{C}$). Regardless of microbiological safety during the 60 days of cold storage, the color was found to be the quality limiting factor of MPR peach-halves. The treatment was efficient to maintain quality with shelf-life of about 35 days, afterwards the color and dehydration become strong enough to affect the appearance. Consequently, shelf life elongation properly due to a low temperature which can constitute a valuable hurdle against quality loss. MPR can consider useful to the fast food industry and other ready-to-eat products, attending the demand for healthy and convenient food stuffs.

REFERENCE

Alzamora, S. M., Gerschenson, L. N., Cerrutti, P. and Rojas, A.M. (1989). Shelf-stable pineapple for long-term non-refrigerated storage. *Lebensm. Wissu. Technol.*, 22, 23336.

Alzamora, S. M., Lopez-Malo, A. and Tapla, M. S. (2000). Overview In: Minimally processed fruits and vegetables: Fundamental aspects and applications. Galthersburg, Md: Aspen.

Ankita, Rongen. S. and Nayansi (2014). Effect of hurdle technology on the quality and stability of minimally processed papaya *International Journal of Scientific Research.*, 31: (8):173 –176.

AOAC (2000). Official methods of analysis, 17th ed. Association of Official Analytical Chemists International, Maryland.

Ares G., Martínez I., Lareo C. and Lema, P. (2008): Failure criteria based on consumers' rejection to determine the sensory shelf life of minimally processed lettuce. *Post-harvest Biology and Technology*, 49: 255–259.

Ashraf, C.M., Iqbal, S and Ahmed, D. (2010). Nutritional and physicochemical studies on fruits Pulp, seed and shell of indigenous Prunns Persica. *J. of Mediainal Plants research* ; 5 (16) :3917-392.

- Barbagallo R.N., Chisari M. and Patané C., (2012). Polyphenol oxidase, total phenolics and ascorbic acid changes during storage of minimally processed “California Wonder” and “Quadrato d’Asti” sweet peppers. *LWT-Food Science and Technology*, 49: 192–196.
- Bolin, H. R. and Huxsoll, C. C. (1989). Storage stability of minimally processed fruit. *Journal of Food Processing and Preservation*, 13(4), 281–292.
- Carter, P., Gray, L. J., Troughton J, Khunti, K. and Davis, M.J. (2010). Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis. *Br Med J* 341(c):4229
- Chagas, P.C., Shirahige, F.H. Silve, P.P.M. Spoto, M.H.F. Chagas, E.A., and PIO, R. (2008). Avaliação da qualidade de pêssegos “regis” minimamente processados. *B. CEPPA, Curitiba* 26(2): 179–186.
- Chauhan, OP., Raju PS., Shylaja R., Dasgupta DK. and Bawa AS. (2006). Synergistic effects of modified atmosphere and minimal processing on the keeping quality of pre-cut papaya (*Carica papaya* L.). *J Hort Sci Biotechnol* 81:903–909 (2006).
- Cortez, .W., Piotrowicz, I.B., Prentice .C. and Borges,D.C. (2014). Influence of different edible coating in minimally processed pumpkin. *International Food Research Journal*,21 (5):2017-2023.
- Costa, A.C. (2010). Study of the Conservation of peach (*Prunus persica* (L.) Batch minimally processed. Thesis (Agro industrial Science and Technology), Federal University of Pelotas. Brazil. 79p.
- Dalla-Valle, A.Z., Mignani,I., Spinardi, A., Galvano, F., and Cappellano,S.(2007). *Eur Food Res Technol* 225:167-172. (C. F. Vaio, D. C., Graziani, G., Marra, L., Cascone, A., and Ritieni, A. (2008). Antioxidant capacities, carotenoids and polyphenols evaluation of fresh and refrigerated peach and nectarine cultivars from Italy. *Eur Food Res Technol.* 227:1225-1231).
- Dubois, M., Gilles, K A., Hamilton, J K., Rebers, P A. and Smith, F (1956) Colorimetric method for determination of sugars and related substances. *Anal Chem* 26 p350.
- El-samahy, S. K., Abd El-Hady, E.A., Habiba, R. A. and Moussa-Ayoub, T. E. (2007). Cactus Pear sheet and sterilized cactus pear juices *Journal of the Professional Association for Cactus Development*.
- Falade, K. O and Igbeka, J. C. (2007). Kinetics of mass transfer and color changes during osmotic dehydration of watermelon. *Journal of Food Engineering* 80, 979–985.
- Francis F.J. 1983. *Colorimetry of foods: Physical properties of foods*, AVI Publishing, Westport, CT, USA.
- Geetha, P. (2015). Effect of pre-treatments and packaging on shelf life of minimally processed Carrots. *Madras Journal of Agriculture*, 102:268-272.
- Ghidelli C., Mateos M., Rojas-Argudo C. and Pérez-Gago M.B. (2013): Antibrowning effect of antioxidantson extract, precipitate, and fresh-cut tissue of artichokes. *LWT-Food Science and Technology*, 51: 462–468.
- Gorny ,J.R., Hess-Pierce, B., Kader A.A. (1998): Effects of fruit ripeness and storage temperature on the deterioration rate of fresh-cut peach and nectarine slices. *Hort Science*, 33: 110–113.
- Haminiuk C.W.I., Maciel G.M., Plata-Oviedo M.S.V. and Peralta R.M. (2012): Phenolic compounds in fruits-an overview. *International Journal of Food Science and Technology*, 47: 2023–2044.
- Imeh, U. and Khokhars , S. (2002) *J.Agric. Food Chem* 50:6306. (C. F. Vaio, D. C., Graziani, G., Marra, L., Cascone, A., and Ritieni, A . (2008). Antioxidant capacities, carotenoids and polyphenols evaluation of fresh and refrigerated peach and nectarine cultivars from Italy. *Eur Food Res Technol.* 227:1225-1231).
- Jacxsens L., Devlieghere, F. and Debevere J, (2002). Predictive modeling for packaging design: equilibrium modified atmosphere packages of fresh-cut vegetables subjected to a simulated distribution chain. *Int. J. Food Microbiol* 73:331–341.
- Jose, A. U., Hector, E., and Lourdes, D. (2008). Colour behaviour on mango (*Mangifera indica*) slices self-stabilized in glass jars by hurdle technology during storage. *Afr. J Biotech.* 2008; 7(4):487-494.
- Kant, R., Shukla-Rishi,K. R. and Abha-Shukla (2018). A Review on Peach (*Prunus persica*): An Asset of Medicinal Phytochemicals. *International Journal for Research in Applied Science and Engineering Technology*.(6):2186-2200.
- Lima V.L.A.G., Mélo E.A., Maciel M.I.S., Prazeres F.G., Musser R.S. and Lima D.E.S. (2005). Total phenolic and carotenoid contents in acerola genotypes harvested at three ripening stages. *Food Chemistry*, 90: 565–568.
- Lima, G. P. and Vianello, F. (2011). Review on the main differences between organic and conventional plant-based foods. *International Journal of Food Science & Technology*, 46(1), 1-13.
- Lopez- Malo, A., Palou, E., Welti, J., Corte, P. and Argai. A. (1994). Shelf-stable high moisture papaya minimally processed by combined methods. *Food Research international*, 27. 545-553.
- Martinez-Ferrer, M. and Harper, C. (2005). Reduction in microbial growth and improvement of storage quality in fresh-cut pineapple after methyl jasmonate treatment. *Journal of Food Quality*,28, 3-12.
- Martins, R.N. (2010). Minimal processing of peaches Aurora-1’:Stages of maturation, packaging, storage temperatures andnatural additives. Thesis. School of Agricultural Sciences and Veterinary). Estadual Paulista University. p 145.
- Martins, R.N. Mattiuz, B.H. Santos L.O. Morgado, C.M.A. and Mattiuz, C.F.M. (2011). Preservation of minimally processed “Aurora-1” peaches using additives. *Rev Bras Frutic* 33:1229–1239.
- Mehta, G. L. Tomar, M. C. and Gawar, B.S. (1982). Studies on dehydration of pineapple. *Ind. Fd. Pack.* 1982; 36(2):35-40.

- Michael, J. (2012). Standardisation of preservation of osmo-dehydrated ripe pineapple slices by using hurdle processes. M. sc. (Hort.) Thesis, Univ. Agric. Sc. Kerala (India).
- Nanaki, A.E. and Koroneos, J. C. (2018). Sustainable Peach Compote Production: A Life Cycle Thinking Approach. Sustainability, 10, 4229.
- Nogales-Delgado, S., Fuentes-Pérez, C. M. and Bohoyo-Gil, D. (2015). Cultivar characterization of stone fruit for their minimal processing J Food Sci Technol 52(4):2193–2201.
- O'Connor-Shaw R.E., Roberts R., Ford A.L. and Nottingham S.M., (1994). Shelf life of minimally processed honeydew, kiwifruit, papaya, pineapple and cantaloupe. J Food Sci. 59:1202–1206.
- Paull, R. E. (1999). Effect of temperature and relative humidity on fresh commodity quality. Postharv. Biol. Technol. 15:263–267.
- Perez, F. C. M., Nogales-Delgado, S., Ayuso, C. M. and Bohoyo-Gil, D. (2014). Different Peach Cultivars and their Suitability for Minimal Processing. Czech J. Food Sci. 32, (5): 413–421.
- Pinheiro, N.M.S., Figueiredo, E.A.T. Figueiredo, R.W., Maia, G.A. and Souza, P.H.M. (2005). Evaluation of microbiological quality of fruits minimally processed commercialized in supermarkets in Fortaleza. Revista Brasileira de Fruticultura, 27, 153-156.
- Rao, V. S. and Roy, S.K. (1980). Studies on dehydration of mango pulp. Ind. Fd. Pack. 34(3):64-71.
- Rashmi, G. B., Doreyappa, G. I. N. and Mukunda, G. K. (2005). Studies on osmo air dehydration of pineapple fruits. J Fd. Sc. Tech. 42 (1):64-66.
- Remorini, D. Tavarini, S., Degl'Innocenti, E., Loreti, F., Massai, R., and Guidi L. (2008): Effect of rootstocks and harvesting time on the nutritional quality of peel and flesh of peach fruits. Food Chemistry, 110: 361–367.
- Robles-Sánchez, M. Gorinstein, S., Martín-Belloso, O., Astiazarán-García, H., González-Aguilar, G. and Cruz-Valenzuela, R. (2007): Frutos tropicales mínimamente procesados: potencial antioxidante y su impacto en la salud. Interciencia, 32: 227–232.
- Sandhya., (2010). Modified atmosphere packaging of fresh produce: current status and future needs. LWT 43:381–392.
- Shobana, N. (2003). Processing of banana fruits. M.sc. (Hort.) Thesis, Univ. Agril. Sc. Dharwad. India. 2003.
- Tapia, S. M., Lopez-Malo, A., Consuegra, R., Corte, P. and Welti-. (1998). Papaya mínimamente processada mediante técnicas de deshidratación osmótica al vacío (VOD). Food Science And Technology International, 5(1):41-49.
- Tomar, M. C., Singh, U. B. and Singh, S. (1990). Studies on osmotic dehydration of pear. Prog. Hort. 22(1-4):77-83.
- Tomás-Barberán, F .A. and Espín, J.C. (2001). Phenolic compounds and related enzymes as determinants of quality in fruits and vegetables. Journal of the Science of Food and Agriculture, 81: 853–876.
- Torralles, R.P., Vendruscolo, J. L., Vendruscolo, C.T., Delpino, F. A. B. and Antunes, P. L. (2008). Determinação das constantes cinéticas de degradação do ácido ascórbico em purê de pêssego: efeito da temperatura e concentração. Ciênc. Tecnol. Aliment. 28(1): 18–23.
- Totad, M., Doreyappagowda, I. N., Suresh, G. J., Vasudev, K. R., Sreenivas, K. N., Shivashankar, K. S., Venugopalan, R. and Ranjitha, K. (2018). Preservation of pineapple (Ananas comosus L.) slices by hurdle technology International Journal of Chemical Studies, 6(5): 815-820.
- Vanderzant, C. and Splittoeser, D. F. (1992). Compendium of methods for the microbiological examination of food (3rd Ed.). American Public Health Association. Washington, D.C.
- Varoquaux, P. and Mazollier, J. (2002). Overview of the European fresh-cut produce industry. Fresh-cut Fruits and Vegetables. CRC Press, NY, USA, 21-43.
- Vinson, J. A., Su. x., Zubik, L. and Bose, P. (2001). J Agric Food Chem 49:5315-5321. (C. F. Vaio, D. C., Graziani, G., Marra, L., Cascone, A., and Ritieni, A 2008). Antioxidant capacities, carotenoids and polyphenols evaluation of fresh and refrigerated peach and nectarine cultivars from Italy. Eur Food Res Technol. 227:1225-1231.
- Wolfe, K.L., Kang X., He X., Dong, M., Zhang Q. and Liu R.H. (2008). Cellular antioxidant activity of common fruits. Journal of Agricultural and Food Chemistry, 5-6: 8418–8426.

تحسين جودة مدة صلاحية الخوخ المصنع جزئياً بالمعاملات المشتركة تحت تبريد رقية رمضان عبدالسلام ، سناء محمد عبد الحميد ، أسماء محمد شحاته محمد و هاني مصطفى على محمد قسم علوم الأغذية - كلية الزراعة - جامعة المنيا

يعتبر الخوخ من الفواكه الكلايكتيرية ذات النواة الحجرية ومن المثير للاهتمام حفظ الخوخ المصنع جزئياً نظراً لخصائصه مثل النكهة واللون والرائحة وايضا بسبب مقاومته للتداول ومع ذلك فان مدة صلاحيته قصيرة بعد تقطيعه بسبب التلون البني الانزيمي وكذلك انهيار التجويف النواة الحجرية وتهدف الدراسة الحالية تقدير التأثير المشترك لكل من السلق والتجفيف الأسموزي المواد الحافظة على الخوخ المبرد المصنع جزئياً (MPR) حيث تم تقطيع الخوخ الى انصاف ووضعها في محلول سكري تركيزه 40% على درجة حرارة من 25-30^oم لمدة 4 ساعات وتم ضبط قيمة الرقم الهيدروجيني للمحلول بواسطة حامض الستريك الى 3.60 و اضافة كلاً من سوربات البوتاسيوم بتركيز 0.75% وثلاثي كبريتات الصوديوم بتركيز 0.45% وحامض الاسكوربيك بتركيز 0.50% وتم تجفيفها وتعبيتها تحت تبريد والتخزين على 4±0^o م وتم اجراء التحليلات الفيز وكيميائية (الحموضة الكلية والمواد الصلبة الذئبة اللون، الفينولات الكلية، السكريات الكلية، حامض الاسكوربيك) وتم تقدير الجودة الميكروبيولوجية والتحليل الحسي تم قياسه بانتظام طول فترة التخزين خلال 60 يوم من التخزين حيث لوحظ انخفاض قيمة كلاً من الرقم الهيدروجيني و حامض الاسكوربيك واللون والخصائص الحسية. واثبتت النتائج الخوخ المبرد المصنع جزئياً بحالة جيدة لمدة 30 يوم خلال التخزين المبرد على درجة حرارة 4±1 درجة مئوية .