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Research Paper

Review on Storage and Preservation of Postharvest Vegetables and Fruit

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ABSTRACT: *Fresh vegetables and fruit after harvest are very easy to get deteriorate. Appropriate storage or preservation methods are critical to maintain the quality and prolong their shelf life. Recently, various researches focus on the preservation or storage of postharvest fruit and vegetables. In this review, controlled atmosphere storage or modified atmosphere packaging, edible coating or edible packaging film, chemical preservatives, radiation processing and ultrasonic processing were introduced. Meanwhile, their advantages and disadvantages were also discussed and compared.*

KEYWORDS: *Postharvest, Vegetables, Fruit, Storage, Preservation*

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I. INTRODUCTION

Under the general environment, fresh fruit and vegetables have very high respiration rate thus are difficult to keep fresh. After harvest, the water loss of the fresh agro-product is serious, and they begin to deteriorate and rot, leading to the decline of commodity quality. Therefore, the storage and preservation are very important for postharvest fruit and vegetables [1].

II. STORAGE AND PRESEARVATION METHODS

2.1 Controlled atmosphere storage or modified atmosphere packaging

The air-controlled fresh-keeping technology is to artificially control the composition proportion of oxygen, carbon dioxide, nitrogen, ethylene and other gases in the environmental, so as to delay the metabolism of stored substances. The physiological metabolic activities of the fresh agro-product under the gas environment are inhibited, so that the appearance, color, flavor and nutritional composition of the storage are basically unchanged for a long time, so as to achieve the purpose of prolonging the storage period [2].

Air-conditioned preservation technology can be divided into controlled atmosphere (CA) storage and modified atmosphere (MA) packaging technology. Controlled atmosphere storage is a technology that achieves the preservation of meat, fruits and vegetables by artificially changing the composition of environmental gas on the basis of low temperature storage. Specifically, controlled atmosphere is actually to reduce the content of oxygen in the ambient gas and appropriately increase the content of carbon dioxide or nitrogen while maintaining an appropriate low temperature. Fruit and vegetables still have very high respiration after harvest, and the energy they need for life activities is obtained by decomposing long-term accumulated nutrients through their respiration. Therefore, the preservation of fruits and vegetables is essentially to reduce their respiration to reduce the loss of nutrients [3].

By reducing the oxygen content in environmental gases, controlling low temperature and humidity, the respiration of fruit and vegetables can be reduced, so that fruit and vegetables can maintain their original natural appearance, color, texture, flavor and nutrients for a longer time [4].

Modified atmosphere packaging will have the change of oxygen concentration drop and carbon dioxide concentration rise, the shorter the time used in the oxygen concentration drop process, the better, generally speaking, the shorter the time, the more obvious fresh-keeping effect. The size of the package should be appropriate and must be sealed. At the same time, the gas concentration of carbon dioxide and oxygen should be appropriate. Too low oxygen concentration will induce anaerobic respiration and affect the flavor of fresh mushroom [5].

In the process of air conditioning preservation, all factors should be considered comprehensively, mainly the main aspects of contradiction. Temperature is the most important factor in the condition of air-conditioned preservation. It not only affects the physiological and biochemical process of stored substances, but also affects the physiological activities of microorganisms. At the same time, temperature also affects other environmental conditions, so we must pay attention to the control of temperature in the process of air-conditioned preservation. In addition, humidity is an important condition. Humidity affects not only the respiration and transpiration of stored fruit and vegetables, but also the physiological activities of microorganisms [6,7]. Therefore, proper humidity should be controlled in the actual air-conditioned preservation process. In addition, oxygen content is also an important factor affecting the air-conditioned freshness of fruit and vegetables. Oxygen in the air accounted for about 21%, carbon dioxide accounted for 0.03%, nitrogen accounted for 78%, change the composition of gas, appropriately reduce oxygen content and increase carbon dioxide content, in order to achieve the purpose of inhibiting the stored material respiration and transpiration, prevent water loss, slow down the consumption of nutrients, inhibit microbial life activities [8,9].

There are many methods for air conditioning preservation, which can be divided into natural oxygen reduction, gas replacement with the optimal concentration index, nitrogen filling and oxygen reduction, reduced pressure air conditioning and air conditioning packaging [10].

Modified atmosphere (MA storage), depends on the respiration of fruits and vegetables themselves to reduce the oxygen content in environmental gases and increase the carbon dioxide concentration. The biggest characteristic of this method is simple process and low cost. However, modified atmosphere also has some shortcomings. The process in reducing the oxygen concentration in the environment is usually very slow and cannot be accurately controlled. Another method that can quickly deoxygenate is to fill nitrogen and deoxygenate. Nitrogen filling can replace the gas in the package to achieve the purpose of reduction in oxygen ratio. Optimum concentration index gas replacement method refers to an air conditioning method that artificially regulates oxygen, carbon dioxide and other gases into mixed gases according to the optimum concentration index, and pumps out the original gases in the environment while inputting the mixed gases into the storage environment to maintain the optimum concentration of the environment. The application of these air-controlled fresh-keeping methods has greatly extended the storage time of fruit and vegetables, and now people have applied such methods to the fresh-keeping of fruit and vegetables, such as fruit of apples, bananas and vegetables of peppers and broccoli [11, 12].

2.2 Edible coating or edible packaging film

Edible film often uses polysaccharides, proteins, lipids and other macromolecules as coating agents, which have the advantages of safety, environmental protection, low cost and easy operation [9]. The production process also has to add plastic, cross-linking food additives, in order to effectively prolong the food storage period. These solutions are coated on the surface of fruit and vegetables, which can effectively block the penetration of oxygen or various solutes, including water. These solvents will form a transparent film with selective permeability on the surface of fruits and vegetables, which is selective for water and air. Edible preservation coating preservation mechanism: first, reduce microbial pollution; secondly, inhibition of respiration; thirdly, reduce food water loss or moisture absorption; fourthly, reduce contact with air, inhibit the respiration of postharvest product and inhibit enzymatic browning [13].

Using modified atmosphere alone does not effectively prevent mushrooms browning and softening, in addition to this, often use the polymer film on the MAP because of their structure and permeability characteristics so there are some restrictive, they may prompt moisture loss, lead to structural changes, semitransparent, skin dehydration, they may increase the formation of condensation water, and is conducive to microbial proliferation. The semi-permeable barrier provided by edible coating can be used to improve the storage life of fresh-cut fruits and vegetables in MAP packaging, reduce water and salt migration, gas exchange, respiration, oxidation reaction rate, and inhibit physiological disorders. The following describes the coating liquid used in this experiment:

2.2.1 Konjac powder

Konjac powder contains 50% ~ 60% konjac glucomannan, which is often used as a food additive and preservative. It has many characteristics, such as thickening, bonding, water holding and gelation, and is widely used in food industry production [14]. Konjac glucomannan (KGM) is a kind of natural soluble dietary fiber separated and extracted from konjac tubers. It has very few calories and is easy to fill the stomach. The absorption of glucose will be reduced, and the suction speed will be reduced.

2.2.2 Sodium carboxymethyl cellulose

Carboxymethyl cellulose sodium (CMC-Na) is a kind of white or milky white fibrous powder or particle, which has hypersonic properties, freezing and melting stability, almost odorless and tasteless,

anticorrosion and preservation, and has the characteristics of stability, thickening, film forming, swelling and shape preservation, and can prolong storage time [14]. Because of its safety and reliability, so many national food hygiene standards do not set restrictions on it. Sodium carboxymethyl cellulose film has water resistance, prevent oxidation, retain food flavor substances, improve mechanical strength, maintain the original structure, maintain the flow of oil, is a good carrier of bacteriostatic agent. It is a very ideal coating material.

2.2.3 Streptococcus lactis mixed coating

Nisin is a natural food preservative, grayish white solid powder, can be degraded by human body enzymes, digestion, and non-toxic, effective, one of the polypeptide substances. Studies have shown that Nisin is effective at killing or inhibiting bacteria that cause spoilage. The effect of Nisin combined with some salts or other single coating preservatives is better than that of alone [15]. Therefore, Nisin is widely used in many countries and widely used in food preservation [16].

2.3 Chemical preservatives

The method of chemical preservation is to use a certain amount of chemical reagents or preservatives to inhibit the respiration of shiitake mushrooms and prevent them from spoilage, deterioration and browning, so as to achieve the preservation effect [17].

The following is a brief introduction to the common chemical preservation methods.

(1) Salt preservation. Fresh agro-products are simply treated and soaked in about 0.6% salt water for more than 10 minutes, then removed and put into a bag after the water dries.

(2) Rice soup film preservation. The edible fungus is soaked in the dilute rice soup containing soda or baking soda for 5 minutes and then cooled, which can keep fresh for about three days.

(3) Sodium metabisulfite preservation. Spray the mushroom with pyrosulfite aqueous solution evenly on the mushroom body. After spraying, put the mushroom into a plastic bag, seal it immediately and store it in a cool place. In this way, it can keep fresh for about 9 days under the condition of 10℃to 25℃. When using, rinse with clean water before using.

(4) Ascorbic acid preservation. Spray a certain concentration of ascorbic acid solution evenly on the fresh mushroom, and then put the mushroom into a container that is not made of iron. This method can play a role in short-term storage of the mushroom, and can maintain the color of the mushroom, but the general freshness period is 3 to 5 days.

(5) Ascorbic acid citric acid mixed preservation. Agro-product could be soaked in a certain concentration of ascorbic acid and citric acid in a mixed fresh-keeping solution for 20min, drain and seal for long-term storage.

(6) Medical stone preservation. The fresh agro-product is immersed in a plastic bag of medical stone water and placed at 0℃ for preservation. The freshness period can reach more than two months, and the color and taste are better.

The method of chemical preservation should pay special attention to the amount of chemical reagents, which should not exceed the standard.

2.4 Radiation processing

Irradiation treatment is a postharvest treatment technology, and its application prospect is limited. For some tropical fruits, the effect is obvious, which can effectively sterilize and kill insects, thus extending the storage and freshness period, but for other fruits, compared with other methods, the effect is not very significant, and the price is too expensive, not suitable for widespread use. The processing is mainly the use of elements of γ -ray and electronic acceleration and X-ray radiation to irradiate food, play the role of sterilization and the elimination of other harmful substances, at the same time to ionize water and other substances to produce free groups, so as to preserve food methods. The deterioration of shiitake mushrooms is mainly due to the breeding and breeding of microorganisms, which lead to the decay of fruiting bodies of edible fungi. However, high radiation will make lentinus edodes black and change the senses of shiitake mushrooms, thus affecting people's selection of lentinus edodes. The appropriate radiation dose is about 0.2 kGy [18]. Irradiation preservation limits many factors, so this method is generally not used on a large scale.

2.5 Ultrasonic processing

Ultrasonic is mainly used for cleaning fresh-cut fruits and vegetables. The technology uses ultrasonic cavitation effect of low frequency and high energy to produce instant high temperature and high pressure in the liquid, resulting in temperature and pressure changes, killing some bacteria in the liquid, inactivation of viruses, and even destruction of small microbial cell walls, thus prolonging the freshness of fruits and vegetables. Gao Xiang et al. [18] cleaned fresh-cut cress with ultrasonic bubbles for 10 min and then treated it with 0.4% $CaCl_2$ solution. 80% of microbial colonies could be removed, respiration was obviously inhibited, PPO activity was

always at a low level, and there was no obvious damage to VC, and the sensory quality was good. But at the same time the mechanical action of ultrasonic wave will destroy the cell tissue of fresh cut fruits and vegetables to some extent. Therefore, experimental research on quantification of ultrasonic power is needed for different kinds of fresh-cut fruits and vegetables.

III. CONCLUSION

Storage and preservation approach become increasingly important for postharvest fruit and vegetables. And with the increase of nutrient and safety demand, the more convenient and more effective storage or preservation approach with enough safety will satisfy become necessary. Therefore, research on safe, non-toxic, broad-spectrum antibacterial and efficient natural storage approach and food package will become the direction of future development

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