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The influence of mucilages extracted from some vegetable plants residues as an edible coating on maintaining the quality of sweet pepper fruits.

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Abstract

Sweet pepper (*Capsicum annuum* L.) fruits Monist F1 hybrid were harvested at 3/4 yellow stage on the 10th and 16th of January in the 2021 and 2022 seasons, respectively from a private farm in Ismailia Governorate, then brought to the postharvest lab, HRI, ARC, Egypt, to estimate the effect of dipping sweet pepper fruits in mucilages extracted from Jew's mellow stalks, Taro tuber peel, and Okra fruit peduncle at 0.5% and Chitosan at 1% as an edible coating on maintaining the quality of fruits, visual parameters and growth of microbial during storage (at 10°C and 95 % RH). Results showed that all treatments slowed the rate of weight loss and gave the highest value of L, which resulted in a lighter color and prevented the loss of green color compared to the highest ones obtained from the untreated (control). The best treatments were Jew's mellow stalks and Taro tuber peel mucilages because it is the most reducing weight loss %, color change, total microbial count, total carotenoids, maintaining firmness, total soluble solids, ascorbic acid, and total sugars. Jew's mellow stalks mucilage showed good general appearance and no changes exhibited of fruits till 28 days, while, fruits treated with Taro tuber peel and Okra fruit peduncle mucilages showed good appearance at the same period.

Keywords: Sweet pepper fruits, Jew's mellow stalks, Okra fruit peduncle, Taro tuber peel, Mucilages, Chitosan, Edible coating, Appearance, and Cold storage

Introduction

Sweet pepper (*Capsicum annuum* L.) is an important vegetable crop worldwide and may be green (unripe), red, yellow, orange, or brown when rips. Fruits are low in calories and rich in vitamin C and A [1]. Sweet pepper is highly perishable and high susceptible to fungal disease with short shelf life [2].

Some disorders that may occur after harvest include rapid respiration rate, physiological activities, degradation of quality, decay, and rapid senescence [3].

Therefore, some treatments (Jew's mellow, Taro and Okra mucilages, and chitosan) as an edible coating and refrigeration have been proposed to maintain quality and improve storability.

Edible coatings are used to enhance the shelf life of fruits. They could be a good alternative to chemically preservatives, besides lowing costs. They have been proven to retard physiological activities such as respiration, degradation, and ethylene production, restrict microbial growth and also decreasing firmness loss, maintain color, preserve the antioxidants, and control microbial growth [4].

Mucilage classified polysaccharides (containing galactose, xylose, arabinose, rhamnose, and galacturonic acid) [5], and contain various monosaccharides (i.e. Larabinose, L-xylose, D-galactose, and D-galacturonic acid) [6,7]. Nowadays, Mucilages is safe, low price.

Mucilage is a natural edible coating with a high nutraceutical value with a great water retention capacity so it's useful for fruit preservations [8].

Mucilage is extracted from various parts of plants (i.e. seeds, fruits, leaves) [7,9]. So, it's an important source of phenolic compounds (flavonoids) [10], these compounds make antioxidant, antimicrobial, and antifungal [11].

Jew's mellow, Taro and Okra an excellent source of mucilage, therefore, can be used to make edible coatings applied to fruits [12].

The literature reported that the application of edible coatings mucilage enhanced the quality parameters and elongated the shelf life [13] of okra mucilage [14,15].

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Jew's mellow mucilages have different characteristics because it contains methyl pentose, glucose, galactose, and fructose [12]. The taro plant can contain mucilage of 6.84 g per 100g as an average extracted from the rhizome and this has a viscous appearance and light color [16].

Okra mucilage is a physiological product, formed within the cell (intracellular formation); we can get it without damaging the plant [17,18], this mucilage has polysaccharides (galactose, rhamnose, and galacturonic acid) [19], and these have to contain good levels of protein, carbohydrate, neutral sugars and minerals [20].

Chitosan is a biological neutral polymer, safe, and enhances resistance against fungal (i.e. *Penicillium digitatum*, *Penicillium italicum*) if used before or after harvest [21].

In addition, chitosan coatings are considered to be an edible and biologically safe preservative coating that is ideal for a wide variety of vegetables and fruits with functional benefits. This allows the chitosan coating to act as a semi-permeable barrier to oxygen, carbon dioxide, and moisture, reducing respiratory rate, water loss, consistent quality, extended shelf life, reduced color change, and microbial growth [22].

Therefore, the purpose of this study was to investigate the effects of mucus extracted from some vegetable residues (Jew's mellow, Taro, and Okra mucilage) and chitosan on fruit quality, sensory parameters, and microbial maintenance when applied as an edible coating (stored at 10 ° C and 95% RH).

Material and Methods

Sweet pepper (*Capsicum annuum* L.) fruits Monist F1 hybrid were harvested at 3/4 yellow color stage on the 10th and 16th of January in the 2021 and 2022 seasons, respectively from a private farm in Ismailia Governorate, then brought to the postharvest lab, HRI, ARC, Egypt. Only fruits homogeneous in size, weight, and color with approximate calyx (1 cm) that were healthy and free from any visible defects were selected for the experiment.

Preparation of mucilage:

The extraction process of mucilage from some vegetable plants residues of Jew's mallow stalks, Taro tuber peel, and Okra fruit peduncle by-products was done according to the method described by [23] with some modification. These previous by-products were dried using a hot air oven dryer. The dried material was milled to fine particle size using a locally grinding machine. 20 gm of sample powder was added to 500 ml distilled water and boiled for 30 min. After cooling the supernatant was separated by a trilayer cheesecloth and centrifuged at 10000 xg for 30 min. After that mucilage supernatant liquid was precipitated in acetone with the ratio of 1:3 and centrifuged for 10 min. to separate mucilage and dried using under vacuum oven dryer at 50°C.

Table 1: Proximate chemical composition of Jew's mallow stalks, tuber peel, and Okra fruit peduncle mucilages (on a dry weight basis).

	Protein	Fat	Ash	Carbohydrate	Total sugars	Fiber
Jew's mallow stalks	**21.32**	**6.91**	**6.20**	**49.80**	**6.40**	**12.68**
Taro tuber peel	**7.20**	**4.30**	**5.80**	**78.20**	**5.90**	**6.81**
Okra fruit peduncle	**18.92**	**7.68**	**5.00**	**51.40**	**6.80**	**11.60**

Table 2: Proximate mineral composition and total phenolic of Jew's mallow stalks, tuber peel, and Okra fruit peduncle mucilages (mg/g DW).

	Ca	K	Fe	P	Total phenolic
Jew's mallow stalks	**14.30**	**13.10**	**0.13**	**3.40**	**14.24**
Taro tuber peel	**17.80**	**16.50**	**0.17**	**3.10**	**12.78**
Okra fruit peduncle	**17.20**	**15.20**	**0.11**	**2.70**	**11.70**

Analytical methods:

Proximate analysis of protein, fat, ash, carbohydrate, total sugars, minerals, and fiber was determined according to the standard methods of the [24]. Total phenolic content was determined according to [25] using a Folin reagent (mg GAE/g DW)**.**

The fruits were dipped in:

- Chitosan at 1% for 5 min T1.
- Mucilage extracted from okra fruit peduncle at 0.5 % for 5 min T2.
- Mucilage extracted from Taro tuber peel at 0.5 % for 5 min T3.

- Mucilage extracted from Jew's mellow stalks at 0.5 % for 5 min T4.
- Untreated control (distilled water) T5.

The samples of dipped fruits were dried by air fan; the fruits from each treatment were packed in bags sealed with polypropylene (30 µm thickness, 25×30 cm). Each sealed bag contains 3 fruits (as an experimental unit) (EU). Next, each treatment was twelve replicates (stored at 10 ° C and 95% relative humidity) for 28 days. Randomly take the samples and arranged them in a complete randomized design. Three replicates from all treatments were examined at zero time and every 7 days intervals for the following properties.

- **Weight loss** content is assayed according to the description of [26], and the results were expressed as percentages.
- **The general appearance:** as evaluated using a scale from 9 to 1, where 9= excellent, 7= good, 5= fair, 3= poor, and 1= unsalable fruits rating (5) or below were considered as unmarketable, as described by [27].
- **Surface color:** Measured on both sides of each fruit using the Minolta Model 400 Chromameter, which measured lightness (L value) and b value [28].
- **Fruit firmness:** was measured by a hand pressure tester (Italian model) expressed in kg/cm^2.
- **Total soluble solids percentage** (TSS): turned into decided via way of means of the virtual refractometer, "Model Abbe Leica" in keeping with [26].
- **Ascorbic acid content (Vit. C):** It was described in [26].
- **Total microbial count:** sweet pepper fruits used as replicates from each treatment were weighted and a similar weight of sterile water per volume (1:1 w/v) was added. Bacteria were counted in nutrient agar media after culturing at 30 ° C for 72 hours and expressed as bacterial log CFU/g.
- **Total carotenoid content** (mg/100g fresh weight) was determined according to [26].
- **Total sugars** were determined using Nelson's methods [29], which were determined colorimetrically at a wavelength of 520 nm [30].

Statistical Analysis: Statistical analysis was performed on the characteristics investigated for each season, and pool analysis was performed when the error was uniform. The uniformity of the variance between the two seasons was checked using [31]. Combined data from the two seasons of the study were analyzed.

Result and Discussion

Weight loss percentage:

Figure 1 showed that the rate of weight loss percentage increased significantly during the storage period. These results are inconsistent with [32] and may be due to its respiratory processes, and other senescence-related metabolic processes associated with aging [33].

All treatments maintained weight during storage compared to T5 treatments. In addition, sweet pepper treated with T4 and T3 was the most effective treatment for reducing weight loss%, and there was no significant difference between them. Second, there was no significant difference between the treatments for T2 and T1. These results were consistent with [15,34] for mucilage and by [35] for chitosan.

Minimization of weight loss by mucilage treatment can be due to the formation of a thin film of mucilage surrounding the fruit and can be due to increased water retention due to reduced transpiration and respiration. It reduces weight loss due to a mucous coating that closes the pores and openings of the lenticel [36].

Chitosan coating reduces weight loss by forming a semipermeable membrane around the fruit, thereby reducing water loss and respiratory rate [37]. Chitosan prevents water vapor permeation; seals small cracks, protects the surface of the fruit from mechanical damage, and reduces water and weight loss during storage [38].

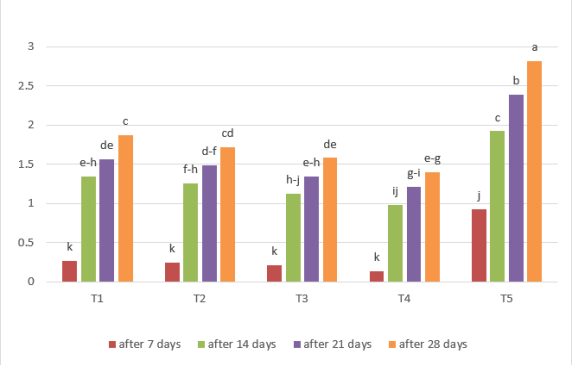

Fig. (1): The influence of mucilages extracted from some vegetable plants residues on weight loss (%) of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan
T2 Okra fruit peduncle
T3 Taro tuber peel
T4 Jew's mellow stalks
T5 Control

In general, the interaction between treatments and storage periods had a significant

impact on weight loss during storage. After 28 days of storage, the lowest weight loss was recorded with T4 treated sweet pepper and the highest was obtained with T5 treatment.

General appearance:

Figure 2 shows that the general appearance of pepper decreased with increasing storage period at 10 ° C. This was in agreement with [32] who found this in sweet peppers. GA decreases during storage. This can be due to shrinkage, wilting, color changes, and rot [39].

Sweet pepper treated with all treatments showed significantly higher appearance scores compared to untreated controls. However, pepper treated with T4 and T3 was the most effective treatment for maintaining a general appearance, and there was no significant difference between them. These results are in agreement with [33] in mucilage and [37] in Chitosan.

Mucilage extracts contain polyphenolic compounds such as phenolic acids, flavonoids, and anthocyanins. These extracts contain phenols and their derivatives that act as powerful antioxidants and antibacterial agents. Phenol acts as an antioxidant through free radical scavenging activity, which in turn blocks the oxidative chain reaction [11]. Phenol primarily destabilizes microbial membranes, then enters cells, blocks protein synthesis, and ultimately causes cell death. Therefore, the mucosal coating was able to suppress the ripening process and maintain the quality of the fruit during storage.

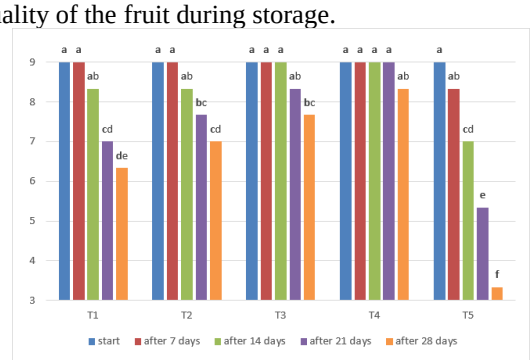

Fig. (2): The influence of mucilages extracted from some vegetable plants residues on general appearance (score) of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan
T2 Okra fruit peduncle
T3 Taro tuber peel
T4 Jew's mellow stalks
T5 Control

It was shown by [40] that using edible coating mucilage nanoparticles reduces mold growth and enhances the quality of packing fruits.

Mucilage has a very good property as an oxygen barrier due to the presence of hydrogen bonding embedded between its molecules, and further modifications have been investigated [41]. The use of mucilage as an edible coating reduces gas exchange inside the fruit by controlling the enzyme activity and microbial growth, contributing to quality retention in the coated product during refrigeration [42].

Chitosan coating acts as a semi-permeable barrier for oxygen and carbon dioxide gases on the surface of the fruits as well as moisture, and this reduces respiration rates, water loss, metabolism, and deteriorations caused by increased enzymatic activity and bacterial rot, which reduces and resists drying and shrinkage, ethylene production and maintains the quality of fruits and prolongs shelf life [43]. Chitosan coatings can well inhibit the increase in the activity of oxidative enzymes, increased the activity of antioxidant enzymes, and free radical scavenging ability during storage which would reduce physiological deterioration, enhance tissue resistance to microbial invasion and reduce spoilage of fruits [44].

In conclusion, the interaction between treatments and storage periods was significant during storage. Results recorded that sweet pepper fruits dipped in T4 treatment showed the best appearance. Sweet pepper fruits did not exhibit any changes in GA till the end of the storage period (28 days of storage at 10°C), while T3 and T2 treatments give a good general appearance at the end of storage (after 28 days). On the other hand, T5 treatment had a poor appearance after 28 days of storage at 10°C.

Fruit firmness:

Figure 3 shows that there was a significant reduction in fruit firmness by the prolongation of the storage period. This is similar to what was found by [32] on sweet pepper fruits.

Sweet pepper fruits dipped in T4 and T3 gave the highest value of fruit firmness during storage (with no significant differences), followed by T2 and T1 with no significant differences between them. The lowest value of fruit firmness was obtained from control (untreated). These results were in agreement with [15,34] findings for mucilage and [37] for chitosan.

The decreased firmness during refrigeration might be due to the de-polymerization of pectin substances [45]. Softening enzymes altered the cell wall and caused softening of fruits [46] that could have been reduced in the coated fruits. This may be due to the presence of calcium in coati mucilage [47] that make an interaction between pectic acid and calcium pectate (presence in cell

well), This preserves the integrity of the cell wall and increases the fullness of the fruit.

Mucilage coating may inhibit the activity of the pectin enzyme by slowing down the metabolism and maintaining the stability of the fruit, as mentioned before [34]. Moreover, the fruits treated with mucilage may have improved their resistance against structural changes in the cell walls and reduced moisture loss, which led to reduced fruit ductility.

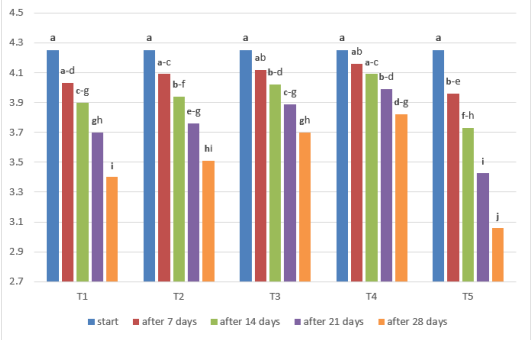

Fig. (3): The influence of mucilages extracted from some vegetable plants residues on firmness (Kg/cm^2) of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan T2 Okra fruit peduncle T3 Taro tuber peel
T4 Jew's mellow stalks T5 Control

On the other hand, the positive effect of chitosan coating could be due to the stability of the fruits and this is due to what was observed from the low content of the fruits of malondialdehyde and relative leakage rates, as an indicator of the integrity of the membrane compared to the untreated control fruit, which indicates the preservation of higher membrane integrity [48]. This could be due to its high activity against fungi and covering the surface of the skin and lentils, thus reducing the incidence of infection, reducing respiration and other maturation processes during storage, and maintaining the integrity of the membrane [49].

In general, the interaction between treatments and storage periods was significant. After 28 days at 10°C, sweet pepper fruits dipped in T4 and T3 treatments were the most obvious in maintaining fruit firmness at the end of the period. The lowest value of fruit firmness was obtained from the T5 treatment during the same period.

Color (L value):

Figure 4 shows that the L value of fruits was significantly decreased with the progress of the storage period indicating that darker color. This is similar to what was found by [32] on sweet pepper fruits. [38] showed that decreasing in L value relates to water loss in fruit.

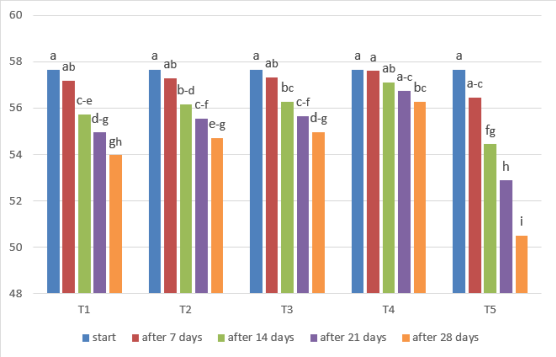

Fig. (4): The influence of mucilages extracted from some vegetable plants residues on color (L. value) of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan T2 Okra fruit peduncle T3 Taro tuber peel
T4 Jew's mellow stalks T5 Control

Sweet pepper fruits dipped in T4 being the most effective treatment in maintaining the L values, resulted in lighter color (high L value), while T5 treatment give the lowest one of L values during storage, resulting in darker color (low L value). The rest of the treatments were less effective in this regard. These results were in agreement with [15,34] for mucilage and [38] for chitosan.

Color (B Value):

Figure 5 indicated that a significant increase in the b value of sweet pepper fruits was noticed with prolonging the storage period. These results were in agreement with those obtained by [50] on sweet pepper fruits.

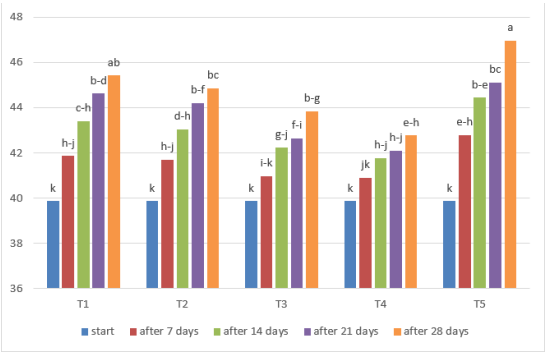

Fig. (5): The influence of mucilages extracted from some vegetable plants residues on color (b. value) of sweet pepper fruits during storage at 10 °C.

Means in the same column having the same letter are not significantly different at the 0.05 level by

Duncan's multiple range test.
T1 Chitosan
T2 Okra fruit peduncle
T3 Taro tuber peel
T4 Jew's mellow stalks
T5 Control

All the treatments indicate a significantly reduces and change rate of yellow color compared with untreated fruits, this means delaying fruit ripening and senescence. Fruits dipped in T4 and T3 were the most effective treatments for reducing changes of color with no significant differences between them and that indicates retained more green color of fruits, followed by T2 and T1 with no difference significantly between them. While higher b value was detected in the T5 that indicate had the high yellow color of fruits. These results were in agreement with those obtained by [51] for chitosan.

The retardation of color development in pepper fruit treated with chitosan and mucilage as edible coating based on polysaccharides decreases metabolic activities such as lowering respiration and rate lowering ethylene production which leads to a modified internal atmosphere around the fruits and then delaying the ripening, this, in turn, delayed the color loss [37,52].

Total soluble solids percentage:

Figure 6 demonstrates that the total soluble solids % of sweet pepper fruits significantly decreased with the prolongation of the storage period. This is similar to what was found by [32] on sweet pepper fruits. The lower TSS may be due largely to a higher rate of sugar loss through respiration than water loss through transpiration during storage [53].

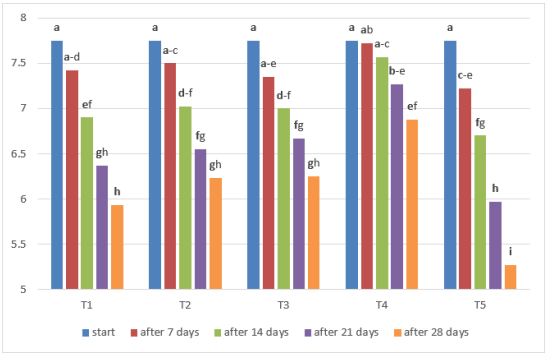

Fig. (6): The influence of mucilages extracted from some vegetable plants residues on TSS (%) of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.
T1 Chitosan
T2 Okra fruit peduncle
T3 Taro tuber peel
T4 Jew's mellow stalks
T5 Control

Sweet pepper fruits dipped in T4 treatment retained more TSS percentage followed by T3, T2, and T1 treatments with no significant differences between them. T5 treatment gave the lowest value of TSS %. These results were in agreement with those obtained by [15,34] for mucilage and [51] for chitosan.

The effect of cold storage along with the application of edible coatings on metabolic activities can reduce the consumption of organic acids during the respiration process and thus demonstrates the maintenance of TSS during cold storage [54].

The effect of chitosan coating is probably due to the maintenance of TSS and this is caused by slowed breathing and slower metabolic activity, thus delaying the maturation process [55]. The modified atmosphere created by chitosan coating (low O_2 and high CO_2) suppresses the loss of TSS% during storage [49].

Overall, the interaction between treatments and period of storage was significant. After 28 days at 10°C. The fruits dipped in T4 or T3 resulted in high significant TSS % with no significant differences between them, followed by T2 and T1 with no significant differences between them, while T5 gave the lowest ones in the same period.

Ascorbic acid content:

Figure 7 shows that the ascorbic acid content of sweet pepper fruits decreased long storage period, these results are similar to those obtained by [32] on sweet pepper. Ascorbic acid is reduced during storage as a result of a higher respiratory rate [56].

Sweet pepper fruits treated with T4 were the most effective in maintaining ascorbic acid, followed by T3 or T2 with no significant differences between them. The lowest values resulted in T5. These results were in agreement with those obtained by [15,34] for mucilage and [57] for chitosan.

Ascorbic acid can scavenge the reactive oxygen species (ROS) because it is a powerful antioxidant that is made several diseases in fruits [58]. The mucilage coating appears to be beneficial in increasing the nutritional value of sweet pepper fruits during storage.

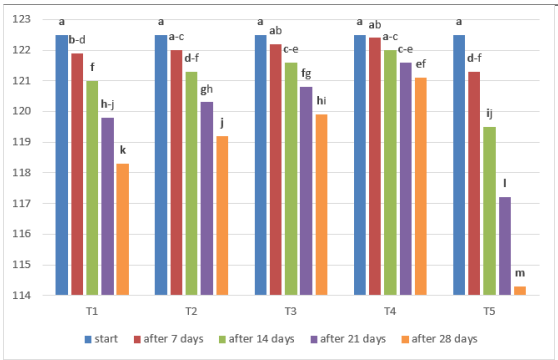

Fig. (7): The influence of mucilages extracted from some vegetable plants residues on Ascorbic acid content (mg/100 g FW) of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan

T2 Okra fruit peduncle

T3 Taro tuber peel

T4 Jew's mellow stalks

T5 Control

The high level of ascorbic acid in chitosan-coated fruits may be due to decreased oxygen permeability, which reduced the activity of enzymes involved in the oxidation reaction of the ascorbic acid vitamin [59]. Also, it was found by [49] that the modified atmosphere created by chitosan coating (low O_2 and high CO_2) suppresses the loss of ascorbic acid content during storage.

Chitosan coating, like other coatings, increases the activity of the enzyme cytochrome oxidase by decreasing the activity of the internal oxygen as well as around the fruits, and the activity of this enzyme can significantly reduce the rate of decomposition of ascorbic acid vitamin [45]. It was found by [22] that treatment of chitosan inhibits damage that causes oxidation of ascorbic acid in Navel orange. Whereas, the low level of vitamin C in the control fruit may be due to physiological disturbances as well as decomposition and weight loss, which in turn leads to the rapid oxidation reaction of vitamin C, so decreased and showed the lowest level in control fruits.

Overall, the interaction between treatments and periods of storage was significant. After 28 days of storage, sweet pepper fruits dipped in T4 resulted in higher ascorbic acid content, followed by T3 or T2 with no significant differences between them, while T5 gave the lowest ones in the same period.

Total Microbial Count:

Figure 8 indicates that microbial growth in sweet pepper fruits increased significantly with increasing the storage period, particularly in the untreated control. Similar results were reported by [60] on fresh-cut sweet pepper.

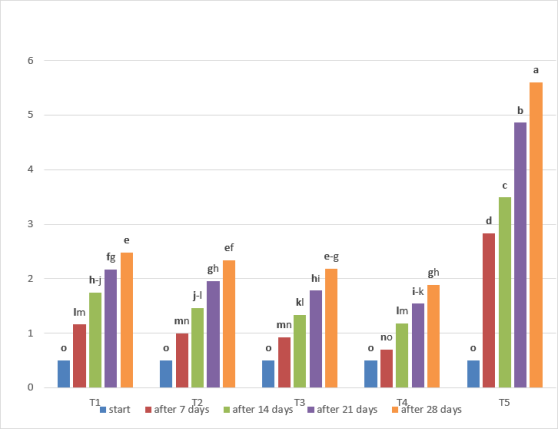

Fig. (8): The influence of mucilages extracted from some vegetable plants residues on total microbial count (log CFU/g) of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan

T2 Okra fruit peduncle

T3 Taro tuber peel

T4 Jew's mellow stalks

T5 Control

The sweet pepper fruits coated with all used treatments had lower levels of microbial load in comparison to the control treatment. Sweet pepper fruits dipped in T4 treatment provided the lowest count in all types of microorganisms, followed by T3 or T2 treatments with no significant differences between them. T5 treatment had higher levels of microbial load. These results were in agreement with those obtained by [14,34] for mucilage and by [61] for chitosan.

The use of mucilage as an edible coating led to a decrease in the total count of bacteria. The reason may be the high percentage of phenolic compounds in the mucilage. The greater the total phenolic compounds, the more this leads to an increase in the antimicrobial properties of the mucilage. It may also be observed that the diffusion of phenolic compounds in the cytoplasmic membrane, and the disruption of the force of the movement of the proton, the electric current, and the contents of the fusion cells [14].

The interaction between chitosan and the microbial cell membranes is likely to have an antimicrobial effect; this, in turn, leads to the leakage of proteinaceous and other intracellular constituents. Chitosan can destroy the fungi by penetrating the nuclei of fungi and interfering with RNA and protein synthesis [62].

Concerning the interaction between postharvest treatments and storage periods, data

revealed that sweet pepper fruits dipped in T4 or T3 treatments were the most effective treatments in reducing the levels of microbial load, followed by T2 and T1 treatments with no significant differences between them, while T5 treatment had the highest value of microbial count after 28 days of storage at 10°C.

Total carotenoids:

Figure 9 indicates that total carotenoid contents in sweet pepper fruits increased significantly with increasing the storage period, particularly in T5 treatment. Similar results were reported by [60] on sweet pepper. Chloroplasts may transform into pigment makers and this is related to the changes in the pigment content of green pepper fruits as they ripen [50].

Sweet pepper fruits dipped in T4 and T3 treatments gave the lowest values of total carotenoid contents with no significant differences between them as compared with the T5 treatment which gave the highest values of total carotenoid contents. These results were in agreement with those obtained by [63] for chitosan.

Delayed color development may be due to the mucilage as the edible coating depends on polysaccharides and chitosan coating as well, and this, in turn, indicates a delay in the rate of ripening which leads to inhibition of carotene synthesis, delay of ripening, prolongation of storage and marketing period [37,52].

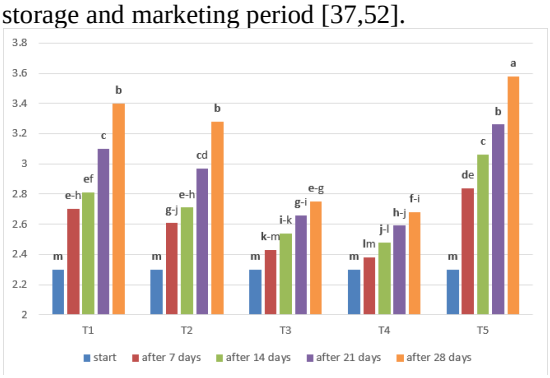

Fig. (9): The influence of mucilages extracted from some vegetable plants residues on total carotenoids content of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan
T2 Okra fruit peduncle
T3 Taro tuber peel
T4 Jew's mellow stalks
T5 Control

Concerning the interaction between treatments and storage periods, data revealed that fruits dipped in T4 or T3 gave the lowest values of total carotenoid contents with no significant differences between them, while T5 had the highest values of total carotenoid contents after 28 days of storage at 10°C.

Total sugars:

Figure 10 revealed that the total sugar content of fruits was significantly affected by the storage period. There was a significant reduction in total sugars over a long storage period. These results were in agreement with those obtained by [64] on strawberry fruits. The decrease in total sugar content is probably due to the consumption of sugars through respiration [56].

Sweet pepper fruits dipped in T4 and T3 retained more total sugar content with no significant differences between them, followed by T2 and T1 with no significant differences between them. The lowest value of total sugar content was obtained from T5.

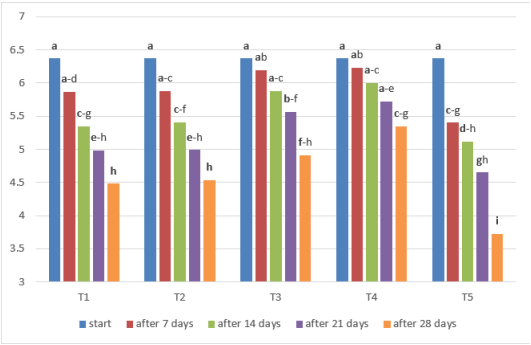

Fig. (10): The influence of mucilages extracted from some vegetable plants residues on total sugars content of sweet pepper fruits during storage at 10°C.

Means in the same column having the same letter are not significantly different at the 0.05 level by Duncan's multiple range test.

T1 Chitosan
T2 Okra fruit peduncle
T3 Taro tuber peel
T4 Jew's mellow stalks
T5 Control

The reduction of total sugar loss of fruits during storage by mucilage as edible coating based on polysaccharides and chitosan treatments may be attributed to these materials' reduced respiration rate and enzymatic activity [37,52], resulting in reduced consumption of total sugars during storage.

In general, the interaction between treatments and storage periods was a significant effect on total sugar content. After 28 days of storage at 10°C, sweet pepper fruits dipped in T4 and T3 treatments had the highest values of total sugar content as compared with the T5 treatment, which gave the lowest values in the same period.

CONCLUSION

From the previous results, it could be concluded that sweet pepper fruits dipped in

Jew's mellow mucilage were the most effective treatment for delaying fruit ripening and maintaining fruit quality and gave an excellent appearance after 28 days of storage at 10°C and 95 % RH.

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