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Application of Edible Coating for Improvement of Quality and Shelf-life of Raisins

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Abstract: Raisin is one of the most important products in terms of agriculture exports. During storage period, the product turns sticky and hard due to exudates syrup and moisture loss. To overcome this problem the application of edible coating suggests being of proper assistance. Edible coating is defined as a thin layer of edible material form as a film on the surface of the fruits and vegetables. This coating can affect the respiration and moisture loss. In this research, three different edible coating materials including Pectin, Plant Gum and Starch as well as two varieties of raisin, Thompson seedless and Shahani were investigated. The coated raisins were kept under proper conditions for 6 months. During this period of storage, chemical, microbiological and sensory properties were evaluated. The data indicated that performance of pectin film was better than gum and starch coatings. Microbiological evaluation showed that the microbial count decreased significantly in both PDA and Osmophilic Agar media during storage period ($P<0.05$). The results of sensory evaluation showed that the colour and texture of Thompson seedless variety coated with pectin were the best, while in the term of flavour, samples covered with gum proved to be the best. In the case of Shahani variety, the samples coated with pectin had better colour, texture and flavor, significantly ($P<0.05$). The scanning electron microscopy evaluation of coated samples showed that the pectin film was the most even among all of the other coating materials.

Key words: Raisin · edible coating · pectin · plant gum · starch

INTRODUCTION

Grape is one of the most important fruits consumed by human beings since ancient times which the scientific name of grape is,*Vitis vinifera,* belongs to *Vitaceae* family. Raisin is ripped and dried form of grape. Based on the different ways of drying, dried grapes are called as sun, alkaline, or shadow Raisin [1].

Grape is cultivated differently in all over the world such as Europe, Asia, America and Africa, mainly the most considerable countries are America, Greece, Turkey, Australia and Iran. The most important cultivated area in Iran are central Fars, Khorasan and west Azerbaijan provinces [1, 3].

Grape is a nutritional fruit which have a lot of glucose, fructose, sucrose, formic acid, citric acid, specially malic acid and tartaric acid [1, 4, 5, 17].

Today, use of edible coating is a common issue that is beneficial to protect nutrients material of food specially fruits and vegetables and provide a long durability. The idea of using edible coatings has been obtained from skin of fruits and vegetables [7, 11]. These are a thin layer of edible materials which restrict loss of water, oxygen and other soluble material of food [6, 10, 11]. Some advantages of edible coating are as follows:

- It is palatable
- It reduces environment pollution
- It has a great effect on taste properties
- It develops nutritional value
- It has bactericidal effects [10, 11, 17]

There are different kinds of films which are used such as protein, polysaccharide, lipid and composed films [2, 7, 9, 13]. These films can be placed on fruit and vegetable surfaces through different ways like dipping, spraying and fluidized bed systems [15].

Schultz *et al.* found that pectin could provide a soft and shiny coat. It restricted loss of nutrient and volatile materials during storage and transport. Also

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contamination of product by microorganisms could be controlled by pectin film. It was used for coating of dried fig, raisin and some kind of candies. Separating of product in its package was the most important characteristic of this film [14, 17].

Wax also combination of wax and some kind of vegetable oils was applied by Debeaufort *et al.* [5] for coating of fig, raisin, date and dried sliced peach. They concluded that carbohydrate films can be effective in shining of surfaces and separating of product in packaging [5].

The first edible film from fruits was produced by McHugh *et al.* It was produced from apple puree and different amounts of fatty acid, alcohol, bee wax and vegetable oil. It acted as an appropriate barrier against oxygen loss especially in relatively low or medium humidity. Also it could reduce browning reaction, loss of moisture and maintained the flavor of sliced apple. It can be used for coating of walnut, almond and bakery products [15-17].

MATERIALS AND METHODS

In this study two types of shadow raisin produced from Seedless Thompson and Shahani grape varieties, gum, high methoxy pectin, wheat starch, corn syrup and calcium chloride were used. During primary tests appropriate time for dipping and the best concentration of solution were determined.

Dipping was the most capable method of coating for raisin with uneven surface. Furthermore, it could be used easier by farmer [2, 8]. This process was done in three replications. The stages of coating are following according below:

- Preparation of film solution
- Dipping of samples in solution for 2-3 minutes
- Exiting of samples
- Shaking of samples for 4-5 minutes for removing the excessive solution
- Drying of samples in 10-15°C for 7-8 hours
- Packaging in polyethylene pouch
- Storage of packs in 20-25°C for 6 months

After packaging, samples were kept in a dark room in 20-25°C for 6 months. Moisture content, sensory properties and microbial examination were determined during storage in the fist day and 15, 30, 60, 90, 120 and 150 days after starting the storage. Moreover, the thickness of coats could be evaluated by electronic microscope and chosen the best and more even coats on raisin. Of course, in order to prepare the samples the following stages should be done: selection of the sample, cleaning, fixation, dehydration and covering with conductor. It is important that the tri-dimensions structure of samples must be preserved with this respect [12, 14].

Split-plot in time unit and Dankan test in level of 95% were applied for variance analysis and means comparing by MStat software.

RESULTS AND DISCUSSION

Moisture: The results of moisture content (mean) have been shown in Fig. 1.

Lowe *et al.* [11] reported that a thin layer of lipid compounds can limit moisture loss. They found that the moisture content of control samples which did not have any coating reached to 10% after 10-12 days. While in the case of samples with wax coating the moisture content reached to 10% after 25 days. Therefore they realized that the amount of wax determined the time of reaching to this moisture. So that these samples had the most moisture content at the beginning of storage and the least moisture were observed after six month. The moisture content decreased gradually during storage time.

Figure 2, illustrates the effects of different coatings on moisture content in both varieties. Different coatings did not have any significant effect on moisture content with the exception of pectin in seedless Thompson. It is known that carbohydrate films are weak in moisture preserve.

Figure 3 and 4, demonstrate the effects of various coatings and varieties on moisture content during the storage time, respectively. It is obvious which coating of both varieties had significantly effects on moisture loss.

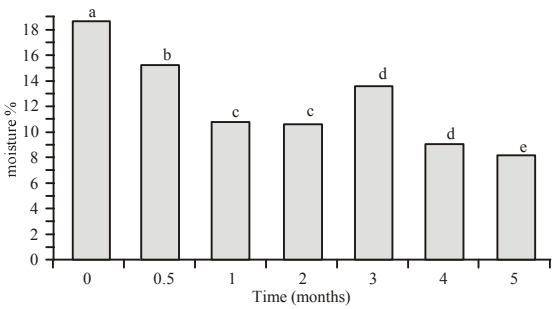


Fig. 1: Moisture percent in different samples during storage time

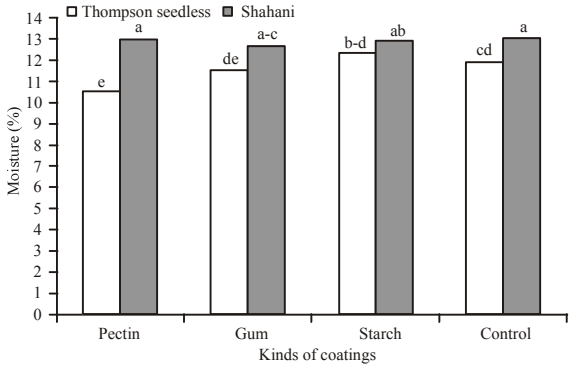


Fig. 2: Moisture contents mean in both varieties during storage time

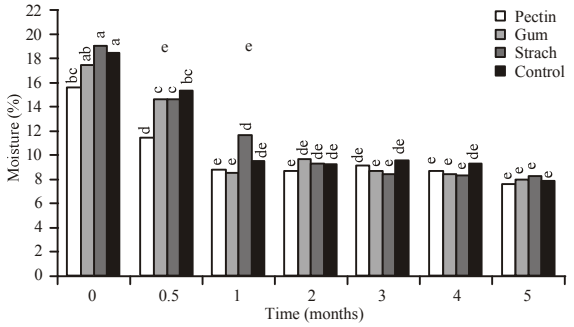


Fig. 3: Misture contents mean of seedless thompson with different coating during storage time

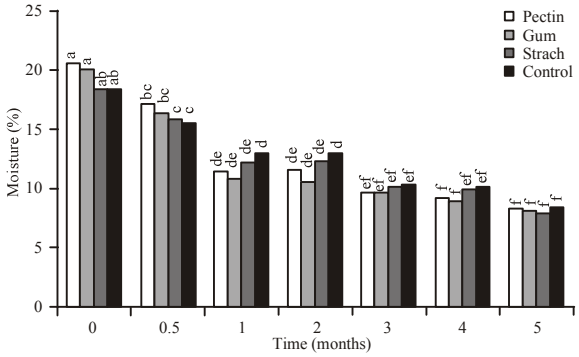


Fig. 4: Moisture contents mean of shahani with different coating during storage time

The results showed that, carbohydrate films cannot prevent moisture loss in different varieties. Therefore it reduces constantly during storage time.

Microbial results: Evaluation of microbial examinations demonstrates that some kinds of molds namely *Aspergillus, Penicillium* and *Rhizopus* are able to grow in PDA and Osmophilic agar.

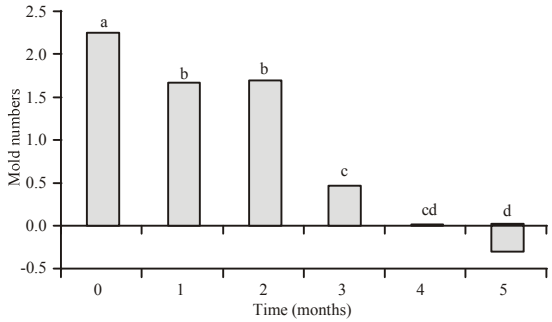


Fig. 5: Logarithmic changes of molds in all samplesduring storage time

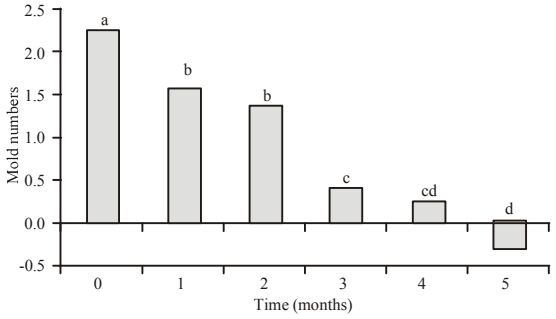


Fig. 6: Logarithmic changes of osmophilic molds in all samples during storage time

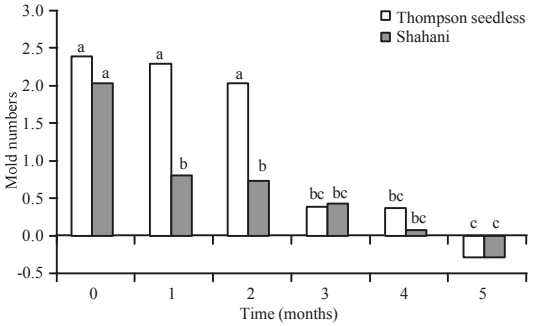


Fig. 7: Molds numbers in two varieties during storage time

The two following figures show the results of microbial tests (Fig. 5 and 6). The logarithmic changes of mold count during 6 months have had significant differences ($P<0.05$). Therefore it has a peak in the beginning of storage and then it decreases significantly due to moisture loss, water activity and oxygen content in their packages.

As Fig. 7 and 8 show, microbial counts in both varieties decreases dramatically after 6 months.

Sensory evaluations: For sensory evaluations color, flavor, texture, stickiness and changes on the surface of raisins were investigated. These examinations showed

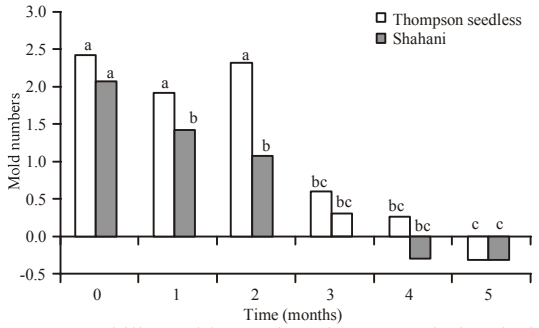
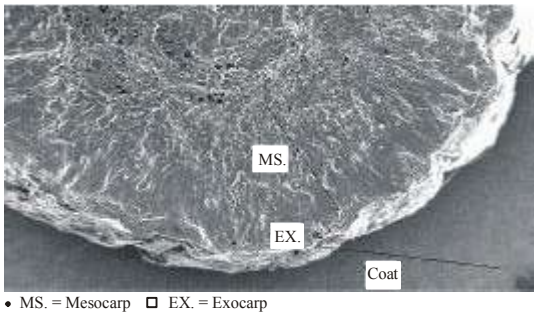
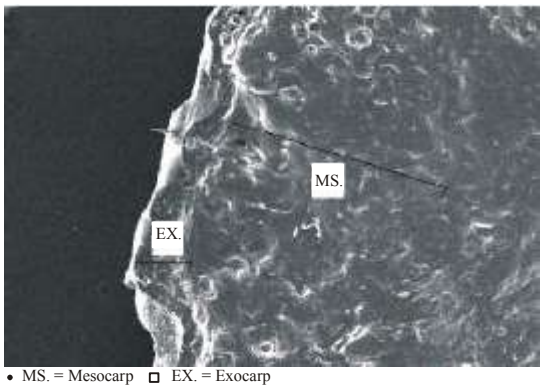


Fig. 8: Osmophilic molds numbers in two varieties during storage time



• MS. = Mesocarp □ EX. = Exocarp

Fig. 9: The picture of Seedless Thompson which was coated with pectin



• MS. = Mesocarp □ EX. = Exocarp

Fig. 10: The picture of Seedless Thompson without coating(control sample)

Table 1: Evaluation of seedless thompson's color in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start (0)	P	G	S	C
15	P	G	S	C
First month	P	G	S	C
2nd month	P	G	S	C
3rd month	P	G	S	C
4th month	P	G	S	C

P = Pectin, G = Gum, S = Starch, C = Control

Table 2: Evaluation of seedless thompson's flavor in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start (0)	G	C	S	P
15	G	C	S	P
First month	G	C	S	P
2nd month	G	C	S	P
3rd month	G	C	S	P
4th month	G	C	S	P

P = Pectin, G = Gum, S = Starch, C = Control

Table 3: Evaluation of seedless Thompson's texture in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start (0)	P	S	G	C
15	P	S	G	C
First month	P	S	G	C
2nd month	P	S	G	C
3rd month	P	S	G	C
4th month	P	S	G	C

P = Pectin, G = Gum, S = Starch, C = Control

Table 4: Evaluation of seedless Thompson's stickness in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start (0)	P	G	C	S
15	P	G	C	S
First month	P	G	C	S
2nd month	P	G	C	S
3rd month	P	G	C	S
4th month	P	G	C	S

P = Pectin, G = Gum, S = Starch, C = Control

Table 5: Evaluation of changes on the surface of seedless Thompson in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start(0)	P	G	S	C
15	P	G	S	C
First month	P	G	S	C
2nd month	P	G	S	C
3rd month	P	G	S	C
4th month	P	G	S	C

P = Pectin, G = Gum, S = Starch, C = Control

Table 6: Evaluation of Shahani's color in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start(0)	P	G	S	C
15	P	G	S	C
First month	P	G	S	C
2nd month	P	G	S	C
3rd month	P	G	S	C
4th month	P	G	S	C

P = Pectin, G = Gum, S = Starch, C = Control

Table 7: Evaluation of Shahani's flavour in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start(0)	P	G	S	C
15	P	G	S	C
First month	P	G	S	C
2nd month	P	G	S	C
3rd month	P	G	S	C
4th month	P	G	S	C

P = Pectin, G = Gum, S = Starch, C = Control

Table 8: Evaluation of Shahani's texture in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start(0)	P	G	S	C
15	P	G	S	C
First month	P	G	S	C
2nd month	P	G	S	C
3rd month	P	G	S	C
4th month	P	G	S	C

P = Pectin, G = Gum, S = Starch, C = Control

Table 9: Evaluation of Shahani's stickness in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start(0)	P	G	C	S
15	P	G	C	S
First month	P	G	C	S
2nd month	P	G	C	S
3rd month	P	G	C	S
4th month	P	G	C	S

P = Pectin, G = Gum, S = Starch, C = Control

Table 10: Evaluation of changes on the surface of Shahani in all samples during the storage time

	Ranking			
Time	Rank 1	Rank 2	Rank 3	Rank 4
Start(0)	P	G	C	S
15	P	G	C	S
First month	P	G	C	S
2nd month	P	G	C	S
3rd month	P	G	C	S
4th month	P	G	C	S

P = Pectin, G = Gum, S = Starch, C = Control

that the best coating in both varieties, seedless Thompson and Shahani, was pectin film. The results have been presented in Table 1 to 10.

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