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Research Paper

Effect of edible coating on the physiology and nutrients of shiitake mushrooms (*Lentinula edodes*)

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ABSTRACT: *The effect of edible coating of CMC-Na on physiology and nutrients of shiitake mushrooms was studied. Different concentrations of CMC-Na (1%, 1.5%, 2%) were prepared for coating by immersion, and stored in 15℃ storage chamber for 6 days. During storage, soluble protein content, total phenolics, PPO activity and DPPH· scavenging rate of shiitake were determined. The results showed that the 1 % edible coating with CMC-Na could retard the reduction of soluble protein, inhibit the PPO activity and maintained the antioxidant ability.*

KEYWORDS: *Edible coating, Shiitake mushrooms, Physiology, CMC-Na*

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I. INTRODUCTION

Shiitake mushrooms (*Lentinula edodes*) have high water content, vigorous physiological metabolism, soft and tender tissues, intense respiration, thus they will quickly lose water, shrivel and shrink, causing serious browning and corruption. Shiitake mushrooms lose their commercial value when stored after 2 days under natural conditions [1]. Therefore, it is particularly important to study the preservation of shiitake mushrooms. Edible coating technology is a new way to keep fruit and vegetables fresh. Shiitake mushrooms will soon turn brown and deteriorate when exposed to the air at room temperature, because of the effects of microbial proliferation, enzyme activity changes and post-ripening [2-5]. Edible coating preservation has the advantages of low cost, less residue, less pollution, good preservation effect, simple and easy to operate. In this study, sodium carboxymethyl cellulose (CMC-Na) with different concentrations was used to make edible coating for fresh shiitake mushrooms. Weight loss rate, hardness, sensory attributes of overall quality, aroma, texture, cap color, gill color and gill integrity were measured. And the optimum concentration of CMC-Na coating solution and its effect on the sensory quality of shiitake mushrooms during storage were determined.

II. MATERIALS AND METHODS

2.1 Sample preparation

Shiitake mushrooms were harvested from local farm in Zibo, Shandong in China, and transported within 1 h to the lab. After cooling to the room temperature, shiitake mushrooms were separated to four groups. Three groups of shiitake mushrooms were coated with different concentrations of CMC-Na (1%, 1.5%, 2%) were taken as the treatment groups, and the other one group without any treatment was taken as the control set (CK). Then all the samples were stored at 15 ℃ for 6 days. The quality attributes were determined every 3 days.

2.2 Soluble protein content

The extraction method of soluble protein was as follows: 4.00g of shiitake mushroom sample was weighed, 20 mL water was added, the extraction temperature was 10 ℃, the extraction time was 20 minutes, and the extracted substance was centrifuged at a speed of 10000r/min, the centrifugation temperature was 4℃, and the centrifugation time was 10min. After centrifugation, the supernatant was obtained, and then the supernatant was filtered [6]. The absorbance was measured after the mixture with coomassie bright blue dye.

2.3 Total phenolics

A total of 1 g mushroom tissue was added with 20 mL 95 % methanol, and then put into a constant temperature water bath at 60 ℃ for 30 minutes. Then the mixture was centrifuged at 10000 r/min and 4 ℃ for 10 minutes. After centrifugation, the supernatant was collected and add another 20 mL of 95 % methanol to the remaining material and repeat the procedure above. The supernatants obtained twice were combined and diluted to a final volume of 50 mL with 95 % methanol. Then 0.4 mL extraction solution was added with 2 mL of diluted folinol reagent was added to it, and the two were mixed evenly. After being placed in the dark for 5 minutes, 1.8 mL of 7.5 % sodium carbonate solution was added, and the mixture was placed in the dark for 1 hour at room temperature, and the absorbance at 765nm was measured [7].

2.4 PPO activity

Extraction of PPO: mushroom tissue of 2 g was added with 6 mL phosphoric acid buffer (PBS: pH 7.8, containing 5 % (W/V) PVP). Then put into a pre-cooled mortar for grinding in ice bath, followed by centrifugation at low temperature (10000 r/min, 4 ℃) for 15min, and the supernatant was taken as enzyme extract [8].

Determination of PPO activity: 2.0 mL of acetic acid buffer with pH 4.75, 1.0 mL of catechol solution as the substrate, and 0.5 mL of crude enzyme solution were successively mixed. And absorbance at 410 nm was recorded. One activity unit (U) was defined as the amount of enzyme required to cause a 0.01 change in absorbance value per minute under the measured conditions, and the result was expressed as U/g/min [9].

2.5 DPPH · scavenging rate

Shiitake mushroom sample of 1 g was weighed, and 20 mL of 80 % methanol was added into the sample, which was extracted in a constant temperature water bath at 60 ℃ for 30 minutes. Then centrifugation was carried out at a speed of 10000 r/min at 4 ℃ for 10 minutes. After centrifugation, the supernatant was collected. Then 20 mL of 80 % methanol was added to the precipitate, and extracted again followed the steps above. The obtained supernatants were combined and diluted to a total volume of 50 mL with 80% methanol [10].

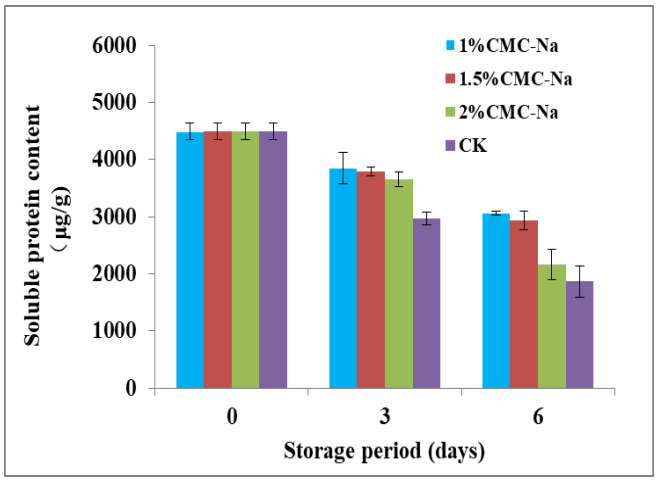
Then 400 μL extract was added with 3.5 mL of DPPH· solution and placed in dark at room temperature for 30 minutes, and the absorbance at 517 nm. The DPPH· scavenging rate was calculated by the recorded absorbance [11].

III. RESULTS AND DISCUSSION

3.1 Changes in soluble protein content

The protein content decreased with the increase of the concentration of coating solution. On the sixth day, the protein content was the highest in 1% CMC-Na treatment.

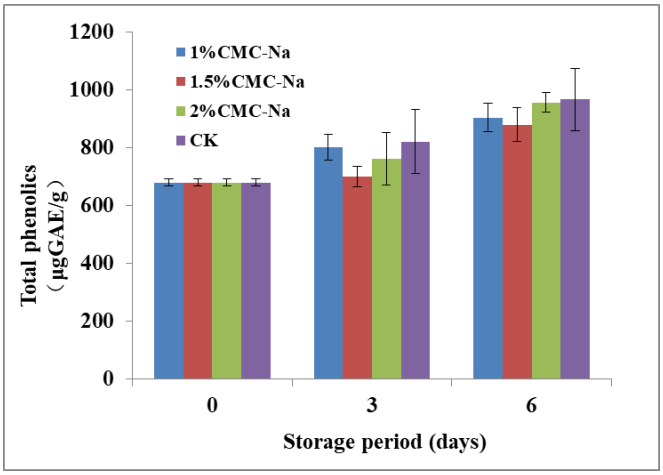
After harvest of shiitake mushrooms, the nutrients in mushrooms were consumed consistently, but without any supply of exogenous nutrients [12]. And the moisture was also lost during the storage. Therefore, the edible coating inhibited the moisture loss of mushroom tissue. Thus, the physiological activity of shiitake mushrooms was inhibited and the consumption of soluble protein was reduced. So the protein content in edible coating treatments was higher overall than the control group.



3.2 Changes in total phenolics

Total phenolics in shiitake mushrooms kept increasing during the storage. But there was no obvious difference between treatments on 6 d.

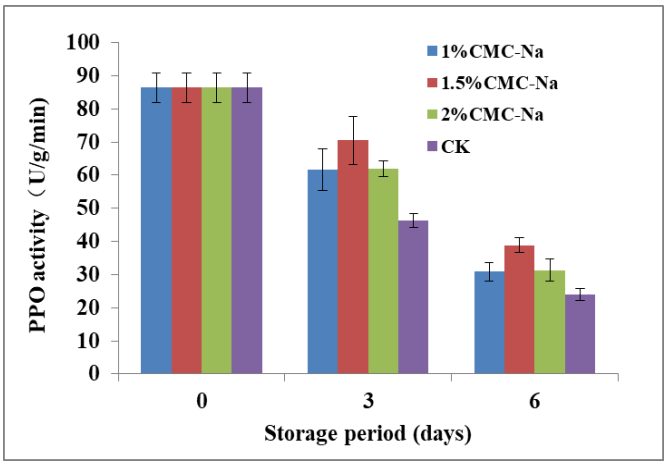
Phenolics as browning substrates of mushrooms and antioxidants are closely related to the quality of the mushroom. Total phenol content increased with the extension of storage, which may be attributed to the changes in permeability of cell membrane during the storage, thus induced the phenolic compounds release from the cell [13].



3.3 Changes in PPO activity

In general, PPO of shiitake mushrooms decreased gradually with the extension of storage period. But there was no obvious difference between treatments at the end of the storage.

Polyphenol oxidase is a copper containing enzyme, widely existing in all kinds of fruit and vegetables, which can catalyze the formation of quinones from some phenolic substances, which can then polymerized quinones into brown substances, leading to browning [14].

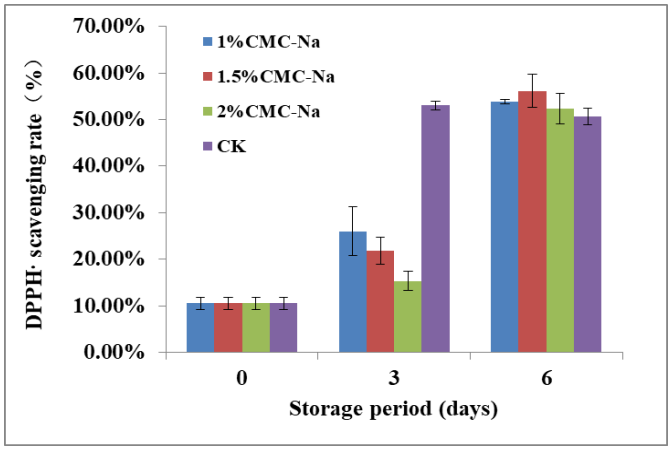


3.4 Changes in DPPH· scavenging rate

DPPH· scavenging capacity of shiitake mushrooms increased with the extension of storage. Higher DPPH· free radical scavenging rates were detected in 1 % and 1.5 % CMC-Na. The DPPH· scavenging rates in edible coating treatments were lower on the third day and higher on the sixth day than that of the control group.

The antioxidant capacity of shiitake mushrooms comes not only from phenols, but also from some polysaccharides and proteins. With the extension of storage period, phenolic compounds were released gradually, resulted in a higher DPPH · scavenging ability in mushrooms [15, 16]. Edible coating could prevent oxygen contacting with mushroom, thus reducing production of free radical. It also reduced the loss of moisture and nutrients, while antioxidants have not been fully released. Therefore, on the third day, the scavenging ability of the control group was better than that of the control group. With the extension of storage time, antioxidant substances were consumed, and the scavenging ability of DPPH· in control group decreased, while the

mushrooms with edible coating began to release antioxidant substances. Therefore, on the sixth day, the DPPH· scavenging abilities in the edible coating treatments were higher than that in the control group.



IV. CONCLUSION

Edible coating of 1 % CMC-Na could maintain the protein content, reduced the dissipation of total phenolics of shiitake mushrooms, which has a good effect on physiology characteristics maintenance of shiitake mushrooms.

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