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Original research

Effect of coating application by carboxy methyl cellulose on the quality and validity of grapes (Vitis vinifera)

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Abstract:

Flame seedless grapes (Vitis vinifera) were coated with edible films. The samples were divided to three groups. The first group was coated with 1% Carboxy methyl cellulose, the second groups were coated with 1% Carboxy methyl cellulose,0.2% citric acid and 0.1% ascorbic acid. The third group was the control (without coating). All treatments were then stored at room temperature(28±3ºC) for 12days or at cool temperature(4±1ºC) for 90 days. Shelf-life sensory traits including taste, color, texture, and overall acceptability were in control T0 was 9.7,9.5,9.0 for 0,4,8 day stored at room temperature(28±3ºC) with treatment T1 was 9.7,9.5,9.1, 8.9 after 0,4,8,12 day stored at room temperature (28±3ºC), and the sample control were 9.7,9.5, 9.0 after 0, 15, 30 day stored at refrigerator temperature (4±1ºC) with treatment T2 were 9.8,9.5,9.2,8.9,8.7,8.5after 90 day stored at refrigerator temperature (4±1ºC). Also the better sensory acceptance was detected for the treated samples along the storage period. Moisture content significant reduction in moisture was detected in untreated samples compared to treated, moisture decreased during the storage period, as it reached in the sample control (80.06–73.78) after 4 day stored at room temperature and the treatment T1(79.73-75.84) After 12 days from the storage at the temperature of the room. And the treatment T0 (80.22-76.01) after 15 days from the storage at cold temperature comparison with the treatment T1 were (80.1- 76.28) after 90 days from the storage at refrigerator temperature. color, thickness and microbial examination were determined during coating with carboxy methyl cellulose displayed greater external adequacy than untreated ones.

Key words : Coating; carboxy methyl cellulose; grapes;CMC; edible films

1- Introduction

Grapes fruits of *(Vitis vinifera)* have been consumed by human for thousands of years because of their nutritional and medicinal benefits. Sugars, flavonoids, anthocyanins and proanthocyanins, organic acids, tannin, mineral salts, and vitamins are abundant in them (Goldstein et al 1992; Baldwin et al., 1995; Cuq, et al., 1998; Debeaufort, and Voilley, 1998).

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The skin of grapes, especially red and black varieties, is high in resveratrol, a stilbene derivative. Resveratrol has been demonstrated in studies to be one of the most powerful natural antioxidants.It may be found in abundance in black grape juice, peel, and seed. (Ruaaaziz et al ., 2010). The seeds and the leaves of the grapevine are used in herbal medicinse and its fruits are utilized as a dietary supplement (Marjan & Zadeh (2009).

Grapes are nutritious fruit rich in glucose, fructose, sucrose, formic acid, citric acid, and particularly malic and tartaric acid. (Watters and Brekke, 1961; Baldwin et al., 1995; Cuq, et al. 1998; Debeaufort, and Voilley, 1998).

Demand, vineyard practises, and post-harvest storage facilities all have an impact on quality (Crisosto et al. 2002). The importance of postharvest grape quality is growing as the supply of high-quality commodities continues to outstrip demand, not just during harvest but also after storage. (Thompson, A.K., 2001).

The idea of using edible coatings came from the skin of fruits and vegetables (Lowe at al., 1963 and Goldstein et al .1992). This is a thin coating of edible ingredients that prevents food from losing water, oxygen, and other soluble elements. (Lowe at al., 1963; Lachman, et al., 1986 and Gennadios & Weller, 1990). Some advantages of edible coating are as follows: Some advantages of edible coating are as follows: It is palatable, reduces environment pollution, It has a great effect on taste properties, develops nutritional value, and has bactericidal effects (Watters and Brekke, 1961; Lowe et al., 1963 and Lachman, et al., 1986).

Edible films are thin films made of edible material that act as a shield to external agents (moisture, oils, gases, and vapours), protecting the food, extending its shelf life, and increase the consistency of the product (Suyatma et al..,2005). Edible films may regulate the transfer of moisture, oxygen, carbon dioxide, taste, and fragrance between food components or the environment surrounding the food. An edible film is generally described as a preformed thin layer or solid sheets of edible material deposited on or between food components (Krochta and Johnston 1997). They can be used as film wraps or pouches for food. Different food ingredients, derived from meats, cereals, nuts, fruits and vegetables, are being used to produce edible films for strips and pouches. These films act as novel packaging systems and control the release of active compounds such as antioxidants, flavors and antimicrobial agents (Rojas et al .,2006 and Du et al.,2009). The use of edible films in food protection and preservation has recently increased since they offer several advantages over synthetic materials, such as being biodegradable and environmentally safe (Tharanathan,,2003).

There are different kinds of films which are used such as protein, polysaccharide, lipid and composed films (Owens and Schultz, 1952 ; Goldstein, et al., 1992; Baldwin, et al. .,1995 and Hershko, and Nussinovitch, 1998). These films can be placed on fruit and vegetable surfaces through different ways like dipping, spraying and fluidized bed systems (Senesi and Mchugh, 2000).

Carboxy methyl cellulose (CMC) is a cellulose derivative that is mainly used in many food applications for its viscosity, water binding properties, and solution clarity. There are several available viscosity grades of CMC, ranging from ~50 (2% concentration) to 13,000 cP (1% concentration) in water.

The CMC structure involves carboxymethyl substitution of the native cellulose polymer at C 2, C-3 or C-6 positions of anhydroglucose units (Fig. 1). The degree of substitution (DS) is generally in the range of 0.6–0.95, but the legal limit is a DS of 1.0. The higher the DS, the more

soluble and stable the CMC solution. However, the uniformity of substitution along the cellulose backbone also influences the solubility and smoothness of CMC solutions.

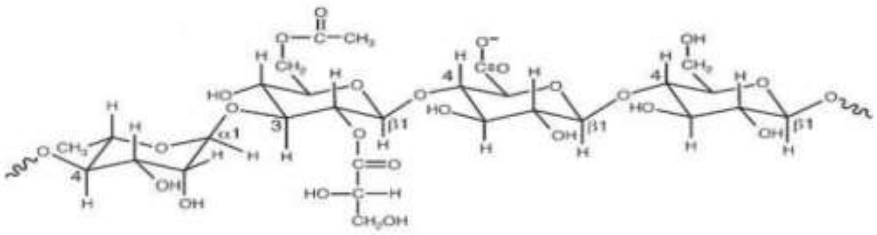

Fig.1 . The CMC structure involves carboxymethyl substitution of the native cellulose polymer at C 2, C-3 or C-6 positions of anhydroglucose units .

The aim of this study was to:

1- Evaluate the efficacy of carboxy methyl cellulose coating on quality of the grapes.
2- Extend the shelf life of the seedless grapes variety.
3- Improves the quality of grapes during storage.

2. Materials and Methods

2.1 Plant materials and treatments

In this study, fruittype of grapes (Vitis vinifera) of the cultivar flame seedless cultivar were used. The treatments were done according to table 1. with dipping the fruitDuring primary tests appropriate time for dipping and the best concentration of solution were determined. Dipping was the most capable method of coating for grapes. This process was done in three replications

2.2. The stages of coating are followed according below:

Preparation of film solution.

The first solution was prepared from Carboxy methyl cellulose 1%, w/v was suspended in 30 ml 95% ethanol. Seventy ml distilled water was added while stirring (Yao and Ranawat,. 1996). The second solution was prepared from 1% carboxyl methyl cellulose concentration , 0.2 % citric acid, and 0.1 % ascorbic acide. Dipping of samples in solution for 2-3 minutes and then left for 0.5 - 1 h at room temperature to be dried, then coated grapes were packed in polypropylene bags of 20 x 20 cm2 with a 29.2 pmol s-1 m-2 Pa-1 oxygen transmission rate film stored in cold temperature (4 ºC ±1) for 90 days, and stored in room temperature (28 ºC ±3) for 12 day.

Moisture content, sensory properties ,color, the thickness and microbial examination were determined during storage in the first day and 4, 8 and 12 at room temperature (28±3 ºC) or at cooling temperature (4±1 ºC) for 15, 30, 45, 60, 75 and 90 starting then stored.

Table 1: postharvest treatments to prolong the shelf life of grapes:

treatment	CMC	Citric acid	Ascorbic acid
T0	----	----	----
T1	1 %	----	----
T2	1 %	0.2 %	0.1 %

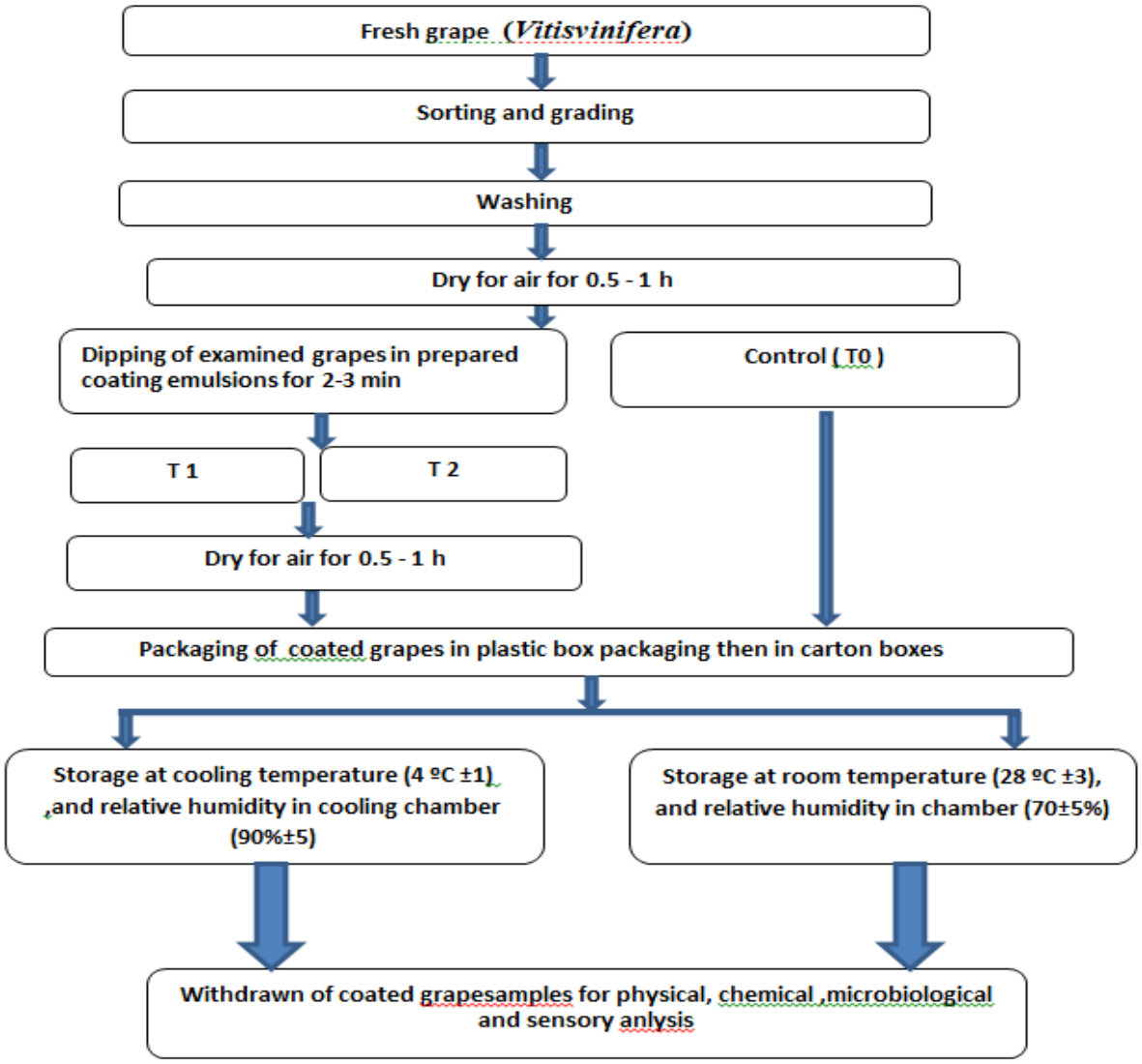

Fig.2 . Flow diagram of preparation and coating with edible edible films scheme for the edible film coating of grapes.

2.3 Storage conditions

Every treatment was divided into two groups, the first group stored at room temperature (28 ºC ±3), and relative humidity in chamber (70±5%) for 12 days (Month july). While the second one was stored at cooling temperature (4 ºC ±1), and relative humidity in cooling chamber (90%±5) for 90 days.

Table.2 : Shelf life of fresh grapes coated with edible films.

Emulsion constituents	Shelf life per day at room temperature (28C ±3) (day)	Shelf life per day at under cooling temperature(4C±1) (day)
T0	5	15
T1	14	95
T2	15	96

2.4. Analytical methods

2.4.1. The moisture content

The moisture content was determined by drying samples under vacuum at 70 ºC according to A.O.A.C. 2000).

2.4.2. Fruit firmness (Ib/inch2)

The firmness of fresh fruit was determined by measuring the comporession force of the samples using a Fruits Hardness Tester Cat.Nos. 510-1 (FHR-1).

2.4.3. Microbiological analysis

The microbiological analysis comprised the determination of total colony count, psychrophilic bacterial count and molds and yeasts was carried out as following ;

2.4.3. 1. Preparation of sample for microbiological analysis:

Under aseptic conditions, 50 gram of each sample were added to 450 ml of sterilized peptone water (1 gm/liter) in sterilized glass blender jar. The weighed samples were blended for 5 min. The provided a dilution of 10. appropriate serial dilution were made, and then samples were plated by standard microbiological pour plat technique for enumeration (FAO/WHO, 1995). All the microbiological counts were carried out in duplicates

2.4.3.1.1. Total plate count (TPC)

Total plate count of bacteria was determined as (CFU/g) using plate count agar medium according to the procedures, described (FAO/WHO,1995)

2.4.3.1.2. Psychrophilic bacterial count

Psychrophilic bacterial count was determined as (CFU/g) described in typical procedure of the total colony count method, except incubation was carried out at 7ºC for 5-7 days in refrigerator according to(Diliello ,1982)

2.4.3.1.3. molds and yeasts count:

The mold and yeast were determined using the methods for the microbiological examination of foods described by American public Health association (AP.H.A, 1976).

2.4.4. sensory evaluation

The sensory quality of each replicate berry was evaluated by taste , color , texture , overall acceptability . They were rated on a ten-point hedonic scale (١٠-٧, excellent; ٦-٤, good; and ٣-1, poor); intensity and acceptability increased with the numerical value. (Po-Jung Chien et al ..2005)

3. Results and discussion

Effect of coating with edible films the quality of grapes:

3.1. The moisture content:

The results of moisture content (mean) have been shown in Fig. 3,4. demonstrated the effects of various coatings on moisture content of grapes during the storage time. where T0 was 80. 06 at the beginning of storage and after 4 day stored was 73.78 and T٢ was 78.14 and at the end of storage was 74.9 this after 12 days of storage at room temperature (28 ºC ±3) . As for the refrigerator temperature (4±1 ºC) , moisture content of grapes for T0 was 80.22 at the beginning of storage and after 15 days of storage was ٧٦.٠١, as T١ at the beinning of storage was 80.1 and after 90 day of storage was 76.٢٨ . It is obvious coating had significantly effects on moisture loss. Surface coatings reduce respiration and transpiration rates and improve the mechanical handling properties of the produce and help maintain its structural integrity (Baldwin 1994).

Whereas, it was noticed that the coating protects from moisture loss, whether in the surrounding temperature or in cooling. The coating preserved the grapes for 12 days at ambient temperature and for 90 days in cooling. That is because it worked to preserve moisture content and not lose it. Edible films and coatings can extend the shelf life and improve the quality of fruits and vegetables by creating a modified atmosphere inside the fruit due to their barrier properties to gases and moisture (Coma,et al,2001 and Baldwin, 1994).

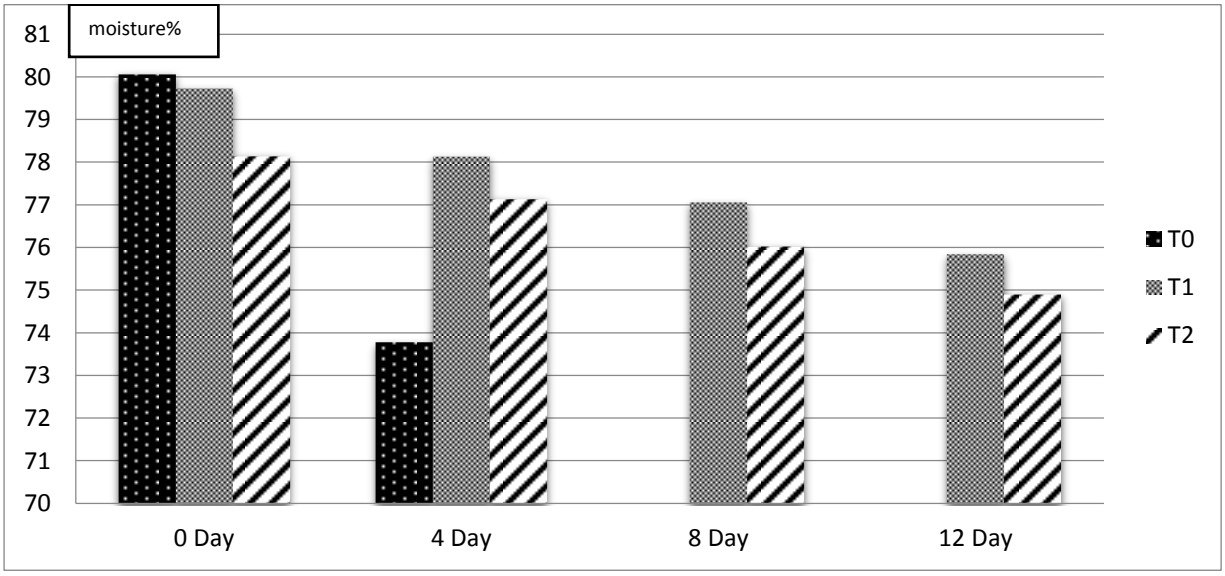

Fig. 3. Effect of coating on moisture of grapes preserved at room temperature (28 ºC ±3) .

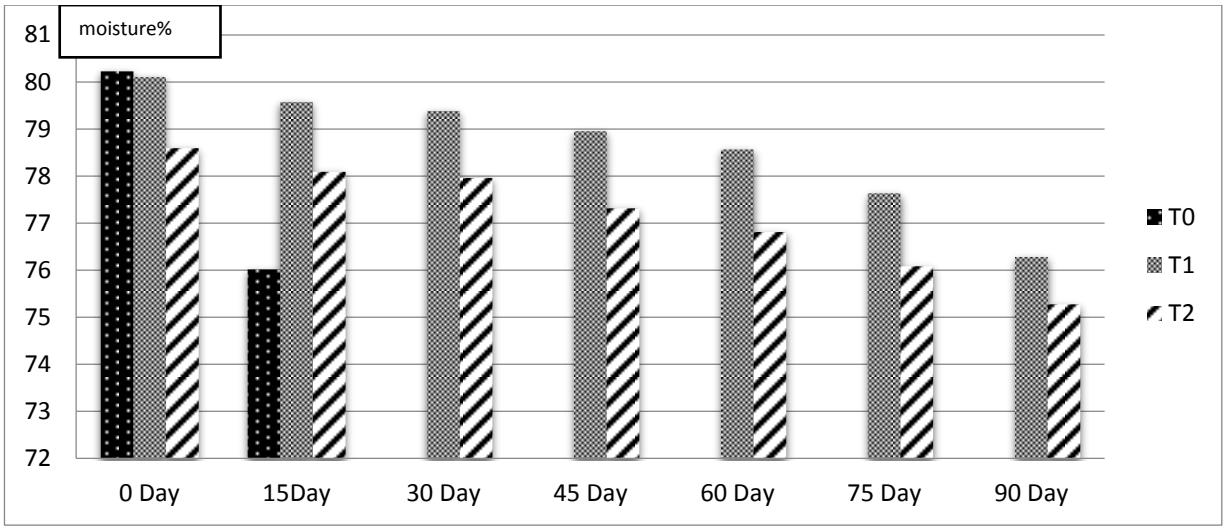

Fig.4. Effect of coating on moisture of grapes preserved cooling temperature (4 ºC ±1).

3.2. Fruit firmness (Ib/inch2):

As shown in Table (3 and 4) the effect of different coating treatments on grape firmness at room temperature (28ºC ±3) and refrigerator temperature (4ºC ±1). Results showed that Carboxy methyl cellulose coating treatments had a better effect on fruit firmness in both storage conditions compared to control Where the treatment (T1) was (225- 205) (gm/cm^2) compared with control (T0) that was (188 - 161) (gm/cm2) in the room temperature (28ºC ±3) at storage.

The treatment (T2) was (220 - 202) (gm/cm^2)as for control (T0) was (211 - 184) (gm/cm^2) at the cooling temperature during storage . It was also observed that treatment with natural grape films in refrigerated storage increases the length of shelf life while delaying the occurrence of softness in the tissues during storage

Table.3. Effect of treatments on firmness (gm/cm2)of coated grapes at room temperature (28ºC ±3).

Treatment / Day	T0	T1	T2
0	g١٨٨	a٢٢٥	٢٢٢ b
4	161 h	c٢١٨	c٢١٦
8		d٢١٢	e٢٠٩
12		f٢٠٥	f٢٠٣

Values are treatments means , n = 24 . Means followed a different letter within row are significantly different according to Duncan's multiple range test, α = 0.05.

Means within columns are significantly different according to LSD when difference is higher than the LSD value.

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

Table.4. Effect of treatments on firmness (gm/cm2)of coated grapes at cooling temperature (4ºC ±1).

Treatment / Day	T0	T1	T2
0	٢١١ abcde	٢٠٠ abcdef	٢٢٠ a
15	184 ef	١٩٧ abcdef	٢١٧ abc
30		١٩٥ abcd	٢١٤ ab
45		١٩٢ bcdef	٢١١ abcde
60		١٩٠ cdef	٢٠٨ abcdef
75		١٨٧ def	٢٠٦ abcdef
90		١٨٣f	٢٠٢ abcdef

Values are treatments means , n = 42 . Means followed a different letter within row are significantly different according to Duncan's multiple range test, α = 0.05.

Means within columns are significantly different according to LSD when difference is higher than the LSD value.

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

3.3. Sensory evaluation

Fig. (5 - 12) show the results of the sensory evaluation indicating the evaluation of the quality of the characteristics of the samples without membrane treatment deteriorate their sensory

properties after 4 days of storage at room temperature at the cooling temperature, as for the case of membranes preservation, the samples were preserved for 12 days in room-temperature storage and 90 days in cooling. It is clear that coating samples had good sensory evaluation. Where Fig. (4 – 5) show the taste in treatment (T1) was (9.4 – 8.6) after 12 days of storage at room temperature (28ºC ±3) while it was for control (T0) scored (9.5 – 8.5) after 4 days of storage at room temperature (28ºC ±3). Also Fig. (6 – 7) it shows the color differences in the results between coating or no coating treatments. Fig. (8 – 9) it show the texture where (T2) recorded (9.6 – 8.0) after 90 days of storage at cooling temperature (4ºC ±1) while control (T0) contained (9.7 – 8.6) after 15 days of storage at cooling temperature (4ºC ±1). Fig. (10 – 11) it show the overall acceptability where (T2) scored (9.8 – 8.8) after 12 days of storage at room temperature (28ºC ±3) better than control (T0) Which had (9.7 – 8.9) after 4days of storage at room temperature (28ºC ±3). Also overall acceptability for (T1) was (9.7 – 8.5) after 90 days of storage at cooling temperature (4ºC ±1) better than control (T0) which had (9.7 – 8.7) after 15 days of storage at cooling temperature (4ºC ±1).

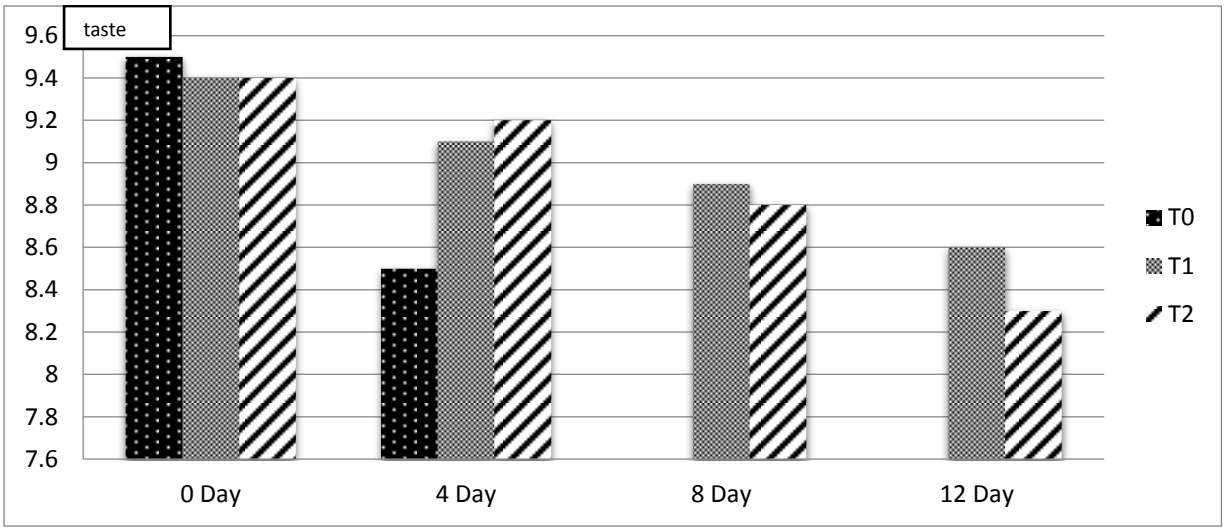

Fig.5. Effect of storage period on the taste of grapes at room temperature (28ºC ±3)

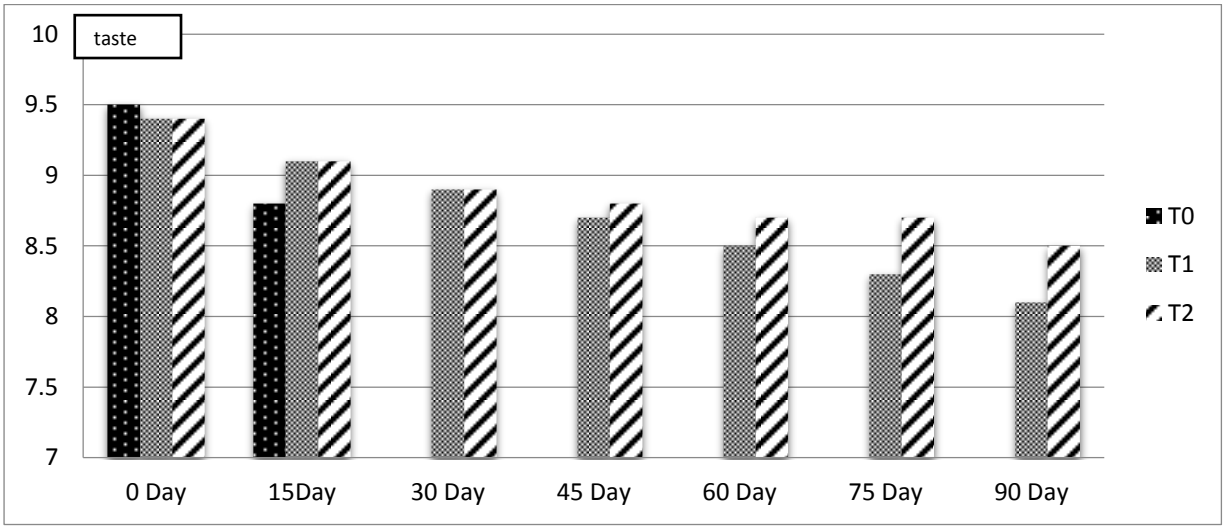

Fig.6. Effect of storage period on the taste of grapes at cooling temperature (4ºC ±1).

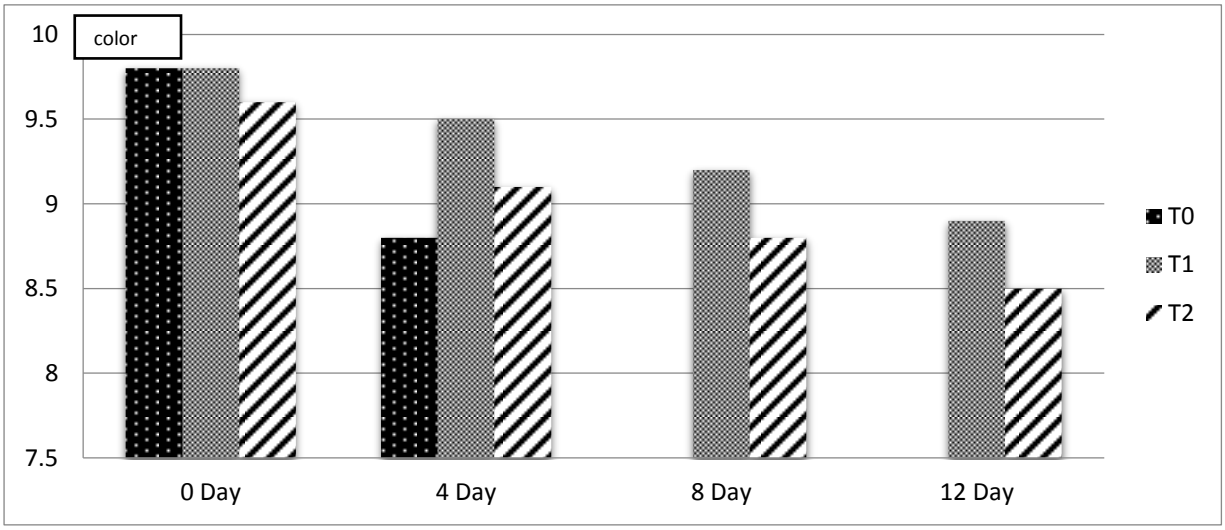

Fig.7. Effect of storage period on the color of grapes at room temperature (28ºC ±3).

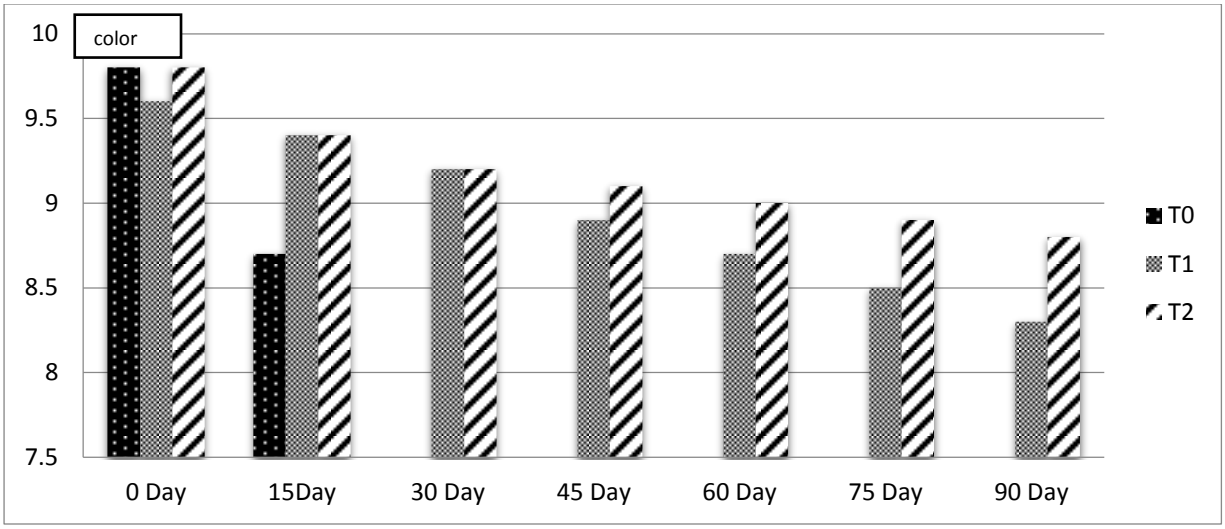

Fig.8. Effect of storage period on the color of grapes at cooling temperature (4ºC ±1).

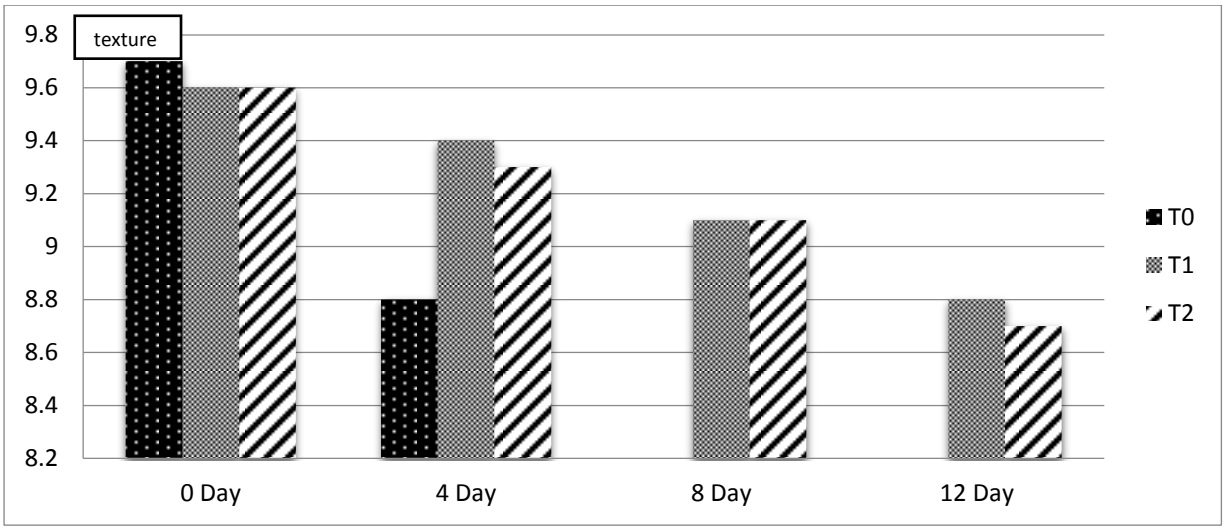

Fig.9. Effect of storage period on the texture of grapes at room temperature (28ºC ±3).

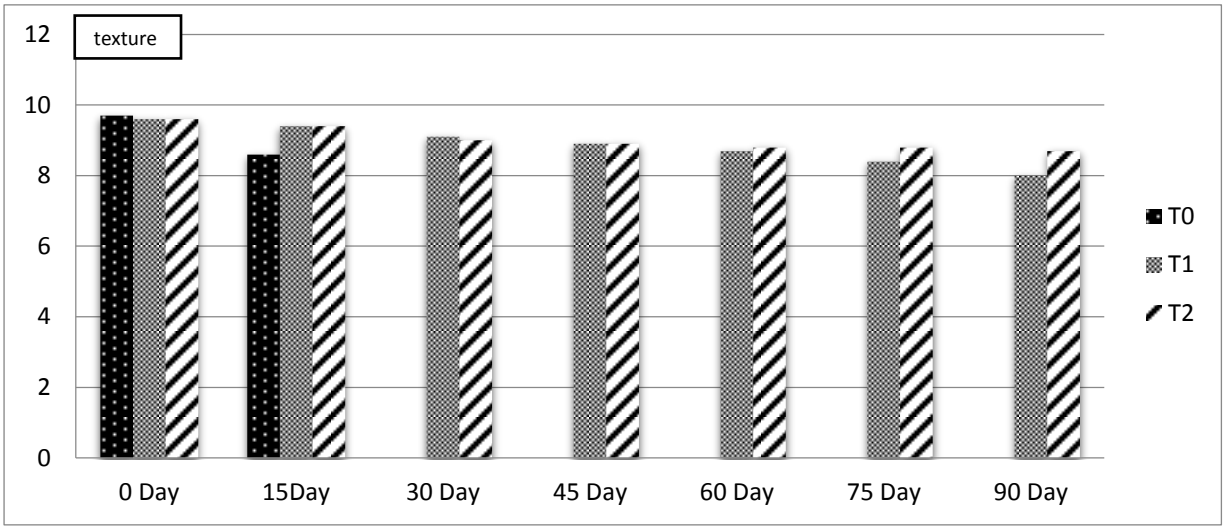

Fig.10. Effect of storage period on the texture of grapes at cooling temperature (4ºC ±1).

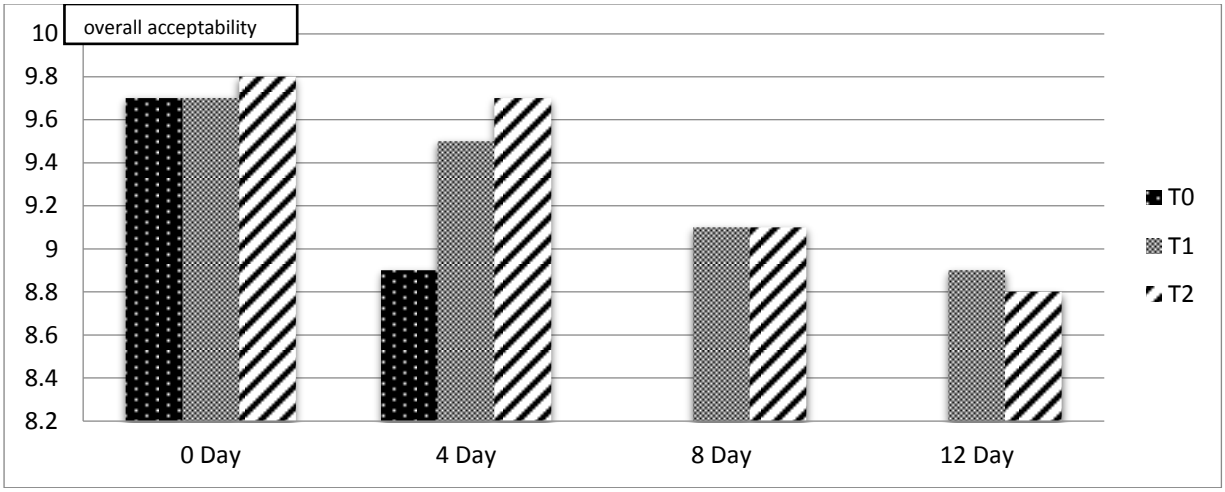

Fig.11. Effect of storage period on the overall acceptability of grapes at room temperature (28ºC ±3).

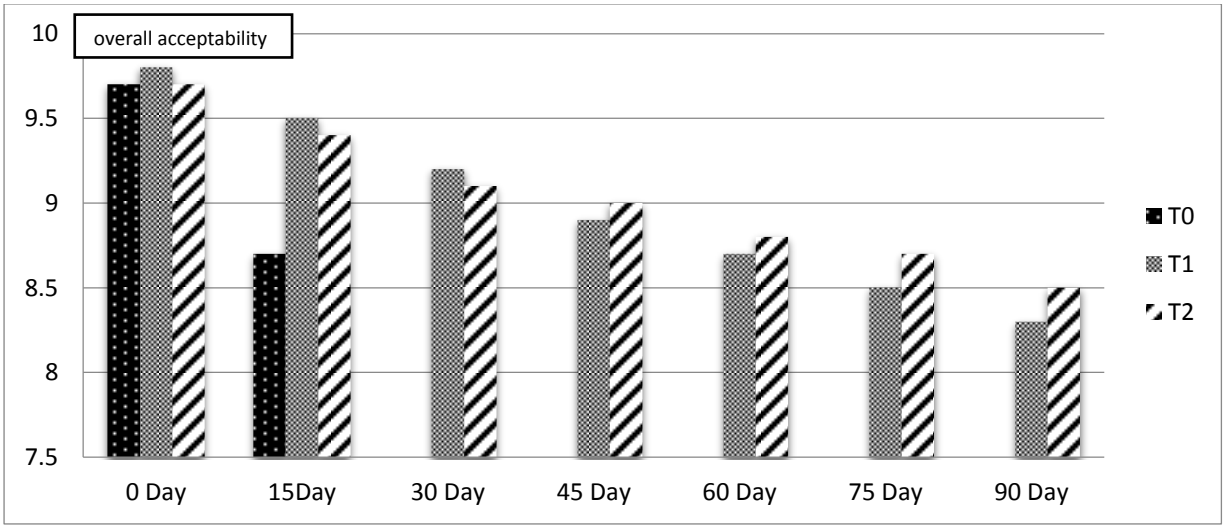

Fig.12. Effect of storage period on the overall acceptability of grapes at cooling temperature (4ºC ±1).

3.4. Microbiological evaluation

Effect of edible films on microbes of grapes :

Total count of bacteria (TC): Tables (5 & 8) show a clear change in the total number of bacteria observed in covered and exposed grape samples during storage at room temperature and refrigeration, as it was found that the total number of bacteria increased gradually with increasing storage period, but the results in the covered samples were better than the uncovered ones . Where the control T0 was 8.3 $\times 10^2$ (CFU/g) after 4 days of storage, while T1 and T2 was 3.33 $\times 10^2$ (CFU/g) after the same storage period at room temperature (28ºC ±3)., So was the control T0 was 9.63 $\times 10^2$ (CFU/g) after 15 days of storage and T1 was 2.33 $\times 10^2$ (CFU/g) during the same storage period at cooling temperature (4ºC ±1). This indicates that the membrane has a significant effect on the small number of TC.

Cold-Loving Bacteria (Psy): Tables (6 & 9) show that the total number of cold-loving bacteria in covered and uncovered grape samples during storage at room temperature increases gradually with increasing storage period. And the covered samples were better than the uncovered. Where the control T0 was 4.33 $\times 10^2$ (CFU/g) after 4 days of storage, while T2 was 4.33 $\times 10^2$ (CFU/g) after 12 days of storage at room temperature (28ºC ±3)., so was the control T0 was 8.66 ×102 (CFU/g) after 15 days of storage and T1 was 2.33 $\times 10^2$ (CFU/g) at the same storage period at cooling temperature (4ºC ±1).

Counting fungi and yeasts: Data in table (7 & 10) show that the number of fungi and yeasts in covered and exposed grape samples increased With increasing storage period at room temperature and refrigeration. But the membrane kept reducing the number of Fungi and yeasts more than uncovered samples. Where the control T0 was ٣.٦٦ ×10١ (CFU/g) after 4 days of storage, while T١ was ١.33 ×10١ (CFU/g) after ٤ days of storage at room temperature (28ºC ±3)., so was the control T0 was ٥.٠٠ ×10١ (CFU/g) after 15 days of storage and it T٢ was ١.33 ×102 (CFU/g) at the same storage period at cooling temperature (4ºC ±1). This indicates that the membrane has a significant effect on the small number of Ym. (Jacxsene et al. (2002) ; Koseki et al. (2004))

Table .5. Microbiological evaluation of studied grapes" T.C" :

Day / Treatments	٠	4	8	12
T0	2.33 $\times 10^2$ (CFU/g)	8.3 $\times 10^2$ (CFU/g)		-
T1	2.0 $\times 10^2$ (CFU/g)	3.33 $\times 10^2$ (CFU/g)	6.66 $\times 10^2$ (CFU/g)	9.66 $\times 10^2$ (CFU/g)
T2	1.66 $\times 10^2$ (CFU/g)	3.33 $\times 10^2$ (CFU/g)	6.33 $\times 10^2$ (CFU/g)	9.33 $\times 10^2$ (CFU/g)

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

Table .6. Microbiological evaluation of studied grapes "Psy":

Day / Treatments	٠	4	8	12
T0	1.33 $\times 10^2$ (CFU/g)	4.33 $\times 10^2$ (CFU/g)		-
T1	1.33 $\times 10^2$ (CFU/g)	2.33 $\times 10^2$ (CFU/g)	3.66 $\times 10^2$ (CFU/g)	4.66 $\times 10^2$ (CFU/g)
T2	1.0 $\times 10^2$ (CFU/g)	2.33 $\times 10^2$ (CFU/g)	3.33 $\times 10^2$ (CFU/g)	4.33 $\times 10^2$ (CFU/g)

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

Table .7. Microbiological evaluation of studied grapes "ym":

Day / Treatments	.	4	8	12
T0	0×10^1 (CFU/g)	3.66×10^1 (CFU/g)		-
T1	0×10^1 (CFU/g)	1.33×10^1 (CFU/g)	2.33×10^1 (CFU/g)	3.33×10^1 (CFU/g)
T2	0×10^1 (CFU/g)	1.33×10^1 (CFU/g)	2.33×10^1 (CFU/g)	3.33×10^1 (CFU/g)

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

Table .8. Microbiological evaluation of studied grapes" T.C" :

Day / Treatme	0	15	30	45	60	75	90
T0	2.33×10^2 (CFU/g)	9.63×10^2 (CFU/g)		-	-	-	-
T1	1.0×10^2 (CFU/g)	2.33×10^2 (CFU/g)	4.66×10^2 (CFU/g)	7.33×10^2 (CFU/g)	9.67×10^2 (CFU/g)	12.67×10^2 (CFU/g)	15.67×10^2 (CFU/g)
T2	1.33×10^2 (CFU/g)	2.66×10^2 (CFU/g)	4.66×10^2 (CFU/g)	7.33×10^2 (CFU/g)	10.0×10^2 (CFU/g)	13.0×10^2 (CFU/g)	15.33×10^2 (CFU/g)

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

Table .9. Microbiological evaluation of studied grapes "Psy":

Day / Treatme	0	15	30	45	60	75	90
T0	1.67×10^2 (CFU/g)	8.66×10^2 (CFU/g)		-	-	-	-
T1	1.33×10^2 (CFU/g)	2.33×10^2 (CFU/g)	3.67×10^2 (CFU/g)	4.66×10^2 (CFU/g)	7.0×10^2 (CFU/g)	9.33×10^2 (CFU/g)	12.33×10^2 (CFU/g)
T2	1.0×10^2 (CFU/g)	2.33×10^2 (CFU/g)	3.33×10^2 (CFU/g)	4.33×10^2 (CFU/g)	6.0×10^2 (CFU/g)	9.0×10^2 (CFU/g)	11.67×10^2 (CFU/g)

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

Table .10. Microbiological evaluation of studied grapes "ym":

Day / Treatme	0	15	30	45	60	75	90
T0	0×10^1 (CFU/g)	5×10^1 (CFU/g)					
T1	0×10^1 (CFU/g)	1.66×10^1 (CFU/g)	2.66×10^1 (CFU/g)	3.66×10^1 (CFU/g)	5.0×10^1 (CFU/g)	6.0×10^1 (CFU/g)	7.66×10^1 (CFU/g)
T2	0×10^1 (CFU/g)	1.33×10^1 (CFU/g)	2.33×10^1 (CFU/g)	3.33×10^1 (CFU/g)	4.33×10^1 (CFU/g)	6.33×10^1 (CFU/g)	7.33×10^1 (CFU/g)

T0: Control **T1:** 1% Carboxy methyl cellulos **T2:** 1% Carboxy methyl cellulos +0.2% Citric acid+ 0.1% Ascorbic acid

4. Conclusion

When covering the grapes with paint of carboxymethylcellulose, it gives a higher quality than that which was not covered, either at ambient temperature or cooling

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