Safe methods to reduce the losses of postharvest wastage of some soft date fruits due to fungal infection during cold storage

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ABSTRACT

The principle of objectives of this study aimed to determine the losses of postharvest wastage of soft date fruits (Rutab) cvs. Zaghloul and Samani with reference to their causal organisms. Posssibilities to control these disease by safe methods such as green algae and propolis extracts. The main causal organisms of postharvest fruits rots of two tested cvs. of date were *Botrytis cinerea*, penicillum *expensum* and *Rhizopus nigricans* during cold storage periods in two seasons (2010 and 2011). Fruits of the two tested cvs. were stored under cold storage (5 ±1 oC). Fruits of each tested were coating with green algae or propolis extracts, the results obtained after 30 and 60 days from treatments under cold storage condition, indicated that the most effective concentration was 100% to green algae and 30% to propolis extracts in two seasons, which reduced percentage of total wastage than control after 30,60 days on cvs. Zaghloul and Samani to (27.4, 35.2%), (28.5, 39.9 %) and (19.1,30.4%), (27.6,46.1%) in the first season and (23.1,33.0%), (25.1, 46.8%) and (17.4,28.9%), (37.6,48.1%) in the second season respectively, coating fruits of two tested cvs. with extracts of green algae (100%) or propolis (30%) caused greater reduction in weight loss, fruits shatter and decay percentages than which obtained at lower concentrations (25, 50%) to green algae or (10,20%) to propolis when fruits were stored 30 and 60 days under cold storage in two seasons.

Key words: Cold storage- Fungi - Green algae- Propolis extract - Soft Date Fruits.

INTRODUCTION

Date palm fruits, particularly those of Zaghloul and Samani cultivars are one to the most luxurious fruits and have high nutritive value (EL- Badawy, 2001).

No doubt that the processes of handling and storage of date fruits for local market and export are as important as fruits production and fruit yield. The extension of marketing period using postharvest treatments is of vital interest. Moreover, as a result of increasing the supply of date fruits, there is a desperate need for studying how the marketing period could be extended and how to reduce loss of fruits and to supply date fruits frequently and over a long period of time. Consequently, storage of date fruits is necessary to regulate the supply of date fruits according to marketing need over a long period of time.

Temperature has a direct effect on the respiration rates of fruits and on the decay percentage caused by the activity of organisms. The respiration rate is an index of the rate at which the fruits is using up its stored reserves of sugars and other metabolites and consequently, an index of the loss in shelf life.

The chemical reactions associated with respiration, results in the production of heat. The amount of generated heat varies with the commodity and with its temperature.

In general, the respiration rate increase two to four times for each 10 oC increase in temperature, and cold storage is required to reduce heat generation and decay percentage and proloning storage life (Abd El- Moniem, Eman and Magda Abd El- Migeed, 2006, Abd El-Migeed and Fatouh, 2007, and Raweewon 2008,).

Recently a great attention has been paid by many investigators all over the world concerning the growing need to develop alternative approaches for controlling postharvest decay.

Coating fruits with green algae decreased postharvest decay of tomato, strawberries and grapes resulting from fungal infection (Abd El- Moniem Eman, *et al.,* 2005) and has been widely used in medicine, agricultural production, (Benhamou *et al.,* 1998; El-Bardai, *et al.,* 2001, El- Gamal, Manal, 2006 and Calvo, 2007).

Recently, coating application of biochemical organic substances, which supply both macro and micronutrients, is of increased demand because they have the advantage that they are safe to human and environment.

Fresh water green microalgae contains high percentage of macro and micronutrients bounded in their major biochemical constituents such as amino acid, carbohydrates and proteins (El- Fouly *et al.,* 1992 and El – Fouly and Shaaban 1999).

Recent health concerns over pesticide contamination of food, public awarence towards chemical residues in the food chain. National Academy of Science report (Anonymous, 1987b) on pesticides residues indicated that fungicides pose more of a carcinogenic risk than insecticides and herbicides. All those factors together have generated an urgent need for the development of safer alternative technologies.

Propolis or bee glue, is a brownish resinous material collected by worker bees from the leaf buds of numerous tree species. The Term propolis – derives from the Greek pro (for in front of at the entrance to) and polis (community' or city) and means a substance in defense of the hive (Jin, 2002).

The major propolis compound are resins composed of flavonoids and phenolic acids, or their esters, which often form up to 50% of all ingredients, the antioxidant. Antimicrobial and antifungal activities of propolis offer scope for applications in food technology. One special advantage is that unlike some conventional preventatives, the residues of propolis seem to have a generally beneficial effect on human health (Krell, 1996).

Propolis has antioxidant, antimicrobial and antifungal activities where diseases are the principal factor limiting manog storage life (Abd EL-migeed and Fatouh, 2007).

Propolis has advantages of coating material that impact on storage life. Propolis reduces enzyme activity (Jin., 2002). This may impact on reducing changes during storage of mango fruits.

The future post- harvest research should aim to provide methods to control ripening avoid or minimize physiological disorders and to provide maximum fruit quality to the consumer.

The present work aims at evaluating the efficacy of the water extract of cell green algae (chlorella vulgaris) or proporis extract as coating treatment to recue the losses resulted from postharvest of date fruits, (cvs. Zaghloul and Samani). Possibilities to reducing this wastage by water extract of green algae or propolis extracts and testing it in cold storage against the most important postharvest decay pathogens of date fruits was also investigated.

MATERIASL AND METHODS

I- Isolation and identification of the causal pathogens:

Date fruits (cvs. Zaghloul and Samani) were stored 30 and 60 days at (5 ±1 oC). Each treatments consisted of three replicates 3Kg ± 250g each. Fruits were examined during storage at 30 and 60 days. The ones showed rotten symptoms, were used for isolation the causal which caused date rots according to (Waller, 1981) and identified according to (Barnett & Hunter, 1987).

II- Post harvest treatment of date fruits, with algae fresh cells during storage:

1- Preparation of algae extract:

A fresh slurry of the microalga Chlorella vulgaris (contains about 10% water) was washed with distilled water, reconcentrated by centrifugation and freezed and then remelted at room temperature. The melted slurry was then centrifuged at 5000 rpm to obtain a clear cell sap. Major components and nutrient content of the algae extract is shown in Table (1).

2- Coating date fruits with algae cell extract:

Fresh of date (cvs. Zaghloul and Samani) apparently free of physical damage and diseases were utilized to be coated with algae cell extract. Fruits of the two tested cultivars were dipped in 25,50, or 100% green algae cell extract. Control were dipped in sterilized water. Tested fruits were air dried for 2 hour and packed in carton boxes (45 x 35x 10cm) and directly stored at (5 ±1 oC). Each treatment included replicates, 3Kg ± 250g each.

3- Ethanol extracted propolis (EEP)

Preparation for extraction: The propolis was prepared by removing coarse debris and excessive wax then be broken into small pieces. Propolis concentrations at rates 10, 20 and 30% were prepared by weighing propolis at rates 100, 200 and 300g then each rate of propolis poured with 900, 800 and 700g ethyl alcohol respectively into 1L clean, dark colored bottle which can be tightly closed then be shaken briefly. Shaking was repeated twice a day; the mixture was left in a warm dark place. After one weeks the liquid was filtered through a paper filters. Twice finally, the filtrate was kept in a cool dark place (Krell., 1996).

II-Determine of post harvest treatments of date fruits with algae or propolis extracts under cold storage periods:

Percentage of decay (%): The detection of decay was carried out at 30 and 60 days under cold storage. Fruit date showed symptoms of decay were detached and the percentage of decay was calculated by weight as follows:

$$\text{Decay}\,\% = \frac{\text{weight of decayed date fruits (g.)}}{\text{initial weight of date fruits (g.)}} \times 100$$

Weight loss (%): Was calculated by weighting of sample date fruits each 30 and 60 days during cold storage the initial weight of date fruits were recorded at zero- time:

The following formula was used to determine the percentage of weight loss.

$$\text{Weight loss}\,\% = \frac{\text{Initial weight} - \text{Weight of Sampling date}}{\text{initial weight of the date fruits (g.)}} \times 100$$

Shattering percentage: The value of shatter fruits was determined as follow:

$$\text{Shattering}\,(\%) = \frac{\text{weight of shattered fruits}}{\text{initial weight of date fruits}} \times 100$$

Wastage percentage: The value of wastage (%) was determined according to (Wassel, 1985) as fellow:

Wastage (%) = Decay % + Weight loss % + Shattering %.

Reduction percentage: The reduction in wastage fruits was calculated as compared to wastage of control:

$$\text{Reduction of wastage}\,(\%) = \frac{\text{Total wastage of treatment} - \text{Control}}{\text{Control}} \times 100$$

Statistical analysis:

Data obtained were statistically analyzed when necessary using L.S.D. procedure outlined (Snedecor and Cochran, 1982) and using the standard procedure for split designs mentioned by (Snedecor and Cochran 1967).

RESULTS

1-Frequency and identification of isolated fungi (%) causing rot to date fruits:

Date fruits of Zahgloul and Samani were harvested at full coloured stage (Khlal) were stored at (5 ±1 oC) and examined at 30 and 60 days during storage for rot causal organisms. Date fruits, which showed rot symptoms, were subjected to isolating and culturing the associated fungi. Frequency of various isolated fungi during cold storage period are presented in table (3). Data in table 3 show that in cv. Zaghloul the frequency of *Botrytis* recorded (37.6, 27.4%) after 30 and 60 days, while the frequency of *Penicillum* recorded (21.1, 29.5%) in the first season. Mean while, in the second season recorded (32.7, 28.6%) and (19.6, 24.3%). in cv. Samani, recorded (36.3, 36.5%), for *Botrytis* and (22.7, 24.9) for *Penicillum* in the first reason, while in the second for *Botrytis* receded (32.6, 37.5) and (22.9, 26.6%) for *Penicillum*. Results indicate that, the percentage of frequency of the fungi, *Botrytis*,*Penicillum* and *Rhizopus* increased as the storage periods increased.

The isolates that exhibited the highest percentage of frequency were identified as *Botrytis cinerea*, *Penicillum expensum* and *Rhizopus nigricans*

2- Fruit decay percentage

Data in Table (4, 5) show that decay percentage is storage temperature dependent. In other words, the lower storage temperature the longer is the storage period. The obtained results emphasize these words, hence the storage period under cold storage at 5oC was extended up to 60 days in two seasons. Moreover, it is clear that Samani fruits proved to be more tolerant to decay agents during the storage period. Besides, Zaghloul fruits recorded nearly similar values of decay percentage throughout the storage period. As for the effect of fruit treatment with algae or propolis extracts on decay percentage, it is obvious that two treatments succeeded in reducing decay percentage as compared with the control. On the contrary, untreated fruits (control) of the two studied cultivars recorded comparatively higher decay percentage.

3- Fruit weight loss percentage:

Furthermore tables (4,5) demonstrates that the interaction between the cultivar and green algae or propolis extracts treatments induced a pronounced effect on weight loss percentage of date fruits. Briefly, Samani fruits treated with

100% algae or 30% propolis showed statistically similar and the lowest weight loss percentage during the storage period 30 and 60 days in two seasons, followed ascendingly by the analogous ones of Zaghloul cv. treated with 100% algae or 30% propolis extracts. On the contrary, untreated fruits (control) of Zaghloul and Samani cvs. recorded the highest values of fruit weight loss. Other studied combinations gave in between values in this respect.

4- Fruits shattering percentage:

Data of presented in Table (4, 5) indicate that two tested cvs. fruits shattering percentage increased by progress in cold storage period to 60 days in two seasons. However, fruits treated with 100% algae or 30% propolis extracts had lower fruits shattering percentage (45, 38%) and (42, 33%) for Zaghloul and Samani in the first season and (47, 30%), (40, 35%) in the second season after 60 from cold storage.

5- Total wastage and reduction than control percentage:

Data presented in Table (4, 5) show that the highest percentage of total wastage and reduction than control were determined after 60 days, from cold storage at (5 ±1 oC). Algae 100% or propolis extracts 30% resulted in the highest reduction in total wastage and reduction than control. For Zaghloul cv. fruits treated with algae 100% or propolis 30% recorded (78.2%, 65.8%) total wastage and reduction than control recorded (28.5%, 39.9%) in the first season and (81.7%, 58.0%) total wastage and reduction than control recorded (25.1 %, 46.8%) in the second season. For Samani cv. recorded (70.7, 52.6%) total wastage and reduction than control recorded (27.6, 46.1%) in the first season and (64.1, 53.3%) total wastage and reduction than control recorded (37.6, 48.1%) in the second season.

6- Shelf life:

The effect of cultivar namely Zaghloul and Samani, fruits treatment with algae 100% or propolis extracts 30% on shalf life of date fruits stored at (5 ±1 oC) is illustreated in Table (6). It is obvious that increasing storage period at room temperature resulted in increasing decay percentage at room temperature and shelf life was decreased. Moreover the two tested treatments succeeded in enhancing shelf life of date fruits stored at (5 ±1 oC).

Zaghloul and Samani cultivars treated with 100% algae or 30% propolis extracts exerted equally and highly positive effect in this respect. Besides, untreated (control) and separated fruits of Zaghloul and Samani gave the least positive effect in this sphere the remaining interactions came in between in this concern.

DISCUSSION

Date fruits are one of the largest cultivated fruit crops in several countries. Fruits are mostly subjected to infection during handling, transportation and storage, which causes high losses. Study the problem was to reach safe alternative for preservation against postharvest decay and prolonging storage period of date fruits.

Fruits of Zaghlgul and Samani cultivars were stored at cold storage (5 ±1 oC) for 60 days. Samples were taken every 30 days for evolution. The experiment was repeated for two seasons (2010 and 2011).

Botrytis ceinerea, *Penicillium expensium* and *Rhizopus nigricans* were the most frequent fungi on three tested cultivars during storage in the two seasons. *Botrytis* rot is known to be the most widespred and major cause of deterioration of date fruits in cold storage (Hoa *et al.,* 2002 and Tripathi and Dubey, 2004). This of ungns is the main decay problem all over the world in date fruits exposed in the field to high humidity.

As for decay in date fruits, weight loss, shattering and total wastage estimated during storage, four those factors increased as the time of storage was increased.

The role of cold storage reducing decay percentage could be explained by the fact that the chemical reactions associated with respiration results in the production of heat. Microbial organisms also are more active at high than low temperature. Therefore, cold storage is required to reduce this generation of heat and fruit decay. The results of cold storage and related discussions are in harmony with the finding of on Samani and Zaghloul date fruits of (El Badawy, 2001) on date palm fruits (Mehaisen, 2005 a and b) in guava and pear.

Green algae or propolis extracts could be used as a substitute of fungicides to inhibit postharvest decay. Green algae or propolis extracts coating decreased postharvest decay of several fruits (Abd El – moniem, Eman *et al.,* 2005) on grapes and (Abd El – Migeed and Fatouh 2007) on mango fruits. These findings are confirming with the obtained results which approved that green algae or propolis extracts at high concentration were effective in preventing postharvest decay of grape fruits. The effects appear to be related the fungistatic property of the coat as indicated by (Abd El-Moniem, Eman *et al.,* 2008 and Soliman, *et al.,* 2009).

It could be suggested that green algae or propolis extracts might be safty used commercially as fruit coating to control postharvest disease and for prolonging the shelf life of sensitive fruits.

The role of green algae and propolis extracts in reducing the decay percentage may be due to the fact that calcium appears

to have an important regulating effect in the metabolism of date fruits. Metabolic disorders such as bitter pit, cork spot, internal breakdown and water core are all severely reduced if calcium is present in sufficiently high quantities in fruit. This suggests that calcium may regulate respiration and perhaps other metabolic processes in the mature fruit.

The results reported that coating of green algae significantly reduced the respiration rate, ethylene production and interval O2 level of Awis mango. (Abd El – Migeed and Fatouh 2007) reported that treatment with propolis coat were effective in decreasing weight loss and reducing respiration rate. Mean wile, results indicate that all propolis extract concentrations significantly decreased the disease incidence of mango fruits, and promising treatment to prolong shelf life, preserve fruit quality and reducing disease incidence significantly.

The weight loss is mainly a result of water loss from the fruit tissues and partially of the respiration process. The higher storage temperature, the higher are the respiration rate and weight loss (Mehaisen, 2005 a and b). He mentioned that the higher the air temperature, the more is water loss because of its capacity to evaporate water (Diga et al, 2000) on salustina orange fruits (El Badawy, 2001) on date palm fruits and (Mehaisen 2005b) on pear fruits.

They mentioned that there was reversible relationship between the storage temperature and weight loss. Moreover, the role of green algae or propolis extracts treatments on reducing weight losse was reported earlier by (Daood, 1995) on Zaghloul dates, (Bhartiya *et al.,* 1998) on apple fruits, (Farooq *et al.,* 1999 and Mehaisen 2005b) on pear fruits. They demonstrated that the physiological weight loss was generally lower in green algae treated fruits.

Use of algae cell or propolis extracts decreased the percentage of total wastage as well as precnetage of decay. Highly significant reverse correlation were found between the increased concentration of extract and percentage of total wastage.

Nutrients present in the cell of green algae or propolis extracts, which mostly are in organic from can be directly involved in the metabolism. Mean while, the amino acids derived from proteolysis can work as chelating agents, facilitating the penetration of elements through fruits (El Fouly, *et al.,* 1992). Amino acids can also migrate to fruits and play a role as phytosiderphores, facilitating the absorption of micronutrients through the fruits (Shaaban and Mobarak 2000). Moreover, algae extract as a natural plant cell sap contains certain amounts of hormones, enzymes and vitamins that may improve nutrient assimilation.

As for shelf life, the results of storage temperature go in line with finding of Zhang *et al.,* (2000) on Litchi. Besides, the obtained results of fruits treatment with green algae or propolis extracts are in harmony with those mentioned earlier by (Freire and Chitarra 1999) on mango, (Mehaisen 2005a&b) on pear and (Abd El Mgeed& Fatouh 2007) on mango fruits.

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Tables

Table 1: Major chemical composition and elemental contents of algae Chlorella vulgaris cell extract. (El-Fouly *et al.,* 1992).

General composition			Element content	
Protein (%)		44	**Macro-elements (%)**	
Fats (%)		6	N	7.1
Carbohydrate (%)		7.3	P	0.66
Amino acid composition (g/100g protein)*		12	K	2.15
Arginine	6.9	8	Mg	0.34
Histidine	2.0		Ca	0.18
Isoleucine	3.2		Na	0.04
Lucien	9.5			
Lysine	6.4	48.6	**Micro-elements (ppm)**	
Methionine	1.3	6	Fe	245
Phyenylalanine	5.5		Mn	131.2
Theronine	5.3		Zn	111.5
Tryptophan	1.5		Cu	28
Valine	7.0			

The treatment was carried out at three replicates.
Control: distilled water
T1: 25% (v/v) algae cell extract in distilled water.
T2: 50% (v/v) algae cell extract in distilled water.
T3: 100% (v/v) algae cell extract.

Table 2: The major compounds of propolis .

Class of components	Group of components
Resins	45 to 55% Flavonoids, Phenolic acids and esters 25 to 35%
Wax and fatty acids	Most are usually from bee wax, but may are of plant origin
Essential oils	10% volatiles
Pollen	5% Proteins probably from pollen: free amino acids.
Other organics and minerals	5% 14 trace minerals of which Fe and Zn are most common ketones, lactones, quinines, steroids, benzoic acid and esters, vitamins (only B) and sugars.

Table 3: Frequency of various isolated fungi(%)causing rot to date fruits cvs. Zaghloul and Samani under cold storage conditions (5 ±1 oC)

Isolates Fungal group	1st Season (2010)							
	cv. Zaghloul				cv. Samani			
	30 days		60 days		30 days		60 days	
	No. of date fruits	% isolation	No. of date fruits	% isolation	No. of date fruits	% isolation	No. of date fruits	% isolation
Botrytis cinerea	320	37.6	195	27.4	205	36.3	183	36.5
Penicillum expensium	180	21.1	210	29.5	128	22.7	125	24.9
Rhizopus nigricaus	135	15.8	122	17.1	105	18.6	98	19.5
Fusarium sp.	90	10.6	100	14.1	65	11.4	60	11.9
Alternaria alternata	55	6.5	-	0.0	-	0.0	-	0.0
Aspergillus sp.	50	5.9	85	11.9	42	7.4	36	7.2
Others	22	2.6	-	0.0	20	3.6	-	0.0
Total	852	100	712	100	565	100	502	100
2nd Season (2011)								
Botrytis cinerea	272	32.7	125	28.6	138	32.6	120	37.6
Penicillum expensium	163	19.6	106	24.3	97	22.9	85	26.6
Rhizopus nigricaus	128	15.4	73	16.7	85	20.1	66	20.7
Fusarium sp.	96	11.5	65	14.9	50	11.8	30	9.5
Alternaria alternata	78	9.4	48	10.9	-	0.0	-	0.0
Aspergillus sp.	63	7.6	20	4.6	35	8.3	18	5.6
Others	32	3.8	-	0.0	18	4.3	-	0.0
Total	832	100	437	100	423	100	319	100

Table 4: Effect of green microalgae and propolis extracts as fruit coating (%) on total wastage and reduction than control percentage of date fruits (cv. Zaghloul) stored at cold storage (5 ±1 oC)and (90-95 R.H.) after 60 days from cold storage.

1st Season (2010)											
Cold storage periods (5 ±1 oC)											
		30 days					60 days				
Treatments	Con.%	Decay %	Weight loss %	Fruit shatter %	Total Wastage %	Reduction than Control%	Decay %	Weight loss %	Fruit shatter %	Total Wastage %	Reduction than Control%
Control (untreated)	-	8.7	6.4	25.0	40.1	-	34.6	9.8	65.0	109.4	-
Green algae extract	25	8.5	5.2	23.0	36.7	8.5	33.0	10.0	53.0	96.0	12.3
	50	6.9	5.0	21.0	32.9	18.0	30.3	8.5	50.0	88.8	18.8
	100	5.5	4.6	19.0	29.1	27.4	25.2	8.0	45.0	78.2	28.5
Propolis extract	10	6.0	5.1	22.0	33.1	17.5	26.0	8.1	45.0	79.1	27.7
	20	4.5	4.3	20.0	28.8	28.2	21.5	7.8	40.0	69.3	36.7
	30	4.0	4.0	18.0	26.0	35.2	20.6	7.2	38.0	65.2	39.9

L.S.D. at 5% for : Treatments (T)= 1.6 Storage (S) = 2.1 (T) x (S) = 4.3

2nd Season (2011)											
Control(untreated)	-	7.8	5.6	26.0	39.4	-	35.8	10.3	63.0	109.1	-
Green algae extract	25	7.7	5.0	24.0	36.7	6.9	32.0	9.5	55.0	96.5	11.6
	50	5.9	4.9	20.0	30.8	21.8	27.0	9.1	50.0	86.1	21.1
	100	5.6	4.7	20.0	30.3	23.1	25.7	9.0	47.0	81.7	25.1
Propolis extract	10	6.1	4.6	22.0	32.7	17.0	26.0	10.0	42.0	78.0	28.5
	20	5.5	4.1	21.0	30.6	22.3	22.3	8.6	35.0	65.9	39.6
	30	4.0	3.4	19.0	26.4	33.0	20.0	8.0	30.0	58.0	46.8

L.S.D. at 5% for : Treatments (T)= 1.4 Storage (S) = 2.6 (T) x (S) = 3.8

Table 5: Effect of green microalgae and propolis extracts as fruit coating (%) on total wastage and reduction than control percentage of date fruits (cv. Samani) stored at cold storage (5 ±1 oC) and (90-95 R.H.) after 60 days from cold storage. w

1st Season (2010)											
Cold storage periods (5 ±1 oC)											
		30 days					60 days				
Treatments	Con.%	Decay %	Weight loss %	Fruit shatter %	Total Wastage %	Reduction than Control%	Decay %	Weight loss %	Fruit shatter %	Total Wastage %	Reduction than Control%
Control (untreated)	-	4.3	4.5	32.0	40.8	-	29.0	8.6	60.0	97.6	-
Green algae extract	25	4.0	4.3	31.0	39.3	3.7	27.1	8.5	55.0	90.6	7.2
	50	2.7	4.0	30.0	36.7	10.0	25.0	8.0	49.0	82.0	16.0
	100	2.3	3.7	27.0	33.0	19.1	21.5	7.2	42.0	70.7	27.6
Propolis extract	10	2.5	3.8	31.0	37.3	8.6	20.0	7.3	45.0	72.3	25.9
	20	1.8	3.2	28.0	33.0	19.1	15.7	7.1	40.0	62.8	35.7
	30	1.5	2.9	24.0	28.4	30.4	12.6	7.0	33.0	52.6	46.1

L.S.D. at 5% for : Treatments (T)= 2.7 Storage (S) = 3.1 (T) x (S) = 6.2

2nd Season (2011)											
Control(untreated)	-	5.5	3.7	34.0	43.2	-	27.0	8.7	67.0	102.7	-
Green algae extract	25	4.9	3.5	33.0	41.4	4.2	25.3	7.6	63.0	95.9	6.6
	50	4.7	3.0	30.0	37.7	12.7	20.0	7.3	50.0	77.3	24.7
	100	4.1	2.6	29.0	35.7	17.4	17.1	7.0	40.0	64.1	37.6
Propolis extract	10	4.0	3.1	30.0	37.1	14.1	18.1	7.1	40.0	65.2	36.5
	20	3.3	2.3	28.0	33.6	22.2	16.2	6.5	38.0	60.7	40.9
	30	2.6	2.1	26.0	30.7	28.9	12.0	6.3	35.0	53.3	48.1

L.S.D. at 5% for : Treatments (T)= 2.2 Storage (S) = 4.4 (T) x (S) = 5.8

Table 6: Effect of green microalgae and propolis extracts as coating treatments on shelf life date fruits stored at cold storage (5 ±1 oC)and (90-95 R.H) (after 60 days from cold storage).

Treatments	Conc. %	cv. Zaghloul			cv. Samani		
		Storage on shelf life (days) decay %					
		2	4	6	2	4	6
1st Season (2010)							
Control(untreated)	-	40	55	90	30	45	70
Green algae extract	25	40	50	80	30	40	65
	50	30	40	50	20	30	40
	100	25	30	45	20	30	40
Propolis extract	10	20	30	45	20	30	35
	20	20	30	40	20	25	30
	30	15	20	40	10	25	30
L.S.D. at 5% for:		Treatment (T)= 3.5 Cultivars (C) =1.5 (T) x(C) =4.8					
2nd Season (2011)							
Control(untreated)	-	40	50	75	30	40	65
Green algae extract	25	40	55	75	30	40	60
	50	20	50	60	20	30	40
	100	20	35	40	20	30	40
Propolis extract	10	20	30	45	20	25	35
	20	15	40	45	15	20	30
	30	10	25	35	15	20	30
L.S.D. at 5% for:		Treatment (T)= 4.1 Cultivars (C) =1.8 (T) x (C) =5.2					