

Effects of Three Polysaccharide Coatings on Physicochemical and Organoleptic Properties of Mushroom (*Agaricus bisporus*)

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Abstract: White button mushroom (*Agaricus bisporus*) is one of the main horticultural crops which differ from other crops significantly. It is devoid of the protective cuticle and reserves carbohydrates. For this reason mushroom is perishable product and its texture is damaged fast after harvesting. In this study, the effects of three edible polysaccharide coatings including High Methoxy Pectin (HMP), Commercial starch(%3) and Carboxy Methyl Cellulose(%0.17) were investigated on the shelf life of mushroom. Ascorbic acid (as antioxidant and reducing pH agent) and CaCl₂ (firming agent) were used as pretreatments. Physicochemical and sensory properties including weight, moisture, reducing sugars, texture and color were assayed during storage in refrigerator (4°C) at 1, 7 and 14th day of storage. The effect of coating on moisture content, firmness, color and sugar was significant. Also, the interaction effects between coating and pretreatment on weight was significant.

Key words: *Agaricus Bisporus* % Coating % High Methoxy Pectin % Carboxy Methyl Cellulose % Starch % Shelf Life

INTRODUCTION

Fresh fruits undergo vigorous biological reactions after harvest and their respiration accelerates the natural loss of fruit tissue. Therefore fruits tend to lose water at room temperature. The appearance, texture and quality are changed and thus reduce the commercial value [1,2]. The main changes are enzymatic and non-enzymatic browning which cause reduce consumer acceptance [3-5]. Enzymatic browning may be controlled through using both physical and chemical methods and in most cases both are employed. Physical methods may include reduction of temperature and/or oxygen, using of modified atmosphere packaging, edible coatings and treatment with gamma-irradiation or high pressure. Chemical methods utilize compounds which act to inhibit the enzyme, remove its substrates (oxygen and phenolics) or function as preferred substrate [6]. Ascorbic acid is probably the most widely used antibrowning agent and in addition to its reducing properties, it also slightly lowers pH. Ascorbic acid reduces the O-benzoquinones back to O-diphenols and it

also has a direct effect on polyphenol oxidase [6]. Edible coatings are used as a semipermeable barrier that helps reducing respiration, retard water loss and color changes, improve texture and mechanical integrity, improve handling characteristics, help retain volatile flavor compounds and reduce microbial growth [6]. Lowings and Cutts proposed the coating of fresh fruits and vegetables with a semi-permeable composite film comprising of the sodium salt of Carboxy Methyl Cellulose (CMC) and sucrose fatty acid esters [7]. The CMC sucrose ester coating was later used to control internal gas concentrations of green pre-climacteric banana fruits and Cox's orange pippin apples [8,9]. The sucrose polyester coating was used for extending the shelf life of stored Golden Delicious apples. Therefore, the aim of this research was to determine the effect of three different polysaccharides based coating on the post harvest quality characteristics of *Agaricus bisporus*. Specifically, the study will measure the effect of the coatings on quality changes during storage including firmness, moisture retention, color, weight loss and reducing sugars.

MATERIALS AND METHODS

Materials: Mushrooms (*Agaricus bisporus*) were obtained from a local grower (Shandiz, Khorak Talaie Farm, Mashhad, Iran). Ascorbic acid (pH<4, 10 min) and CaCl₂ (0.3%, 5 min) were prepared from Merck company. Carboxy Methyl Cellulose (CMC) and High Methoxy Pectin (HMP) were obtained from Sun rose (Japan) and Danisco (Denmark) companies, respectively.

Moisture Content: Moisture content of the mushroom samples was measured as an indicator of water losses during storage using the oven drying method. The samples (2 g.) were weighed before and after drying (in 75°C for 4-6hr) [10,11].

Weight Loss: The samples from each treatment were weighed during the study with an analytical weight balance. The results were expressed as percent weight loss [10].

Sugar Content: Reducing sugars were determined by Antron method [10].

Color: The color of mushroom samples were evaluated in a sensory laboratory under white light by a preference method on a 5-point hedonic scale where 5=excellent and 1=very poor. A panel team of 10 judges was used [12].

Firmness: Six mushrooms from each treatment were selected for firmness analysis. Firmness was measured using a Texture Analyzer (QTS-25) fitted with a Kramer shear cell [14].

Statistical Analysis: The experiments were conducted as a factorial with completely randomized design [14].

RESULTS AND DISCUSSION

Moisture Content: The result showed that the effect of coating on moisture content was significant (P=0.05) after two weeks storage, but the interaction effects of coating and pretreatment were not significant. Mushrooms respire after harvest therefore their moisture content reduces during storage. Edible coatings can reduce respiration. Scientists (1991) used protein compounds for coating apple pieces and found that coating samples had higher moisture than uncoating samples after six days [15]. Xie-Jianhua *et al.* [16] investigated the effect of Litchi

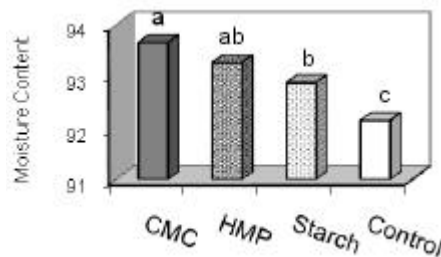


Fig. 1: The effect of coating on moisture content

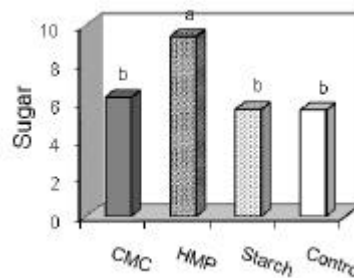


Fig. 2: The effect of coating on sugar content

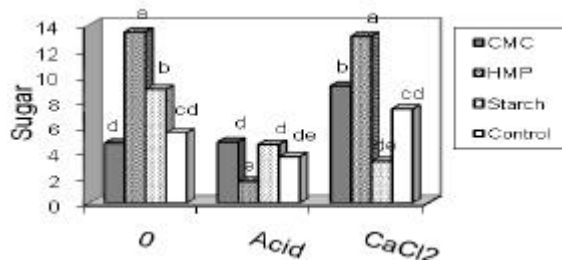


Fig. 3: The interaction effects of coating, acid and CaCl₂ treatments on sugar content

coated with edible konjac glucomannan, the result showed that the effect of coating on browning, fruit quality and inhibition of moisture loss was significant and could extend shelf-life [16].

Sugar Content: The result of reducing sugar measurement (Fig 2) showed that the effect of coating was significant (P=0.01). Also, the interaction effects coating and CaCl₂ were significant (P=0.01). Sugar content in mushroom with HMP was more, but other samples hadn't significant difference together. Mushroom and other products respire after harvest and aerobic respiration cause to break down sugar, therefore amount of sugar decrease during storage.

Weight Loss: As shown in Fig 4, weight loss was less when coating and pretreatments were used together.

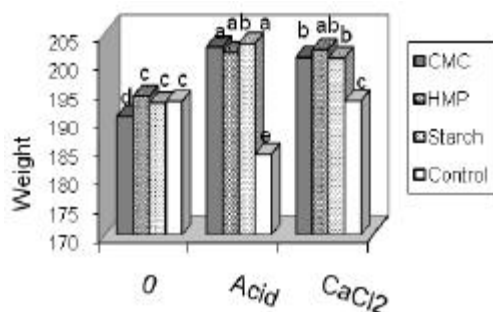


Fig. 4: The interaction effects of coating, acid and CaCl₂ treatments on weight

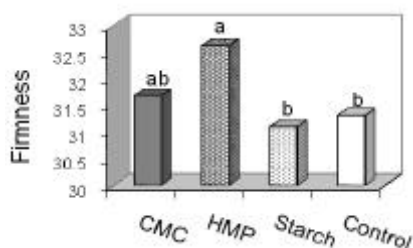


Fig. 5: The effect of coating on firmness

Weight loss in mushroom is related to respiration, because respiration consumes nutrient materials and reduces samples weight. Edible coatings can use as a barrier versus respiration, therefore can reduce weight loss. Park [17] applied zein coating on the surface of tomatoes and reported that the film coating delayed color change, weight loss and maintained firmness during storage [17]. Diaz-Sobac *et al.* [18] investigated the effects of Hydrophobic coating emulsion to extend post harvest life of mango. This coating material is a mixture of maltodextrin, CMC, propylene glycol and mixture of sorbitan fatty acid and showed that respiration rate and weight loss were less in coated samples than control [18]. Alvares-de-oliviera and Cereda [19] investigated the effect of Cassava starch with wax on Biuti peaches. The result showed that coating samples with Cassava starch and wax had less weight loss than Cassava starch samples and uncoated samples [19].

Firmness: The result (Fig 5) showed that the effect of coating on firmness was significant ($P=0.05$), but the interaction effects coating and pretreatments weren't significant. Also, among coatings used HMP and CMC were effective on firmness. Gormley [20] and Finney [21] reported that mushroom firmness changes during storage probably due to change in mushroom loss and solid

Table 1: The score of color different treatments during storage

Time storage(days)	1	7	14
Treatments	Color Score		
HMP	2.9	3.3	3.6
CMC	2.3	2.3	2.7
Starch	2.1	1.9	1.5
Acid	2.5	2.1	2.7
CaCl ₂	3.3	2.4	2.3
Control	1.5	1.1	1.3

compounds [20-22]. Yan-Shijie *et al.* [23] investigated the effect of chitosan coating on physicochemical of Lizao fruit and concluded that chitosan coating was effective on firmness and inhibition of weight loss [23]. Park *et al.* [17] used zein coating on apple and pear and reported that coating delayed firmness and weight loss during storage [17].

Color Evaluation: According Table1, the effect of coating on color was significant ($P=0.01$) during preservation period (7 days time intervals). The effect of HMP coating on color was more effective among other coatings. Edible coating were used as a semipermeable barrier that helps reduce enzymatic browning. Hershko and Nussinovitch [24] considered the effect of different coatings including alginate and orgostrol (with or without emulsifier) on mushroom and the results showed that coating mushrooms had better color and appearance and less weight loss than uncoated samples [24]. Nisperose-Carriedo *et al.* [25] investigated the effect a food coating to extend shelf life of orange, mango, banana, tomato and mushroom. The result showed that coating delayed ripeness in tomato, mango and banana, also inhibited the enzymatic browning in mushroom slices [25]. Zhao [26] reported that chitosan coating can extend strawberry, apple and tomato shelf life. Also, coating can delay polyphenol oxidase and peroxidase activity therefore can delay color loss and browning in Litchi [26]. Feuge and Hagenmaier reported we can use coating to extend appearance in some fruit like apple, citrus fruits and confectionary products [15,27,28]. Nussinovitch and Kampf [29] investigated the effect of alginate on mushroom and result showed that color and appearance in coated mushrooms were better than uncoated samples [29].

CONCLUSION

The results demonstrated that coating can be effective to extend the shelf life of mushroom. The effect

of coating on moisture content, firmness, color and sugar was significant. Also, the interaction effects between coating and pretreatment on weight was significant.

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