EFFECT OF PACKAGING TO QUALITY AND SHELF-LIFE OF FRESH SEA GRAPES (CAULERPA LENTILLIFERA J.AGARDH, 1837)

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ABSTRACT

Fresh sea grapes are succulent, soft, loose and easily perishable by environmental factors. The purpose of this study was to determine the type of packaging which is suitable for preserving fresh sea grapes. Three types of packaging, namely Polyamide (PA), Polypropylene (PP) and polyvinyl chloride (PVC) were used to research. The results showed that while the shelf-life of sea grapes preserved in PVC was only 2 days, that in PA, PP were up to 10 days. Moreover, the weight loss, the rate of damage and total aerobic microorganisms of grape seaweeds preserved in PA were lower than that in PP. This means that suitable packaging will help to maintain the quality and extend the shelf life of fresh sea grapes.

Keywords: Sea grapes, shelf-life

I. INTRODUCTION

Sea grapes (Caulerpa lentillifera, J.Agardh, 1837) is a seaweed belonging to species of Caulerpa. They were internationally documented since the 70s of the 16th century. They fully contain essential nutrients, including fiber, vitamins, amino acids, minerals and bioactive compounds which can be seen as a potential food. Sea grapes, nowadays, are significantly cultured, growth and processed in many countries such as Japan, China, Korea, India and the Philippines [8, 9, 10, 11, 12, 13].

In Vietnam, sea grapes were known in the early years of the 20th century. There had been certain successful aquaculture research in coastal areas in Khanh Hoa, Binh Thuan and Phu Yen provinces [3]. The estimated capacity reached up to 100 tons of fresh seaweed per year in 2002. However, the characteristics of sea grapes are succulent, soft-loose so immuno ability and stability are low. Sea grapes are easily perishable under room temperature [4]. Therefore, it is crucial to study suitable containers to prolong self-life of sea grapes and maintain its quality.

II. MATERIALS AND METHODS

1. Materials

Sea grapes: sea grapes were purchased at Dai Phat B Plus Company, Cam Ranh city, Khanh Hoa province. Then, the sea grapes are immediately transported to a Nha Trang University’s laboratory.

PA (Polyamide) containers were 20x30cm in size and 0.9µm in thickness. These containers were transparent and high-gloss surface. Besides, they were high gas permeability resistance, particularly resistance to oxygen but low water vapor permeability. PP (Polypropylene) containers were 20x30cm in size and 0.6µm in thickness. PVC (Polyvinyl chloride) containers were not plasticized and 20x30cm in size, 14µm in thickness. They were transparent, high mechanical strength and surface gloss. PVC containers were better than PA and PP containers in water vapor and gas permeability.

PA, PP and PVC containers were supplied by the A Chau plastic packaging Co-operation company. Tan Binh District, Ho Chi Minh City.
The containers were produced following food safety standards, particularly QCVN 12-1:2011/BYT standard regarding plastic packaging containers that directly contact food [5].

2. Methods

2.1. Sampling and sample preparation

Sea grapes were harvested in the early morning, then transported to the laboratory. Next, they were washed and re-growth before being storage. The number of each collection were around 6kg. All experiments were run in triplicate.

2.2. General process

2.3. Experimental design

Washing: Washing removes impurities and reduce the risk of damage during storage. Sea grapes are washed with 15 liters sea water/1kg in 7 minutes/time and washing times are 3. With the above washing conditions, sea grapes are clean and their quality is not affected.

Re-growth: To restore the health of harvested sea grapes. They are re-grown with 1kg/40 liter of water for 3 days and the oxygen concentration in the water is saturated. With such conditions, the texture and color of sea grapes are improved the best.

Centrifugation: In order to remove water on sea grape surfaces after re-growth process and reduce damage during storage, the sea grapes are centrifuged at the speed of 120 rpm for 2 minutes. With these conditions, water is removed significantly and the quality of the sea grapes are not affected.

Determination on the rate of sea grapes that are damaged during storage time: Putting exact 250g preliminarily treated sea grapes in PA, PP and PVC containers, then securely closing the lid. All samples were stored at room temperature (29°C±1). They were checked for every two days, damaged sea grapes were collected, then weighted to determine the rate of sea grapes damage during storage time.

Similar experimental designs were established to determine the rate of weight loss, aerobic bacteria total, and average sensory score of sea grapes.

2.4. Analytical methods

The rate of weight loss and sea grapes damage were determined by weighting using a Germany electronic balance branded QUINTIX SARTORIUS224-1S, scales 220g, accuracy $10^{-4}$g

Damage features of sea grapes: sea grapes’ trunks were soft, thrombocytes were broken off and slimy. The color of sea grapes turns to white or yellow or dark blue. There stenches of rotting sea grapes.

Aerobic bacteria total was determined by NMKL86:2006 [7] method.

Sensory quality assessment was conducted following TCVN 3215-79 [6]. There were 5 members in assessment board. All members were equipped and trained with assessing method before doing experiments.

2.5. Data analysis

All experiments were run in triplicate. Analysis of variance (ANOVA) was performed to compare difference with means at the $\alpha = 0.05\%$ significance level. Then SPSS soft ware was applied to determine statistical variance between means.
III. RESULTS

1. Effect of packaging containers and storage time on total sensory scores

The results in figure 1 showed that the packaging containers could strongly affect the average sensory-score total regarding storage time.

In term of PVC containers, after 2 days, there was a significant decrease in sensory quality of sea grapes, particularly average sensory-score total was 20 at 0 storage day then reduced to 4.2 after 2 days stored. This means that the sea grapes were damaged after 2 days. There was a similar trend witnessed to control samples (without packaging).

In opposite, regarding PP containers, samples were good at quality after 6 stored days (scored at 16). However, after 8 days, the sensory quality was at medium (11.2 points) while PA containers showed the sensory quality was still at good (15.2 points) after 10 days stored. Thus, the results indicated that using PA containers provided better sensory quality and longer shelf-life than that using PP and PVC containers.

2. Effect of packaging containers and storage time on weight loss

The weight loss (%) of sea grapes was significantly affected by both packaging containers and storage time. The results showed that PA containers provided lower weight loss than PP and PVC containers. In addition, the weight loss increased with the increase of storage time.

Figure 1. Effect of packaging containers and storage time on total sensory scores

Figure 2. Effect of packaging containers and storage time on weight loss
The results in figure 2 showed that the packaging containers could affect the weight loss regarding storage time. PVC containers and the control samples (without packaging) were seen to be significantly influenced. For examples, after 2 stored days, PVC containers and the control samples showed the weight loss reached 35% in comparison to 0 stored day, while the weight loss was remarkably lower (under 10%) in term of PA and PP containers. In addition, there was no statistical variance between two forms of containers in the first 6 stored days. However, the difference appeared after 6 stored days. For examples, the weight loss after 10 stored days packed by PA was 11.9% while it was 15.5% in that by PP containers. This means that PA containers were less effect to weight loss than that of PP and PVC containers.

3. Effect of packaging containers and storage time to sea grapes damage

![Figure 3. Effect of packaging containers and storage time on sea grapes damage](image)

As can be seen in Figure 3, the spoilage rate of sea grapes increased in accordance with storage time in almost samples. However, the increase depended on forms of containers. For example, sea grapes which were packed with PVC showed a remarkable increase in the rate of damage. After 2 stored days, this percentage was 39.4% in comparison to the day of zero.

There was also difference in the spoilage rates of sea grapes packed by PA and PP containers after 4 stored days. While sea grapes which packed by PA containers had not appeared damage after 4 days, the damage was witnessed to samples packed by PP containers, particularly low percentage (smaller than 5%). After 10 days of storage, the damage rate in sea grapes packed by PA and PP were 15.1% and 21.1%, respectively. This showed that PA containers was better to be selected than that of PP containers.
Bacteria were important criteria which directly effects on sea grapes damage and food safety. Therefore, it was crucial to study the variance of sea grapes related to storage time. The results showed that the microbial population significantly increased in samples packed by PVC containers after 2 days of storage. This number was 6 times more than that of 0 day of storage. Regarding control samples (without packaging), the microbial population raised 5 times more than that of 0 days of storage. Besides, there were moderate increases in samples packed by PP and PA containers during storage time.

Thus, the results in Figure 1; 2; 3 and 4 showed that PA were the best containers which should be used to preserve fresh sea grapes. PVC containers could preserve fresh sea grapes in 2 days but it was 10 days to PA and PP containers. However, the weight loss, the rate of damage and aerobic bacteria total of samples packed by PA containers were lower than those of PP containers, and sea grapes packed by PA containers also provided better sensory quality than that of PP containers. This could explain that PVC containers were able to be high gas and water vapor impermeability (higher than those of PP containers and PA containers) [1]. Therefore, during storage time, respiratory speed increased leading to increasing temperature and produced water vapor so the sea grapes damaged quickly.

IV. CONCLUSION AND PETITION

1. Conclusion
Sea grapes packed by PVC containers could be kept fresh in 2 days of storage but PA and PP containers could be 10 days of storage. However, weight loss, rate of spoilage and total aerobic bacteria of sea grapes which were packed by PA containers were lower than those of PP containers. Besides, PA containers showed that the sensory quality was maintained better than that of PP containers. This means that, the selection of appropriate packaging containers could maintain the quality and prolong the shelf-life of fresh sea grapes.

2. Recommendation
It is necessary to continue to study the effects of temperature and storage conditions to maintain the quality of fresh sea grapes.
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