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EFFECTS OF EDIBLE COATINGS ON THE SHELF-LIFE AND QUALITY OF ANNA APPLE (*Malus domestica Borkh*) DURING COLD STORAGE

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ABSTRACT: *This investigation was carried out during two successive seasons 2007-2008 at the Hort. Res.Inst., Fruit Handling Department. Edible coating has been used for preserving the quality and safety of fresh fruits and vegetables. The objective of this research was to evaluate the effect of soybean gum, jojoba wax, glycerol and Arabic gum as edible coatings instead of paraffin oil, on the shelf-life and quality of Anna apple, during cold storage at (0°C, 90-95% RH). The results indicated that coated apples showed a significant delay in the changes of weight loss, firmness, titrateable acidity, total soluble solids, decay and color of the fruits, compared to uncoated ones. Sensory evaluation results showed that coatings maintained the visual quality of the Anna apple fruits during the storage time. The results suggested using soybean gum, jojoba wax, glycerol and Arabic gum as edible coatings, for the fruits instead of paraffin oil.*

***Key words**: Coating, jojoba, gum, Annaappls, sensory, quality and storage.*

INTRODUCTION

The extension of fruit shelf life is an important goal to be attained. Many storage techniques has been developed to extend the marketing distances and holding periods for fruits after harvest. Different preservation methodologies have been studied. One method of extending post harvest shelf life is the use of the edible coatings (Baldwin *et al*., 1995). Edible coatings provide a semipermeable barrier against oxygen, carbon dioxide (CO_2) moisture and solute movement; thereby reducing respiration, water loss and oxidation reaction rates (Baldwin *et al*., 1999; Park, 1999). Proteins, lipids and polysaccharides are the main constituents of edible films and coatings. Among the studied proteins are wheat gluten, corn zein, soy protein rice protein, egg albumin and milk proteins (Sobral *et al*., 2001; Lee *et al*., 2003; Bai *et al*., 2003; Perez-Gago *et al*., 2005; Falcão-Rodrigues *et al*., 2007; Perez-Gago *et al*., 2010)Polysaccharide-based coatings i.e. Alginate, pectins, cellulose and derivatives, starch and sucrose polyesters have been used to extend the shelf-life of fruits and vegetables (Ni´speros-Carriedo, 1994; Nussinovitch, 1997, 2000; Mancini and McHugh, 2000; Yang and Paulson, 2000; Rhim, 2004; Rojas-Grau *et al*., 2007; Asgar Ali., *et al*., 2010). Lipids also including waxes, acylglycerols and fatty acids have been used for extending the shelf-life of fruits and vegetables (Perez –Gago *et al*., 2006, Falcão-Rodrigues *et al*., 2007).

In this respect, mineral hydrocarbon MHC-based coatings are used on specific types of fruits and vegetables to prevent the loss of moisture, protect the commodities from bruising and add various degrees of sheen. MHC-based coatings may consist of one compound, such as mineral oil, or may consist of a mixture of MHC compounds, such as mineral oil, paraffin wax and petrolatum, blended to modify the melting point of the coating. Furthermore, a coating may be 100% MHC or the MHC product (s) may be part of a water-based emulsion, especially if a mold inhibitor or insecticide is added. When mineral oil is used, it is typically a low viscosity oil <15 cST at 40°C (Heimbach *et al*., 2002). In this regard, several authors noted that certain types of MHC oils and waxes have been shown to cause adverse effects in laboratory test animals (Baldwin *et al*., 1992; Low *et al*., 1992; Firriolo *et al*., 1995; Smith *et al*., 1996; Scotter *et al*., 2003; Farag *et al*., 2007). There is some evidence that mineral oil

exposure may be associated with human disease. Subcutaneous injection of mineral oil induces scalloping lipogranulomas a chronic local inflammatory reaction (Di Benedetto *et al*., 2002) and aspiration causes a severe chronic pneumonitis termed lipoid pneumonia (Spickard and Hirschmann, 1994).

The objectives of this research were to evaluate the potential using of soybean gum, jojoba wax, glycerol and Arabic gum to extend the shelf-life and quality of apple during cold storage and their effect on alternative materials to that of paraffin oil.

MATERIALS AND METHODS

Apple samples:

Undamaged mature Anna apple *(Malus domesticus* Borkh) fruits of uniform size, shape, weight and color, free of physical damage as well as fungal and color, infection were harvested in June 2007 and 2008 at Nubaria City, Egypt, and transported to the laboratory of Fruit Handling Dept. Horticulture Research Institute, Agricultural Research Center, Giza, Egypt.

Edible coatings:

Soybean gum was obtained from Cairo for oil and soap company (Giza, Egypt). Paraffin oil and Glycerol (99.0%) were of reagent grade (Gomhoria Co., Amireya-Cairo, Egypt). Jojoba (*Simmondsia chinensis*) oil (Alkanz Co., Zagazig, Egypt) and Arabic gum (Giza, Egypt) were of commercial grade. Arabic gum solution (15% w/ v) was prepared by dissolving Arabic gum in distilled water and heated at 40°C, with stirring until the solution became clear.

Coating process:

Apple fruits were washed in running tap water and cleaned with muslin cloth. The fruits were divided randomly into 6 groups (100 apples/group):

1- Control group (untreated)
2- Fruits were coated with thin layer of Jojoba wax
3- Fruits were coated with thin layer of paraffin oil
4- Fruits were coated with thin layer of Soybean gum
5- Fruits were coated with thin layer of Glycerol
6- Fruits were coated with thin layer of Arabic gum

The treated and untreated fruits were packed in foam plates and wrapped with polyethylene (thin 10µ micron) and each plate contains 4 fruits. The plates were stored at (0°C, 90-95% RH).

Physicochemical analysis:

The physico-chemical tests were conducted at the beginning of the experiment and after 15, 30, 45 and 60 days of storage. Weight loss was measured by weighting 4 of foam plates with apple fruits (the same plates used during all the storage times) and the losses were recorded for each replicate. Weight loss percentages were calculated as percentage from the initial weight. Apple fruit firmness was measured with a hand-held penetrometer (mod. FT 327, McCormick, Facchini, Alfonsine, Italy) equipped with a 7.9 mm diameter cylindrical probe. Results were expressed as kg/ cm^2. Decay percentage of apple fruits was calculated as the number of decayed fruit divided by initial number of all fruits time 100. External fruit color was determined according (McGuire, 1992; Voss, 1992) using a Hunter LAB DP-9000 colorimeter (Hunter Associate Laboratory, Reston, Va, USA). From 3 apple fruits, juice was extracted with an electrical juicer and used for the determination of Total Soluble Solids content (TSS, Brix %) with a refractometer (Carl Zeiss, Germany) and of Titratable Acids (TA).

TA was measured by titration with 0 .1 NaOH and expressed in percent of malic acid/100 ml of juice *A.O.A.C* (2000). Sensory properties were evaluated at room temperature under fluorescent light by 10 experienced panelists of Horticulture Research Institute (Fruit Handling Dept.). Apple fruits were served in randomly coded containers. Each panelist was asked about taste, odor and appearance and over all acceptability. According to (Bai *et al*. 2003),

the sensory characteristics were evaluated using the following 9 grading categories:

9 = Excellent
7 = Very good
5 = Good, limit of marketability
3 = Fair, limit of usability
1 = Poor, inedible

Statistical analysis:

The data of the present research (except sensory evaluation data) were subjected to analysis by 2 ways ANOVA (Completely randomized design factorial arrangement). Statistical analysis for the sensory data was performed by one way ANOVA (Complete randomized design one factor). P-values of 0.05 or less were considered significant.

RESULTS AND DISCUSSION

Weight loss percentage:

Table 1, shows the changes of Weight Loss Percentages (WLPs) of coated and uncoated apples (control) during cold storage. Generally, the WLP increased gradually (p#0.05) during storage period. The primary mechanism of moisture loss from fresh fruits and vegetables is by vapor-phase diffusion driven by a gradient of water vapor pressure at different locations (Yaman and Bayoindirli, 2002). On the other hand, respiration causes a weight reduction because a carbon atom is lost from the fruit in each cycle (Labuza, 1984; Pan and Bhowmilk, 1992). However, coating process caused a significant (p#0.05) decrease in WLPs compared with control sample. Control samples had significantly (p#0.05) higher WLP (5.82 and 6.03 %) at the end of the storage period, while apple samples coated with soybean oil gum and jojoba wax had significantly (p#0.05) the lowest WL p-values (3.00, 3.75 and 3.11, 3.41%, respectively). This reduction in weight loss was probably due to the effects of these coatings as a semi permeable barrier against oxygen, carbon dioxide, moisture and solute movement, thereby reducing respiration, water loss and oxidation reaction rates (Baldwin *et al*., 1999; Park, 1999). The obtained results are in a good agreement with the findings by(Garc´ia *et al*. 1998a, b) for strawberries coated with starch-based coatings and those of (Joyce *et al*. 1995), who reported that waxing extended the storage life of avocado both through a reduction in water loss and a modification of the internal atmosphere. Similar data were reported by (Bai *et al*. 2003) studying Gala apple, coated with 10% zein (natural corn protein). (Sumnu and Bayindirli 1995) noted that Semperfresh (10 g LG1) Jonfresh and Fames apple wax coatings were efficient in reducing the rate weight loss of Amasya apples. Chitosan and Polyethylene wax (PE) coatings also provide good protection for Hami melon (Cong *et al*., 2007).

Firmness:

Flesh firmness is one of the most important parameters regarding consumer acceptance and eating quality of apples (Wills *et al*., 1980).As shown in Table 2, firmness significantly (p#0.05) decreased with storage period in both treated and untreated fruits. At the end of storage, control samples clearly had the lowest (p#0.05) firmness (3.95 and 4.19 kg/ cm²) while apples coated with jojoba wax, paraffin oil, soy gum and glycerol retained the highest (p#0.05) firmness (4.94, 4.96, 4.95, 4.94 and 5.93, 5.53, 5.96, 5.85 kg /cm²) in both season, respectively. Fruits coated with Arabic gum were significantly less firm than the other treated samples (4.69 and 5.23 kg cm²). Nevertheless, this edible coating still largely reduces firmness losses if compared to untreated fruits. The retention of firmness can be explained by retarded degradation of insoluble protopectins to the more soluble pectic acid and pectin. During fruit ripening, depolymerization or shortening of chain length of pectin substances occur with an increase in pectin esterase and polygalactronase activities (Yaman and Bayoindirli, 2002).

Low oxygen and high carbon dioxide concentrations reduce the activities of these enzymes and allows retention of the firmness during storage (Salunkhe *et al*., 1991). Hence, our results nicely reflect the findings by (Yaman and Bayoindirli 2002) for cherries coated with Semperfresh™. Furthermore,(Patricia *et al*. 2005) reported

that refrigerated strawberry coated with wheat gluten based films had better firmness retention than control fruit.(Sumnu and Bayindirli 1995) also noted that Semperfresh™, Jonfresh and Fomesa apple wax were efficient in reducing the firmness change of Amasya apples during storage process. The same effects were observed by(Pre-Aymard *et al*. 2005) for Anna apple treated with 1-MCP.

Table 1: Effect of coating apples with Jojoba wax, Paraffin oil, Soybean gum, Glycerol and Arabic gum on weight loss percentages during cold storage at (0°C, 90-95% RH) at 2007 and 2008 seasons.

Treatments/storage period (day)	Control	Jojoba wax	Paraffin oil	Soybean oil gum	Glycerol	Arabic gum
1st Season						
0	0.00m	0.00m	0.00m	0.00m	0.00m	0.00m
15	1.99i	0.99l	1.46k	1.15kl	1.28kl	1.52k
30	2.73d-g	2.03j	2.38g-j	2.15ij	2.26hij	2.47f-i
45	3.77c	2.19ij	2.62e-h	2.54f-i	2.79def	2.77d-g
60	5.82a	3.11d	3.94c	3.00de	3.88c	4.66b
2nd Season						
0	0.00ml	0.00ml	0.00ml	0.00ml	0.00ml	0.00ml
15	2.22ij	1.34k	1.98j	1.55k	2.03j	1.99j
30	3.04fg	2.76gh	2.95g	2.56hi	2.88gh	2.89gh
45	4.01cd	3.64de	2.98g	3.05fg	3.13fg	3.01g
60	6.03a	3.41ef	4.18c	3.75de	4.01cd	4.98b

LSD at 0.05 = 0.3541; Values followed by different letter are significantly different at ($p<0.05$)

Table 2: Effect of coating apples with jojoba wax, paraffin oil, soybean gum, Glycerol and Arabic gum on firmness (kg/ cm²) during cold storage at (0°C, 90-95% RH).

Treatments/storage period (day)	Control	Jojoba wax	Paraffin oil	Soybean oil gum	Glycerol	Arabic gum
2007 Season						
0	5.46a	5.46a	5.46a	5.46a	5.46a	5.46a
15	5.00h	5.33b	5.31bc	5.34b	5.26b-e	5.28bcd
30	4.74i	5.26b-e	5.22c-f	5.22c-f	5.19def	5.18def
45	4.50j	5.16ef	5.14f	5.12fg	5.12fg	5.03gh
60	3.95k	4.94h	4.96h	4.95h	4.94h	4.69i
2008 Season						
0	6.04a	6.04a	6.04a	6.04a	6.04a	6.04a
15	5.33ef	5.84a-d	5.69a-e	5.77a-d	5.67a-e	5.76a-d
30	5.98a	5.96ab	5.88abc	5.87abc	5.65a-e	5.99a
45	4.66g	5.84a-d	5.43def	5.63a-f	5.82a-d	5.55b-f
60	4.19h	5.93abc	5.53c-f	5.96ab	5.85abc	5.23f

LSD at 0.05 = 0.3541; Values followed by different letter are significantly different at ($p<0.05$)

Titratable acidity:

Table 3, shows the changes of titratable acidity of coated and uncoated apples (control) during storage period. The results showed that titratable acidity values were gradually and significantly (p#0.05) decreased with increasing the storage period. Control samples without coating treatments had the lowest (p#0.05) level of titratable acidity presenting 0.30 and 0.33% the end of storage period. Titratable acidity of apple coated with jojoba wax, paraffin oil, soybean oil gum, glycerol and Arabic gum at the end of storage period, were approximately 1.23, 1.17,1.20, 1.17,1.17and 1.18,1.12, 1.18, 1.12, 1.15 times higher than titratable acidity of control sample without coating. In both seasons, respectively. Since, organic acids such as malic or citric acid are primary substrates for respiration, a reduction in acidity and, hence, increases in pH are expected in highly respiring fruits. Coatings reduce respiration rates and may, therefore, delay the utilization of organic acids (Yaman and Bayoindirli, 2002). Retention of titratable acidity was indeed reported for various fruits treated with Semperfresh (Dhalla and Hanson, 1988; Bayindirli *et al*., 1995; Summu and Bayindirli, 1995; Yaman and Bayoindirli, 2002. Also, Patricia *et al*. 2005). They indicated that coating fruits with PVC pack were effective in the retention of titratable acidity, losses of strawberry fruit during the storage time. The same observation was noted by(Pre-Aymard *et al*. 2005), who reported that coating with 1-MCP prevented acidity loss of Anna apple stored at 20°C for 12 days.

Total Soluble Solids (TSS):

The results presented in Table 4, show the changes of TSS. Values of coated and uncoated apple (control) during storage. Data showed that control samples without coating treatments had significantly (p#0.05) the highest levels of TSS value, (14.60 and 14.97%) were recorded at the end of the storage period. TSS values of apple coated with jojoba wax, paraffin oil, soybean oil gum, glycerol and Arabic gum at the end of storage period were approximately 1.06, 1.06- 1.06,1.08, 1.08 and 1.06,1.04 ,1.05,1.07 and 1.06 times lower than TSS value of control samples without coating in both seasons respectively . Similar effects were reported by) Kittur *et al*. 2001) for banana and mango coated with polysaccharide-based coatings and by (Patricia *et al*. 2005) for strawberry coated with wheat gluten-based films.

Table 3: Effect of coating apples with jojoba wax, Paraffin oil, Soybean gum, Glycerol and Arabic gum on Titratable acidity during cold storage at (0°C, 90-95% RH).

Treatments/storage period (day)	Control	Jojoba wax	Paraffin oil	Soybean oil gum	Glycerol	Arabic gum
2007 Season						
0	0.45a	0.45a	0.45a	0.45a	0.45a	0.45a
15	0.38f-i	0.41bc	0.40cde	0.42b	0.41bcd	0.41bc
30	0.37h-k	0.40cde	0.39efg	0.40def	0.39e-h	0.38ghi
45	0.35m	0.38ghi	0.37i-l	0.37i-l	0.36klm	0.36klm
60	0.30n	0.37i-l	0.35lm	0.36klm	0.35lm	0.35lm
2008 Season						
0	0.49a	0.49 a	0.49 a	0.49 a	0.49 a	0.49 a
15	0.41abc	0.45ab	0.44ab	0.45ab	0.45ab	0.45ab
30	0.40bc	0.43ab	0.42ab	0.43ab	0.41abc	0.40bc
45	0.37bc	0.41abc	0.39bc	0.39bc	0.38bc	0.39bc
60	0.33c	0.39bc	0.37bc	0.39bc	0.37bc	0.38bc

LSD at 0.05 = 0.3541; Values followed by different letter are significantly different at (p<0.05)

Table 4: Effect of coating apples with Jojoba wax, Paraffin oil, Soybean gum, Glycerol and Arabic gum on Total Soluble Solids (TSS) during cold storage at (0°C, 90-95% RH).

Treatments/ storage period (day)	Control	Jojoba wax	Paraffin oil	Soybean oil gum	Glycerol	Arabic gum
2007 Season						
0	12.50m	12.50m	12.50m	12.50m	12.50m	12.50m
15	12.96jkl	12.82kl	12.87kl	12.87kl	12.73lm	12.83kl
30	13.32f-i	13.00jkl	13.18hij	13.19g-j	13.00jkl	12.97jkl
45	13.95b	13.25f-j	13.46e-h	13.64cde	13.17hij	13.07ijk
60	14.60a	13.75bcd	13.80bc	13.67cde	13.49def	13.47efg
2008 Season						
0	12.95d	12.95d	12.95d	12.95d	12.95d	12.95d
15	13.34bcd	13.21bcd	13.32bcd	13.23bcd	13.01cd	13.11cd
30	13.65bcd	13.34bcd	13.39bcd	13.30bcd	13.45bcd	13.05cd
45	14.23abc	13.67bcd	13.89a-d	13.98a-d	13.75a-d	13.33bcd
60	14.97a	14.02a-d	14.34ab	14.23abc	14.00a-d	14.04a-d

LSD at 0.05 = 0.3541; Values followed by different letter are significantly different at ($p<0.05$)

Decay percentage:

Data summarized in Table 5, shows the changes of decay percentage values of coated and uncoated apple (control) during storage period. No decay signs were observed until 2 weeks after the beginning of storage period. Coating significantly (p#0.05) reduced decay compared to control samples without coating treatment during the storage period. Decay percentages of control samples at the end of storage period were approximately 2.41, 2.45, 3.22,2.35, 1.62 and 2.28,2.41,3.12,2.29, and 1.36 times higher than decay percentage of apple coated with jojoba wax, paraffin oil, soybean oil gum, glycerol and Arabic gum, in both seasons respectively. This decrease in decay percentages of treated samples was probably due to the effects of these coatings on delaying senescence, which makes the commodity more vulnerable to pathogenic infection as a result of loss of cellular or tissue integrity (Patricia *et al*., 2005). These results are in a good agreement with the findings of(Bai *et al*. 2003) for Gala apple, coated with10% zein. They found that coating with zein maintained apple quality similar to a commercial shellac formulation and extended apple shelf life compared with non-coated controls. Also,(Patricia *et al*. 2005) indicated that wheat gluten coatings and films extended the shelf life of strawberries and retarded the senescence process.

Colour:

Colour evaluation of coated and uncoated apples (control) during storage period is shown in Table 6. Lightness gradually decreased during storage in both coated and uncoated samples (Table 6). No significant ($p>0.05$) differences were observed between the different treated apples. Table 7 shows the changes of a* value of coated and uncoated apple (control) during storage period. The a* values of coated and control samples gradually increased (p#0.05) during storage. At the end of storage period the a* value of control sample was approximately 1.19,1.15, 1.20,1.21, 1.17 and 1.17,1.16,1.28,1,20 and 1.21 times higher than that of apples coated with jojoba wax, paraffin oil, soybean oil gum, glycerol and Arabic gum, in both seasons respectively. Our results are in a good agreement with the findings by Summu and Bayindirli 1995for Amasya apple.

Table 5: Effect of coating apples with Jojoba wax, paraffin oil, Soybean gum, Glycerol and Arabic gum on decay (%) during cold storage at (0°C, 90-95% RH).

Treatments/ storage period (day)	Control	Jojoba wax	Paraffin oil	Soybean oil gum	Glycerol	Arabic gum
2007 Season						
0	0.00j	0.00j	0.00j	0.00j	0.00j	0.00j
15	0.00j	0.00j	0.00j	0.00j	0.00j	0.00j
30	9.71c	3.63ghi	3.96f-i	2.95i	3.40hi	6.31d
45	12.33b	5.01ef	4.75ef	4.28e-h	4.48efg	6.69d
60	17.17a	7.11d	7.01d	5.34e	7.30d	10.63c
2008 Season						
0	0.00h	0.00h	0.00h	0.00h	0.00h	0.00h
15	0.00h	0.00h	0.00h	0.00h	0.00h	0.00h
30	9.99d	4.04g	4.12g	3.33g	3.76g	6.98e
45	12.75b	5.45f	5.34f	5.69f	5.97f	7.03e
60	17.95a	7.86e	7.45e	5.76f	7.85e	11.04c

LSD at 0.05 = 0.3541; Values followed by different letter are significantly different at (p<0.05)

Table 6: Effect of coating apples with Jojoba wax, Paraffin oil, Soybean gum, Glycerol and Arabic gum on color L (lightness) during cold storage at (0°C, 90-95% RH).

Treatments/ storage period (day)	Control	Jojoba wax	Paraffin oil	Soybean oil gum	Glycerol	Arabic gum
2007 Season						
0	37.38a	42.73a	42.77a	39.00a	40.08a	36.00a
15	34.65a	40.60a	40.83a	36.19a	38.14a	36.32a
30	34.34a	39.53a	39.76a	35.67a	37.58a	35.29a
45	33.05a	38.41a	38.68a	34.48a	37.07a	34.25a
60	29.71a	38.27a	28.28a	34.27a	36.00a	34.17a
2008 Season						
0	39.24b-f	45.13ab	45.98a	41.07a-f	43.98abc	40.78a-f
15	39.98a-f	42.29a-e	43.43abc	39.97a-f	40.87a-f	39.72b-f
30	37.94c-f	42.98a-d	40.73a-f	38.07c-f	40.91a-f	38.95c-f
45	35.86fgh	40.84a-f	41.84a-f	36.06fgh	39.91a-f	36.96d-h
60	31.65gh	40.84a-f	30.84h	37.06d-g	39.84b-f	36.77e-h

LSD at 0.05 = 0.3541; Values followed by different letter are significantly different at (p<0.05)

Table 7: Effect of coating apples with Jojoba wax, Paraffin oil, Soybean gum, Glycerol and Arabic gum on color (a* value) during cold storage at (0°C, 90-95% RH).

Treatments/ storage period (day)	Control	Jojoba wax	Paraffin oil	Soybean oil gum	Glycerol	Arabic gum
2007 Season						
0	21.20n	21.20n	21.20n	21.20n	21.20n	21.20n
15	25.17ghi	22.79m	23.59j-m	22.86m	22.77m	23.11lm
30	28.26c	23.63j-m	24.72h-k	23.79j-m	23.42klm	24.45i-l
45	30.93b	25.50ghi	26.14efg	26.02fgh	24.87g-j	25.91fgh
60	32.59a	27.36cde	28.45c	27.15c-f	26.92def	27.75cd
2008 Season						
0	23.07g	23.07g	23.07g	23.07g	23.07g	23.07g
15	27.45b-g	24.87d-g	26.01c-g	24.17fg	24.44efg	25.73c-g
30	30.55a-e	25.87c-g	26.89b-g	25.29c-g	26.05c-g	26.36c-g
45	32.83ab	27.84b-g	28.84b-g	28.90b-g	26.91b-g	27.94b-g
60	*35.94a*	*30.67a-d*	*31.07abc*	*28.06b-g*	*29.95a-f*	*29.67b-f*

LSD at 0.05 = 0.3541; Values followed by different letter are significantly different at (p<0.05)

Sensory evaluation:

Sensory evaluation results are given in Table 8, sensory results indicated no significant (p#0.05) difference, between coated and uncoated apple, for odor scores. Control samples had the highest (p#0.05) score for taste, 7.86, and 8.74 at the end of the storage period. No significant differences were observed between the samples coated with jojoba wax, paraffin oil, soy gum, glycerol or Arabic gum. Control sample had the lowest (p#0.05) scores for visual appearance, texture and over all acceptability while samples coated with paraffin oil and jojoba wax had significantly (p#0.05) the highest scores. The results of sensory evaluation suggest that jojoba wax, soy gum, glycerol and Arabic gum can be successfully used as edible coatings instead of paraffin oil.

CONCLUSION

The results of the current investigation indicated that apple fruits coated with jojoba wax, soy gum, glycerol and Arabic gum showed a significant delay in the changes of weight loss, firmness, titratable acidity, total soluble solids, decay and colour, during cold storage compared to uncoated ones. Sensory evaluation results showed also that coatings maintained the visual quality of Anna apples during the storage time.

Table 8: Sensory evaluation of apple samples coated with Jojoba wax, Paraffin oil, Soybean gum, Glycerol and Arabic gum at the end of cold storage (0°C, 90-95% RH).

Treatments/ storage period (day)	Taste	Odor	Visual appearance	Texture	Over all acceptability
2007 Season					
Control	7.86a	7.14a	6.60d	6.07c	6.91c
Jojoba wax	7.17b	7.05a	7.79a	7.61a	7.40ab
Paraffin oil	7.34b	7.07a	7.89a	7.50a	7.44a
Soybean gum	b7.09	6.99a	6.80c	7.57a	6.86c
glycerol	b7.11	7.12a	7.45b	6.83b	7.12abc
Arabic gum	7.27b	7.03a	6.70cd	6.85b	6.96bc
LSD at 0.05	0.5050	NS	0.1488	0.1378	0.4394
2008 Season					
Control	8.74a	8.23a	7.55d	6.97f	7.88c
Jojoba wax	8.23d	7.99c	8.80a	8.45c	8.34a
Paraffin oil	8.18d	7.98c	8.77a	8.66b	8.33a
Soybean gum	8.11e	8.06b	7.65c	8.67a	7.77d
glycerol	8.54b	8.08b	8.33b	7.85d	8.09b
Arabic gum	8.45c	7.88d	7.55d	7.77e	7.89c
LSD at 0.05	*0.0575*	*0.0575*	*0.0575*	*0.000b*	*0.0575*

Values followed by different letter are significantly different at ($p<0.05$); NS: Not Significant

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تأثير استخدام الاغطية الامنة على فترة التخزين وجودة ثمار التفاح (الانا) اثناء التخزين المبرد

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الملخص العربى

اجريت هذه التجربة خلال موسمي2007&2008 بمعهد بحوث البساتين –قسم بحوث تدوال الفاكهة على ثمار التفاح الانا. وقد تم استخدام اغشية رقيقة على الثمار صالحة للاكل للحفاظ على جودة وسلامة الفواكه والخضروات الطازجة. وكان الهدف من هذه البحث تقييم تأثير المعاملة بواسطة فول الصويا، شمع الجوجوبا ، الجلسرين والصمغ العربي بدلا من زيت البرافين التى اثبتت الابحاث العلمية ضررة على الصحة العامة .خزنت ثمار التفاح الانا على درجة حرارة صفر درجة مئوية ورطوبة نسبية من90 –95 % لمدة شهرين . قدرت بعض الصفات الطبيعية والكيماوية خلال فترة التخزين .

وأظهرت نتائج التقييم الحسي أن استخدام اغشية رقيقة على الثمار اثرت على الجودة للتفاح الانا خلال فترة التخزين. واوصت النتائج باستخدام الصمغ العربى وفول الصويا وشمع الجوجوبا ، الجلسرين بدلا من زيت البرافين.