# การเปรียบเทียบผลระหว่างสารเคลือบผิวไคโตซานจากเห็ดนางฟ้าและจากเปลือกแก้วมังกรต่อคุณภาพของกล้วยน้ำว้า

นลินอร นุ้ยปลอด*

งานวิชาศึกษาทั่วไป มหาวิทยาลัยราชภัฏวไลยอลงกรณ์ ในพระบรมราชูปถัมภ์ ปทุมธานี
*Corresponding author email: nalin-on@vru.ac.th

ได้รับบทความ: 31 สิงหาคม 2564
ได้รับบทความแก้ไข: 26 พฤศจิกายน 2564
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**บทคัดย่อ**

งานวิจัยนี้ มีวัตถุประสงค์เพื่อเปรียบเทียบผลของสารเคลือบไคโตซานระหว่างจากเห็ดนางฟ้า (*Pleurotus ostreatus*) และเปลือกแก้วมังกร (*Hylocereus undatus*) ต่อคุณภาพของกล้วยน้ำว้า (*Musa* ABB group) เนื่องจากมีผลการศึกษาก่อนหน้าเกี่ยวกับการยืดอายุกล้วยน้ำว้าด้วยสารเคลือบไคโตซานจากเห็ดนางฟ้า และจากการศึกษาก่อนหน้าเกี่ยวกับยืดอายุสตรอเบอร์รี่ด้วยไคโตซานจากเปลือกแก้วมังกร พบว่าสามารถยืดอายุของกล้วยน้ำว้าและสตรอเบอร์รี่ ได้ 7-10 วัน ตามลำดับ ในอุณหภูมิห้อง ผู้วิจัยจึงมีความสนใจศึกษาเปรียบเทียบค่าการเปลี่ยนแปลงต่าง ๆ โดยใช้เครื่องมือเฉพาะทางเพื่อวิเคราะห์คุณภาพออกมาเป็นค่าต่าง ๆ ได้ชัดเจนมากขึ้น ทั้งนี้เห็ดนางฟ้าและเปลือกแก้วมังกรที่ใช้ในการวิจัย เป็นส่วนเหลือใช้ของผลิตผลทางการเกษตรที่นำมาทำให้มีสภาพพลาสติกคล้ายฟิล์มยืดห่ออาหาร โดยนำกลีเซอรอลและทวีน 80 มาใช้ร่วมกับไคโตซาน จากนั้นศึกษาเปรียบเทียบผลของสารเคลือบไคโตซานทั้ง 2 ชนิด ต่อการเปลี่ยนแปลงลักษณะของผลกล้วยน้ำว้าระหว่างการเก็บรักษาในอุณหภูมิห้อง โดยติดตามในทุก 3 วัน เป็นระยะเวลารวม 15 วัน ได้แก่ การเปลี่ยนแปลงสีเปลือก การเปลี่ยนแปลงน้ำหนัก การเปลี่ยนแปลงปริมาณสารที่ละลายน้ำได้ (TSS) และปริมาณวิตามินซี ผลการวิจัยพบว่า 1) กล้วยน้ำว้าที่เคลือบด้วยไคโตซานมีคุณภาพสูงกว่ากล้วยน้ำว้าที่ไม่ผ่านการเคลือบ และ 2) กล้วยน้ำว้าที่เคลือบด้วยไคโตซานจากเปลือกแก้วมังกรมีคุณภาพสูงกว่ากล้วยน้ำว้าที่เคลือบด้วยไคโตซานจากเห็ดนางฟ้าในอุณหภูมิห้อง

**คำสำคัญ:** ไคโตซาน / เห็ดนางฟ้า / แก้วมังกร / การยืดอายุกล้วยน้ำว้า

# Comparison of the Chitosan Coating Effect between Oyster Mushroom and Dragon Fruit on Banana's Shelf Life

Nalin-on Nuiplot*

General of Education, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani

*Corresponding author email: nalin-on@vru.ac.th

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## Abstract

This research was aimed to compare the effect of chitosan coating between oyster mushroom (*Pleurotus ostreatus*) and dragon fruit (*Hylocereus undatus*) on quality of shelf life in banana (*Musa* ABB group). Due to the results of the previous studies about using chitosan, it was found that the shelf life of bananas and strawberries could be extended about 7-10 days at room temperature. Therefore, this research was studied by using specialized tools to analyze the quality values more clearly. The oyster mushroom and dragon fruit shell used in research were the leftover of agricultural product that are used to make plastic like food wrap, by bringing glycerol and Tween 80 together with the chitosan. The changes in color, weight changes, changes in the total soluble solid (TSS) and also vitamin C were observed during storage at room temperature by monitoring every 3 days for 15 days. The results showed that 1) chitosan-coated bananas were higher quality than untreated bananas, and 2) chitosan-coated bananas from dragon fruit peels were higher quality than from oyster mushrooms.

**Keywords:** Chitosan / Oyster mushroom / Dragon fruit / Extension of banana's life

## Introduction

Banana is a valuable agricultural product that has good taste and can cook a variety of foods. It is a nutritious food source and can be eaten by all ages from infants to old age due to it contains the essential amino acids for growth, arginine and histidine, and has the highest calcium content compared to the same amount of other banana species [1]. It is also important to the economy of Thailand because it is popular to eat both at home and abroad. Although banana is a popular agricultural product [2], sometimes it faces the problems in marketing and export. Because of the short shelf life which is a problem for distribution [3], processing of banana may be another way to extend the shelf life in order to expand the export market. Long-distance distribution, and humid conditions will cause banana to change in quality and rapidly deteriorate from the oxidation process or it may be contaminated with microorganisms that cause food poisoning. Self-degradation can be occurred as well because it is rich in easily digestible proteins and essential amino acids [4], resulting in quality problems thus losing quality and economic value.

Chitosan is a polysaccharide that is mainly obtained from the extraction of the hard shell of organisms such as shrimp, crabs, and also mushroom. It is a natural substance that is safe, non-toxic, inexpensive and biodegradable naturally. There are the studies about its effective in preserving the quality and extending the shelf life of food. It also promotes of food contaminant-free [5] by being effective against various groups of microorganisms, both pathogenic and spoilage. According to the positive charge at the second carbon position of glucosamine, it can react with negatively charged microbial cell membranes [6], causing the microbial cell membrane to leak and lose proteins and other substances within the microbial cell. As a result, microorganisms cannot survive in the end. Chitosan also has anti-oxidation [7] because it can bind to metal molecules (chelating agent) with amino groups that can break down to charge. A positively charge molecule can bind to metals that are catalysts of typical oxidation reactions either enzymatically or non-enzymatically involved.

Therefore, chitosan can help maintain skin color quality of fruits and vegetables. It may be counted that chitosan can be substituted for synthetic antioxidants. In addition, chitosan is a polymer that can be taken orally, therefore, it is likely that chitosan will be used for increasing nutritional benefits. Due to the fact that consumers nowadays are more health conscious by avoiding chemicals by choosing chitosan. It will then reduce the amount of synthetic food preservatives loaded with chemicals that may accumulate and ultimately harm the body. The chitosan extracted from oyster mushroom was approximately 0.5±0.12 g/100 g sample which is above the optimum value for using [5], and the allergy situation of the oyster mushroom was not as common as that of shrimp or crab [8]. Also, the chitosan extracted from dragon fruit can better prevent the spoilage in strawberries as 6.67% which was better than the control of chitosan 1.5% that be as 8.89% [9].

The objective of this research was aimed to compare the effect of chitosan coating from oyster mushroom and dragon fruit on quality of banana's shelf life by observing and measuring the change in quality of bananas stored at room temperature.

## Materials and Methods

1) Preparation of chitosan (adapted from [10])

Sun-dried and crushed materials (oyster mushroom, dragon fruit peel that had been collected by researcher from the surrounding research area) were degreasing with petroleum ether (1 g: 5 ml), then filtered and dried until solid. The solid was then demineralized by boiling with acid (2M HCl 1 g: 5 ml) for 2 h, then washed with water, filtered and dried until solid. The solids were extracted from the protein by boiling with basic solution (2M NaOH 1 g: 5 ml) at 60 °C for 2 h, then washed with water, filtered and dried until solid. The solid was then extracted from the pigment by acetone (1 g: 3 ml), then filtered under pressure and dried. At this stage, chitin was obtained. Chitin was then subjected to acetyl group removal reaction with

50% NaOH at 140 °C for 4 h, then washed with water, filtered and dried. At this stage, chitosan was obtained.

2) Preparation of chitosan coating (adapted from [10])

Weigh 0.3 g of chitosan dissolved in 10 ml of 3% acetic solution, and stir the solution with an electromagnetic stirrer, gradually adding chitosan to the acid until the chitosan was completely dissolved. Then used the ratio between chitosan: glycerol: Tween 80 solution in the ratio 8: 1: 1 and used a stirrer to mix well.

3) Application of chitosan coating

Appropriate coating was selected to coat on the surface of the banana was divided into small combs, about 10 per comb, using the dipping method, and then dry. Then stored at room temperature (approximately 25±2 °C). All three experiments were carried out with ripe bananas that were ready to eat in 1-2 days as follows: 1) control group 1 or uncoated normal bananas (negative control: -ve control) 2) control group 2 or bananas that had been wrapped in stretch film and coated with glycerol and Tween 80 (positive control: +ve control) 3) two experimental groups or bananas that had been coated with chitosan from oyster mushrooms (sample 1) and dragon fruit peels (sample 2). The changes in color, weight changes, and changes in the amount of chemicals were observed during storage at room temperature by monitoring every 3 days for a total period of 15 days. Hand refractometer ATAGO and Chroma meter CR-400/DP-400 machines were used to analyze. The variance ($\pm S.D.^2$) was then analyzed by variance analysis, and the mean was compared at 95% confidence level with the SPSS program.

## Results

According to the study of banana coating with chitosan from oyster mushrooms and from dragon fruit peel, in comparison with uncoated group (negative control: -ve control) and wrapping with film group (positive control: +ve control), it was found that bananas coated with chitosan from dragon fruit peels were able to extend the banana's shelf life for 15 days with a

percentage of minimum weight loss at 0.58±1.07 percent (Table 1) and no percentage of fungal incidence was observed. Meanwhile, that bananas coated with chitosan from oyster mushroom were able to extend the banana's shelf life for 10 days with a percentage of weight loss at 0.90±1.59 percent. Uncoated would begin to show mold on the day 5 of storage, and the film coating started to find fungi in day 7. As for the change in banana fruit skin color, it was found that the skin color L* a* b* of bananas coated with various extracts and stored at room temperature showed a statistically significant difference in skin color ($P<0.05$), consistent with the spoilage effect (Table 1). The results of the experiment on the amount of total soluble solid (TSS) and vitamin C content of bananas coated with various substances showed that the results were statistically different ($P\leq0.05$) (Table 1). It was found that the TSS and vitamin C content changing in sample 2 tended to be changed in the minimum volume while increasing storage time in shelf life (Figure 1 and 2).

**Table 1** Percentage (±S.D.[2]) of spoilage, weight loss, color of skin and chemical compound of bananas at 15 days after various coating

| Group | Spoilage (%) | Weight loss (%) | Color of skin | | | Chemical compound | |
|---|---|---|---|---|---|---|---|
| | | | L* | a* | b* | TSS (°Brix) | Vitamin C (mg/100g) |
| -ve control | 8.98 | * 2.22±1.86 | 39.99 ±0.71 | 37.02 ±1.18 | 28.36 ±0.94 | 9.16 ±1.19 | 54.42 ±2.97 |
| +ve control | 7.13 | 0.70±1.39 | 37.26 ±0.69 | 34.26 ±0.24 | 27.40 ±0.60 | 7.65± 0.49 | 47.24 ±0.54 |
| Sample1 (mushroom) | 7.86 | 0.90±1.59 | 39.44 ±0.87 | 37.44 ±0.42 | 26.22 ±0.88 | 7.85± 0.67 | 48.42 ±1.72 |
| Sample2 (Dragon fruit) | 6.48 | * 0.58±1.07 | 35.48 ±0.46 | 32.37 ±0.41 | 23.37 ±0.48 | 5.02 ±0.11 | 43.91 ±0.41 |

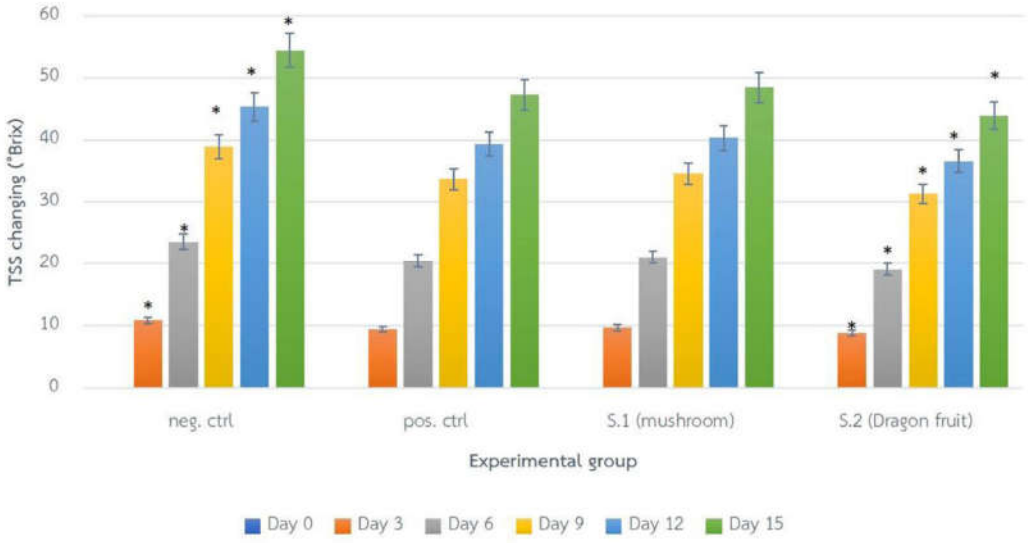


**Figure 1** TSS changing (±S.D.[2]) at every 3 days after various coating (P*≤0.05)

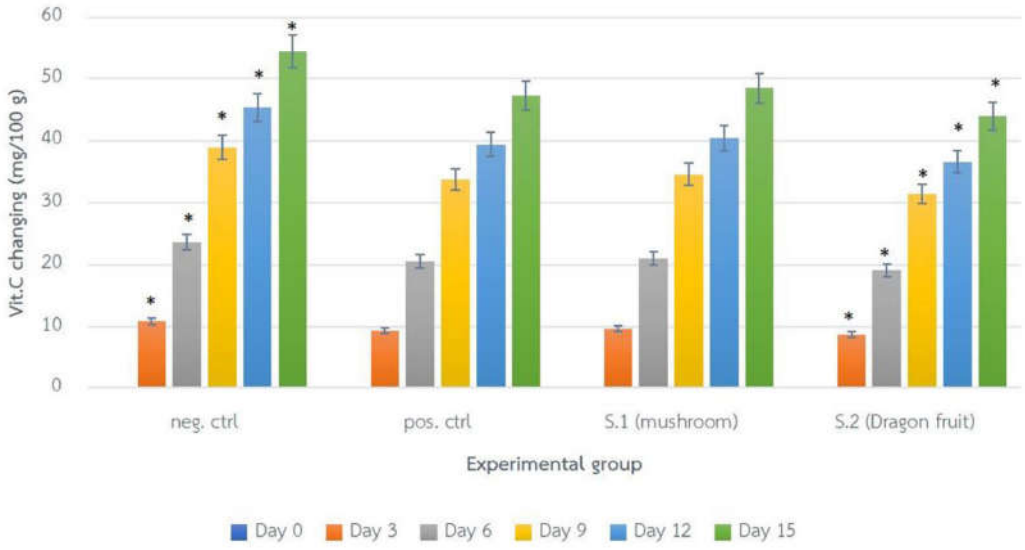


**Figure 2** Vitamin C changing (±S.D.[2]) at every 3 days after various coating (P*≤0.05)

## Discussion

According to the results, it was found that the rate of physical and biological qualities changing in sample 2, or the group of chitosan-coated from dragon fruit peels, had a lower rate than the positive control which was the group of stretch film coated with glycerol and Tween 80. Also, sample 2, had a lower rate than the sample 1 or the group of chitosan-coated from oyster mushroom with a statistically significant different (P≤0.05). This is consistent with the experiment of Pen-khae et al [9] which found that chitosan extract from dragon fruit peel was able to slow down the quality change at a lower rate than the coating from 1.5% chitosan solution and from okra. This is due to extracts from fruits and vegetables that look like mucus, such as dragon fruit (peel), could help to reduce fungal infestation and loss of primary water [11] and also helps to achieve oxygen permeability as good as using glycerol that looks like viscous mucus. This is consistent with the results of the experiments of Srinivasa et al [12] which found that the addition of glycerol to the chitosan film resulted in increased oxygen permeability. This is because its results in increased shifting of the polymer

chain and then causes the resistance between the polymer and oxygen molecules to decrease. The grouped of sample 2 had a slightly higher rate of change in quality than the positive control group but also with a statistically significant change ($P \leq 0.05$). However, all three groups which were positive controls, sample 1 and sample 2 showed a lower rate of change in quality than the negative control group or the uncoated banana group. It has been shown that the coating can slow down the discoloration of banana peels to a slower rate than normal. This is consistent with a study by Kanisorn et al [13] which found that coating the bananas with shellac extract could reduce weight loss, density and slower discoloration of the banana peel. The bananas were stored for 4 weeks at 15 °C. It is also consistent with the study by Umaporn et al [14] which found that the coated banana had higher quality than the uncoated banana, and can extend the shelf life of bananas for at least 12 days at a temperature of 26±2 °C. Moreover, this is also consistent with the study of Nalin-on Nuiplot [15] which found that chitosan coating from oyster mushrooms can extend the shelf life of banana by approximately 10 days at room temperature.

## Conclusion

The extension of banana shelf life by coating of banana's fruit with chitosan extract from dragon fruit peel was more likely to extend the shelf life of banana fruit than using chitosan extract from oyster mushroom, when stored at room temperature, due to the lower rate of change in quality. However, there are other factors that can help control quality in long distance transportation, such as temperature control, or the nature of the packaging that helps to control the impact of the fruit. However, the cost of chitosan film production can be resulted in higher banana prices. It should be one of the factors that must be taken into account in up-scale this film for practical use in the agricultural industry as well.

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