Quality Changes of Different Varieties of Fresh-Type Potatoes during Storage

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Quality Changes of Different Varieties of Fresh-Type Potatoes during Storage

Sijia Liu, Xiangning Chen, Jing Zhou, Xiangzheng Kong and Peixin Han

Email: 412660673@qq.com

Abstract. Fresh-cut fruits and vegetables are actually semi-processed vegetables, which are transported in a low-temperature environment after specific packaging. There are also many problems in the screening of fresh-type potatoes. The problems of microbial contamination, mechanical damage of products and browning of potatoes are the biggest problems faced by fresh-type potatoes. Sensory, color, hardness and other indicators can reflect the changes in the external quality of the potato during storage. Browning degree, PPO enzyme activity, POD enzyme activity, total phenol content and other indicators can analyze the ability of potato to resist browning. The total number of colonies can reflect the changes in the intrinsic quality of the potato. Through these indicators, the most suitable new varieties are selected for market products.

1. Introduction

Fresh-cut fruits and vegetables have developed rapidly in China in recent years, and various cold chain ready-to-eat products have appeared on the market. Fresh-cut fruits and vegetables are becoming more and more popular in China. For example, a series of cold-chain ready-to-eat products such as vegetable salads in convenience stores and supermarkets are all fresh-cut fruits and vegetables products [1], and people's ability to accept fresh-cut fruits and vegetables is gradually increasing. Fresh-cut fruits and vegetables are actually semi-processed vegetables, and the fresh fruits and vegetables are graded [2], the surface soil is cleaned, then peeled, cut, and then fresh-processed, after specific packaging. , transport it in a low temperature environment. Freshness and nutrients of fresh-cut fruits and vegetables can be effectively preserved and allowed to be consumed directly by customers.

Fresh-type potatoes often appear in major supermarkets, convenience stores, restaurants, and so on. There are also many problems in the screening of fresh-type potatoes. The problems of microbial contamination, mechanical damage of products and browning of potatoes are the biggest problems faced by fresh-type potatoes. And the processing time should be controlled within a certain range, the shorter the better, the time of the transportation process is also the same, there must be strict requirements to control the protection of fresh cut fruits and vegetables [3].

Potato is the fourth largest food crop in the world and is the main food in poor areas of China. It is rich in PRO, vitamin C, essential trace elements, a variety of amino acids and carbohydrates. It is an important food crop and a key economic crop in the world [4]. The ten potatoes selected in this experiment are from the world's largest seed potato company, HZPC, the Netherlands, and are the latest fresh potato varieties. Although various methods have been adopted for browning and microbial contamination of fresh-cut potatoes, such as anti-browning agents, ultra-high pressure technology, plasma technology, biotechnology, and modified atmosphere packaging, various treatment methods will not only improve. The cost of the product may also cause harm to the human body. Therefore, it is an optimal method to select the most suitable fresh-type variety for fresh-cut fruits and vegetables.

Sensory, color, hardness and other indicators can reflect the changes in the external quality of the potato during storage. Browning degree, PPO enzyme activity, POD enzyme activity, total phenol content and other indicators can analyze the ability of potato to resist browning. The total number of colonies can reflect the changes in the intrinsic quality of the potato. Through comprehensive analysis, the most suitable new varieties are selected for market products.

2. Materials and Treatment

2.1. Materials, Instruments and Reagents

2.1.1. Materials
The ten potato varieties are: SY; Shepody; ER; Jannie; CB; Channager; MP; IV; IN; LD, supplied by HZPC, the Netherlands.

2.1.2. Instruments
DGN-06 multi-function fresh-keeping sealing machine, Ningbo Xiangshan Lvyuan Light Industry Machinery Factory; HIK7 vegetable drain machine, Guangzhou Jiuying Machinery Co., Ltd.; H1850R desktop high-speed refrigerated centrifuge, Xiangyi Centrifuge Instrument Co., Ltd.; ISO9001 balance, match Doris Scientific Instrument Co., Ltd.; T6 New Century Spectrophotometer, Beijing Spectrum Analysis General Instrument Co., Ltd.; HH-S digital display constant temperature water bath, Changzhou Xiangtian Experimental Instrument Factory; BCD-288WSL refrigerator, Qingdao Haier Co., Ltd.

2.1.3. .Reagents
Phosphoric acid solution (chemically pure), guaiacol (analytically pure), aqueous hydrogen peroxide (chemically pure), catechol (analytical grade), sodium hypochlorite solution (chemically pure).

2.2. Experimental Methods
Potato cutting: select fresh potatoes with uniform size, no buds, no disease, insects and mechanical damage, and complete fleshy whiteness. After washing, the vegetables are divided into 7 cm long, 1 cm wide and 1 cm thick potatoes. article.

(1) Preparation of cleaning agent: sodium hypochlorite 80 ppm.

(2) Pretreatment of potato strips: The cut potato chips are immersed in a 4 ° C cleaning agent for 5 min, centrifuged at 600 r/min with a vegetable drainer for 20 s, and the freshly cut potato chips are pressed with a PE composite nylon bag. Packed in 100 g/pack vacuum and stored at 4 °C.

2.2.1. Determination of browning degree
The browning degree was measured by the extinction method [4].

2.2.2. Determination of PPO activity
PPO activity was determined by the method of Zhou Wenping, Chen Jingcong and Luo Xingwu [5].

2.2.3. Determination of POD activity
POD activity was determined by the methods of Sun Chengxu, Zheng Shufang and Li Jian [6].

2.2.4. Determination of total phenolic content
The total phenol content was determined by the Folin-phenol method [7]. The standard curve equation is: y = 107.4x +0.0186, where: y-absorbance, x-gallic acid content, g; correlation coefficient R^2 = 0.9966.

2.2.5. Determination of chromaticity
The ADCI-60-C color difference automatic detector was used to determine [8].

2.2.6. Determination of hardness
Refer to the measurement method of Jiang et al. [9] and make appropriate modifications.

2.2.7. Determination of the total number of colonies
Adopt the national standard method GB 4789.2-2010 [10].

2.2.8. Data processing
The obtained data were subjected to standard deviation statistical analysis processing by excel software [12], and the results were all represented by the mean of three parallel results. And the data were compared by SPSS software for significant difference analysis.

3. Experimental Results and Analysis

3.1. Changes in Potato Browning during Storage
Browning is a kind of quality change that is common in plants. It refers to natural plant foods such as apples, eggplants, and potatoes. After mechanical or external damage, the color of the damaged area gradually deepens and changes with time. The color increases until it turns completely brown. This phenomenon is called browning [13]. For potato, because it contains polyphenols such as chlorogenic acid and caffeic acid, and the polyphenol oxidase activity is high, browning is likely to occur during processing, transportation, storage and sale. It can be seen from Fig. 1 that the browning degree of each variety showed an increasing trend during storage. The variety with the greatest change in browning degree was In, the change in browning degree was increased by 2.73, and the variety with the lowest change in browning degree was Ja, which increased by 0.5.

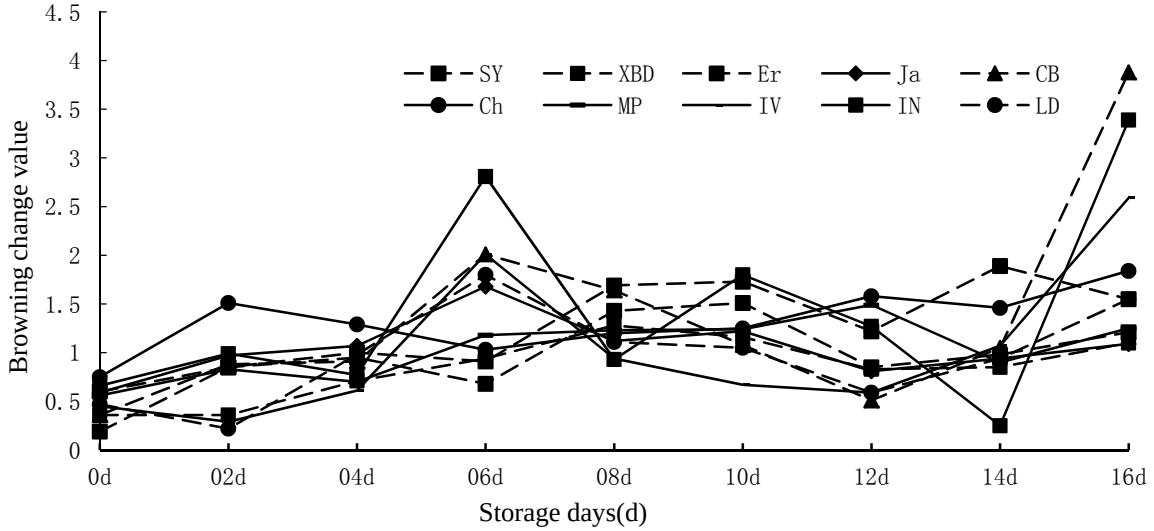


Figure 1. Changes in browning during storage

3.2. Changes in Potato PPO Enzyme Activity during Storage
Polyphenol oxidase is a key enzyme in the metabolism of phenols in fruits and vegetables. It is widely distributed in plant cells. The enzyme catalyzes the oxidation of endogenous polyphenols into hydrazine by oxygen. The accumulation of brown pigments formed by hydrazine leads to browning. PPO enzyme activity is significantly associated with browning of fruits and vegetables [14]. After the potato was cut, the activity of PPO increased rapidly because the cutting injury induced the PPO activity in the latent state of the potato to increase rapidly in a short time. The change of PPO activity in the middle of storage was mainly the balance between induced enzyme activity and suicide inactivation. Results: PPO activity decreased at the end of storage, mainly due to decreased induction

and suicide inactivation. As can be seen from Fig. 2, the species with the largest change in PPO enzyme activity during storage was In, which increased by 116.66 U /min·g. The smallest variation was MP, which increased by only 3.33 U /min·g.

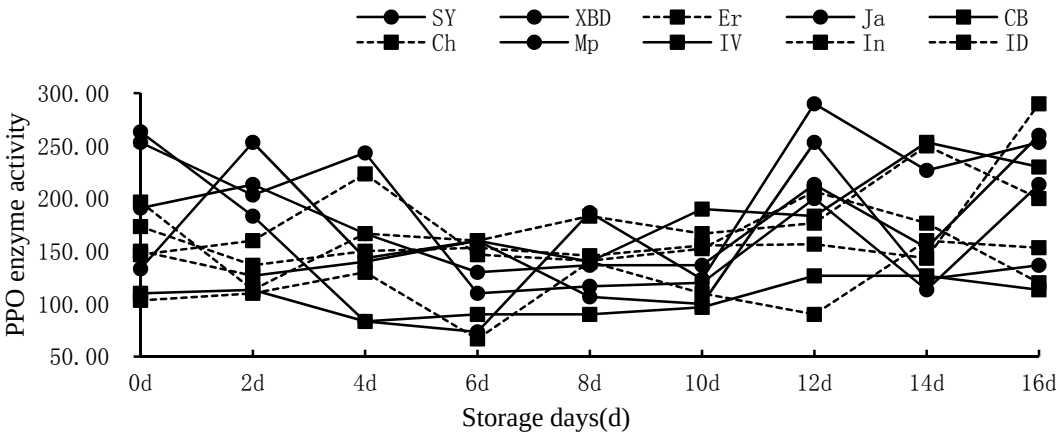


Figure 2. Changes in PPO enzyme activity during storage

3.3. Changes in Potato POD Enzyme Activity during Storage

POD can effectively remove active oxygen free radicals produced by tissues. It is a catalyst in the last step of lignin biosynthesis and is an indicator to measure the aging of fresh-cut fruits and vegetables [15]. The overall activity of POD increased, and the increase in activity at the 1st day indicated that the cutting damage destroyed the membrane structure. The accumulation of H2O2 induced the increase of POD activity and increased the resistance of the fruit to injury stress. The enzyme activity decreased in the late treatment group, indicating that with the prolongation of storage time, the fruit aging increased, the ability to scavenge free radicals weakened, and the fruit resisted. The sex decreased and the POD activity gradually decreased. During the whole storage period, the species with the greatest change in POD enzyme activity was In, which increased by 716.67 U /min·g, which was significantly higher than other varieties. The increase of POD activity was a physiological response of plants to stress.

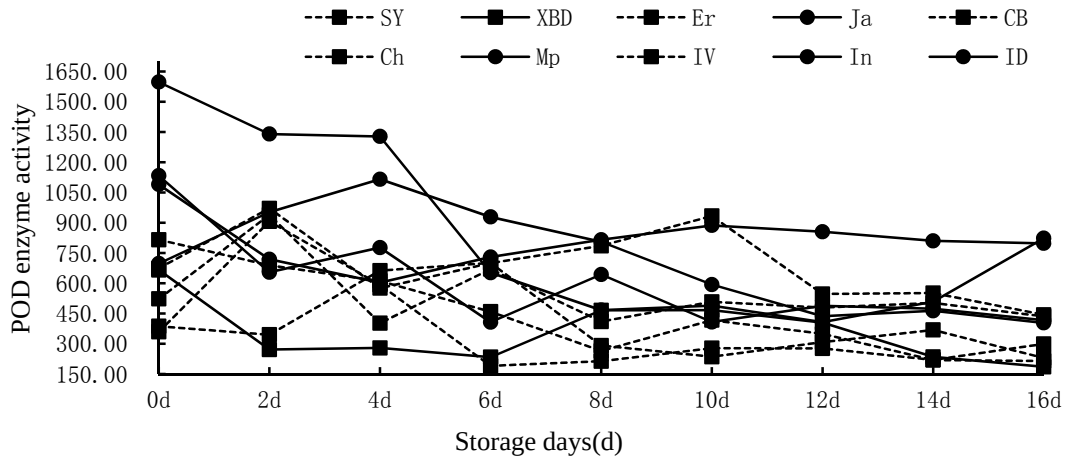


Figure 3. Changes in POD enzyme activity during storage

3.4. Changes in Potato Color During Storage

The color change of the potato strip is one of the important indicators to reflect the degree of browning. The chromaticity L indicates bright or dark color, the positive value is bright color, and the negative value is dark color [16]. Brightness the L* value indicates the difference in the color depth of the potato surface. Studies have found that with the prolonged storage time, the surface of fresh-cut potatoes gradually darkens, indicating that the browning of fresh-cut potato strips is becoming more and more serious with the storage time (Zhang Xiaoyan et al., 2016). After the browning of the potato slices, the surface color became darker and redder, which showed that the color difference L* value decreased and the a* value increased (Cao Yu, 2016). Therefore, the surface color of the cut potato was indicated by the L* value and the a* value. As can be seen from Fig. 4 and Fig. 5, the L* value was significantly reduced when stored at the 6th day, and the most obvious variety was CB, indicating that it had browned severely on the 6th day and lost the commercial value. Ja still maintains its original color, and the L* and a* values are unchanged from the 0d.

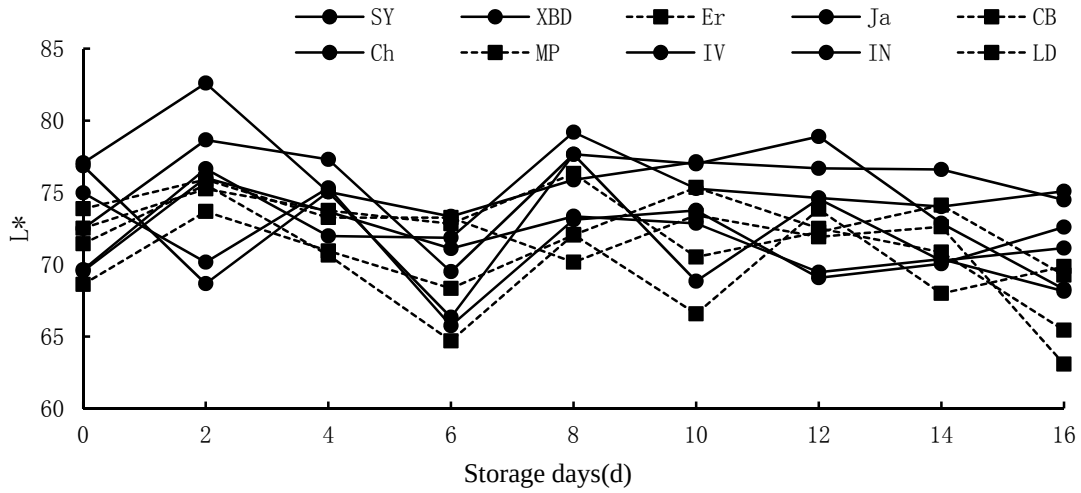


Figure 4. Changes in L* during storage

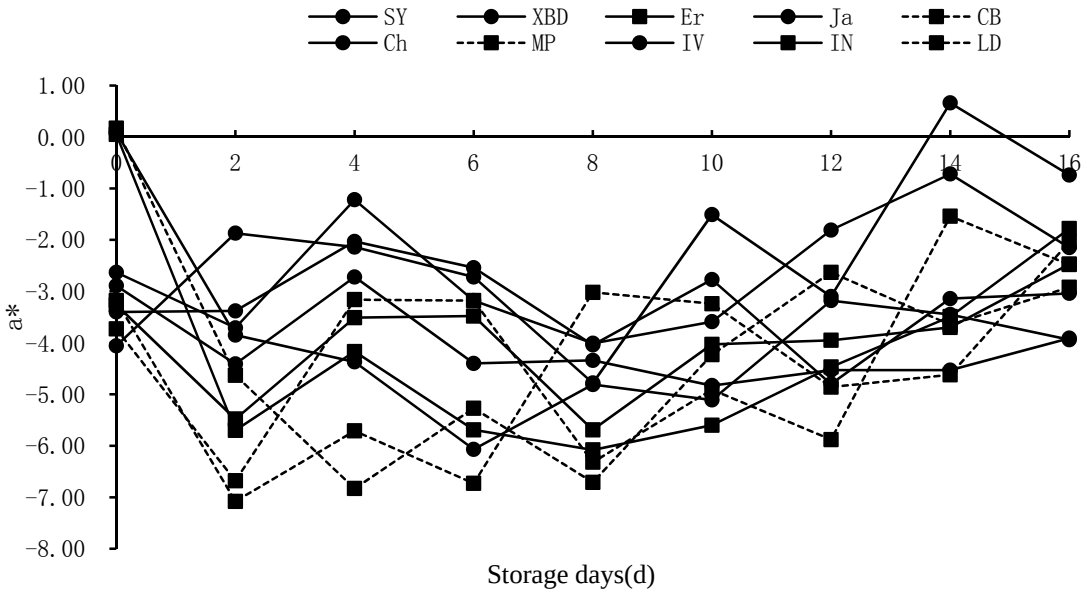


Figure 5. Changes in a* during storage

3.5. Changes in Potato Hardness during Storage

Hardness is an important indicator to judge the value of potato products, especially the potato strips used in vegetable salads. Its hardness seriously affects the taste and is one of the important factors affecting consumers' evaluation of potato quality [17], so the hardness is selected in a short time. Smaller varieties can better meet the needs of consumers. It can be seen from Fig. 6 that the hardness of all varieties of potato strips decreases with the storage time, because the chemical reaction inside the potato accelerates the degradation of potato quality. The variety with the greatest change in hardness was IV. When stored to the 16th day, the hardness decreased by 2350, while the smallest change was Er, which was only reduced by 290. When stored to the 4th day, there was almost no change. It can be seen that the hardness changes of different varieties of potatoes are extremely significant, and the standard for determining the hardness change can provide a good basis for us to screen and apply fresh cut products such as salads in the future.

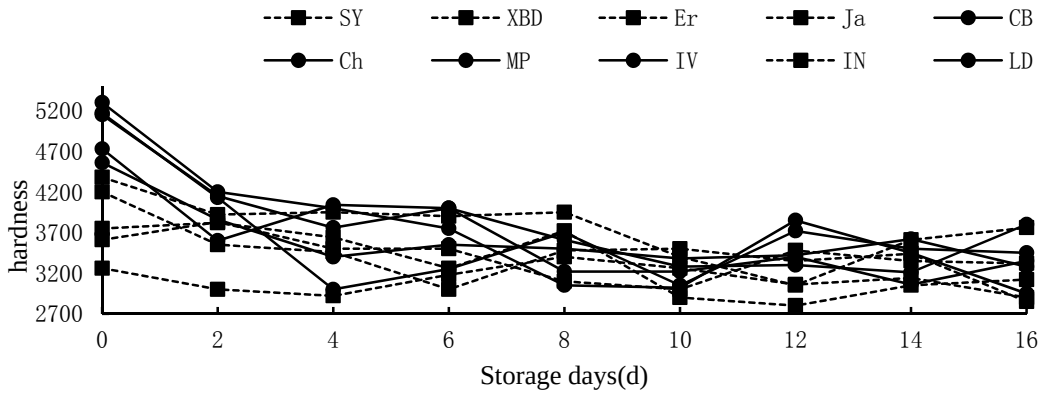


Figure 6. Change in hardness during storage

3.6. Changes of Total Phenolic Content in Potato during Storage

Phenolic substances play an important role in fruits and vegetables and are the substrate for the browning reaction of fruits and vegetables [18]. In the presence of oxygen, phenolic substances are oxidized and browned, affecting the sensory quality of the potato. Studies have shown that the content of phenolic substances is an important factor affecting the browning rate. The higher the content of phenolic substances, the easier it is to brown during processing. At 0d, the total phenolic content SY >IN> Channager > Iv>Er>XBD>CB>LD>MP>Ja. After the 10th day, the polyphenol content of each group of samples increased significantly. Therefore, the content of polyphenols may be one of the reasons that affect the browning of fresh-cut potatoes.

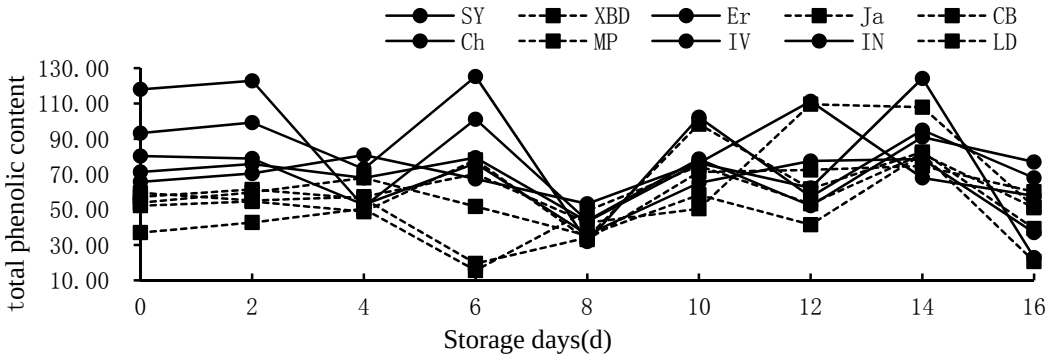


Figure 7. Changes in total phenolic content during storage

3.7. Changes in the Total Number of Potato Colonies during Storage

The most important factor affecting the quality of fresh-cut fruits and vegetables is the number of microorganisms. The growth of microorganisms not only causes harm to consumers' health, but also has a direct impact on sample quality [19]. The potatoes are freshly cut, internal organs and tissues are destroyed and exposed to the air, in contact with harmful bacteria in the air. The number of microbes in the samples showed an increasing trend, and the number of organisms increased significantly. The growth of microorganisms in each group was basically the same, and the growth was slow. During storage, the three species with the least number of colonies were Ja, In, and Channger. The three most important varieties were Iv, MP, and CB. A major problem facing fresh-cut fruits and vegetables is microbial reproduction. Therefore, it is important to choose a variety that remains safe without treatment.

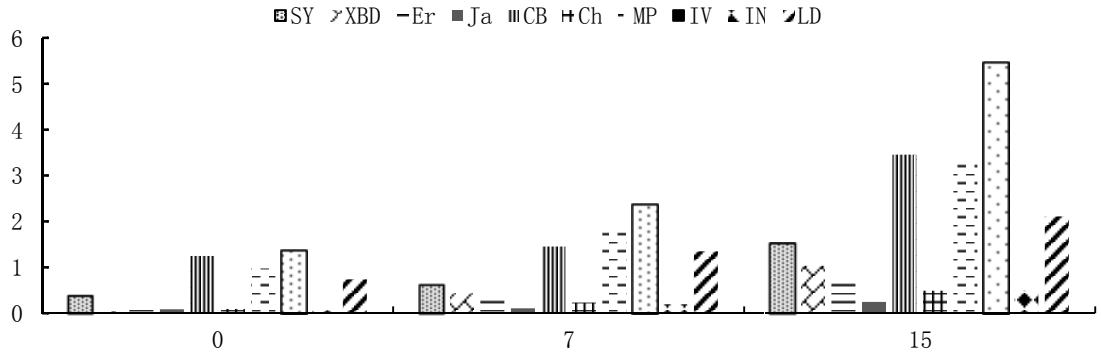
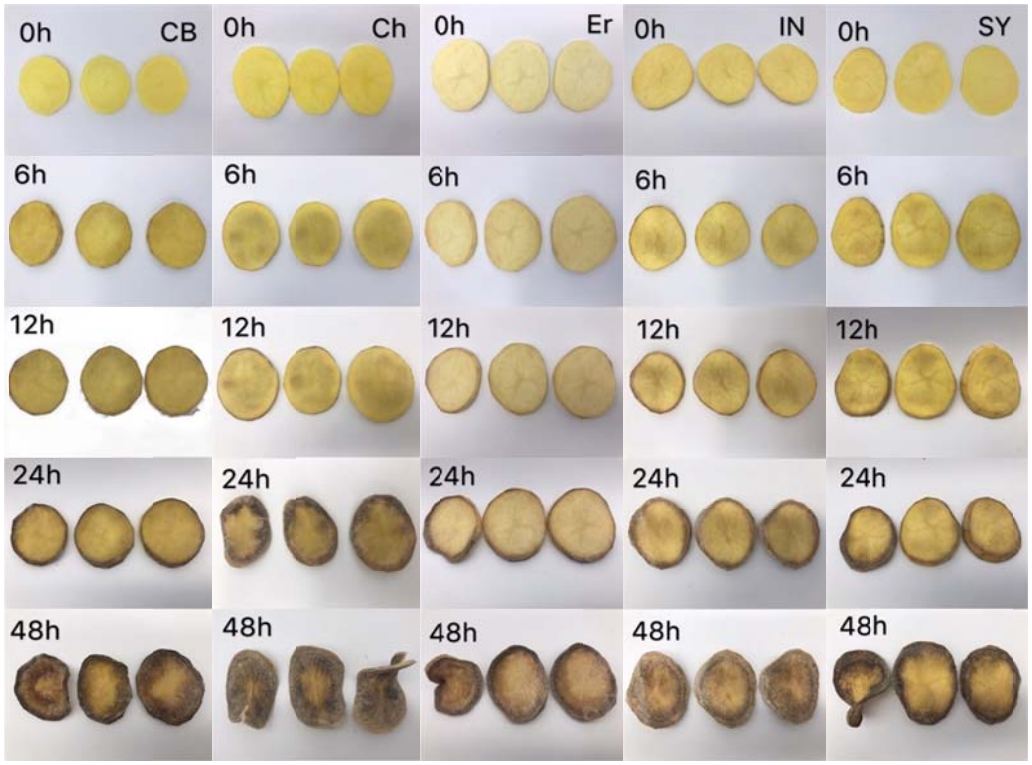


Figure 8. Changes in the total number of colonies during storage

3.8. Sensory Photos



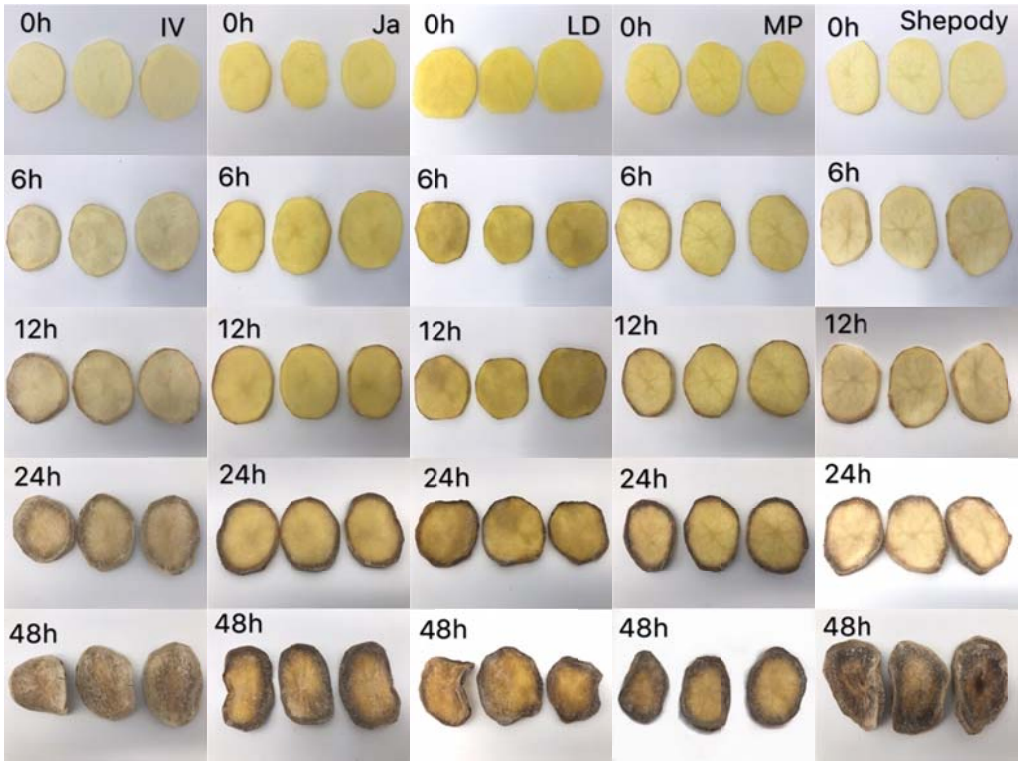


Figure 9. Appearance changes of ten fresh-cut potatoes during storage

It can be seen from the sensory photos that browning and water loss are extremely serious after freshly cut potatoes of different varieties. However, there is a big difference in the browning speed of the fresh-cut potato slices of these varieties. It can be clearly seen that even if the Ja variety is stored in the air for 12 hours, there is no obvious browning, and the water loss phenomenon is not obvious. Sensory photos can be a very intuitive reflection of the quality changes of fresh-cut fruits and vegetables during storage.

4. Conclusion

Fresh-type potatoes are increasingly active in the market, but the potato is prone to browning and rapid microbial growth after cutting, which affects the shelf life of fresh-cut potatoes. Therefore, the physiological and biochemical indicators of the above ten new types of fresh potato can be better classified. The variety that is more suitable for fresh-cut ready-to-eat is Ja, which retains good commercial value when stored to the 4th day. Previously, we used browning inhibitors and other methods to treat the potatoes, which increased the cost on the one hand, and the use of chemical reagents on the other hand would discourage consumers. Therefore, in the future, it is possible to cope with the different needs in the market by cultivating a new pair of fresh-type potatoes.

5. Acknowledgment

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