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การยืดอายุการเก็บรักษาแตงกวาญี่ปุ่นโดยใช้สารเคลือบผิวบริโภคได้จากเมือกเมล็ดแมงลักและเมล็ดควินซ์จีน

Storage Life Extension of Japanese Cucumber Fruit Using Edible Coatings from Lemon Basil Seed and Chinese Quince Seed Mucilage

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บทคัดย่อ

การศึกษาผลของสารเคลือบผิวที่บริโภคได้จากเมือกเมล็ดแมงลักและเมล็ดควินซ์จีนต่อการยืดอายุการเก็บรักษาของผลแตงกวาญี่ปุ่น โดยใช้สารเคลือบผิวจากเมือกเมล็ดแมงลักและเมือกเมล็ดควินซ์จีนที่ความเข้มข้น 0.3 และ 1% (น้ำหนักแห้งต่อปริมาตร) ตามลำดับ และใช้แตงกวาที่ไม่เคลือบเป็นชุดควบคุม โดยศึกษาสมบัติเชิงกลและอัตราการซึมผ่านของฟิล์มจากเมือกเมล็ดแมงลัก 0.3% และเมือกเมล็ดควินซ์จีน 1% และศึกษาผลการประยุกต์ใช้สารเคลือบที่ได้ต่อคุณภาพแตงกวาญี่ปุ่น (การเปลี่ยนแปลงของสีเปลือก เนื้อ การสูญเสียน้ำหนัก และพีเอช) ตลอดการเก็บรักษาที่อุณหภูมิ 11±1 องศาเซลเซียส ความชื้นสัมพัทธ์ 95% เป็นเวลา 18 วัน ผลการทดลองแสดงให้เห็นว่า ที่ความเข้มข้นเมือกเมล็ดแมงลัก 0.3% และเมล็ดควินซ์จีน 1% ฟิล์มที่ได้มีค่าความหนาเท่ากัน และมีสมบัติเชิงกลที่ไม่แตกต่างกันอย่างมีนัยสำคัญ จึงสามารถใช้เป็นสารเคลือบเปรียบเทียบกันได้ด้วยความหนาที่เท่ากัน ฟิล์มจากเมือกเมล็ดควินซ์จีนมีอัตราการซึมผ่านของน้ำและออกซิเจน (6.61±0.33 g.mm/day.cm².mmHg และ168.58±2.85 cc.mm/m².day kPa ตามลำดับ) สูงกว่าฟิล์มจากเมือกเมล็ดแมงลัก (5.40±0.89 g.mm/day.cm².mmHg และ 149.58±0.25 cc.mm/m².day kPa ตามลำดับ) สำหรับการใช้ประโยชน์พบว่า แตงกวาที่เคลือบด้วยเมือกเมล็ดแมงลัก 0.3% และเมล็ดควินซ์จีน 1% มีการสูญเสียน้ำหนัก การเปลี่ยนแปลงของเนื้อสัมผัส และการเปลี่ยนแปลงสีเปลือกน้อยกว่าชุดควบคุม ผลการทดลองแสดงให้เห็นว่า การเคลือบแตงกวาด้วยสารเคลือบผิวที่บริโภคได้จากเมือกเมล็ดแมงลักและเมือกเมล็ดควินซ์จีนสามารถยืดอายุการเก็บรักษาของแตงกวาญี่ปุ่น (จาก 10-12 วัน เป็น 18 วัน)

คำสำคัญ: สารเคลือบผิวที่บริโภคได้, เมือกเมล็ดแมงลัก, เมือกเมล็ดควินซ์จีน

Abstract

Effect of edible coatings from lemon basil seed mucilage (LBSM) and Chinese quince seed mucilage (QSM) on the storage life extension of Japanese cucumber fruit were studied by using the concentration of LBSM and QSM at 0.3 and 1% (dry weight / volume), respectively, in comparison with uncoated fruits (control). Mechanical and permeability properties of the edible films from 0.3% LBSM and 1% QSM were investigated and the effect of edible coating application on the quality of Japanese cucumber fruit (changes in peel color, texture, weight loss, and pH) during storage at 11±1°C, 95% RH for 18 days was also examined. The results showed that the films derived from 0.3% LBSM and 1% QSM had the same thickness and had no significant difference in mechanical properties. Thus, the BSM and QSM can be used as comparable edible coatings with the same thickness. The QSM film had the higher water vapor permeability (WVP) and oxygen permeability (6.61±0.33 g.mm/day.cm².mmHg and 168.58±2.85 cc.mm/m².day kPa, respectively) than the QSM film (5.40±0.89 g.mm/day.cm².mmHg and 149.58±0.25 cc.mm/m².day kPa). For application, the coated Japanese cucumber fruits showed lower weight loss and changes in texture, pH and peel color than the uncoated fruits. The results indicated that the edible coatings from LBSM and QSM can be used for extending the storage life of Japanese cucumber fruits (from 10-12 days to 18 days).

Keywords: edible coating, lemon basil seed mucilage, Chinese quince seed mucilage

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Introduction

Japanese cucumber is a vegetable that consumers prefer to eat fresh like salad or ready-to-eat produce as the pulp has crispy nature and thin skin. The main postharvest problem for Japanese cucumber is skin shriveling because of rapid water loss. Normally harvested of Japanese cucumbers need to be placed in a plastic bag before storage at 8-12°C for a shelf life of 10 days but using plastic bags results in global warming. An edible coating is a product that consumers widely accept for replacing plastic polymers which are hard to decompose and can cause environmental pollution.

The mucilage from lemon basil seeds and Chinese quince seeds are insoluble dietary fiber, the same category as gum. Lemon basil seeds are readily available in Thailand at a low price. Their mucilage has an advantage in increasing stickiness in chicken dipping sauce (Noydoung and Virapana, 2007), ice cream (Janpong, 2006) and cooked dried noodles (Sajjaanantakul and Simsrisakul, 2003). Moreover, the lemon basil seed mucilage was used the coat rose apples (Khonmane *et al*., 2011) to protect them from skin damage and to extend their shelf life. Chinese quince seeds are a waste material from the food industry in China, Japan and Korea. However, the mucilage from this kind of seed has not been used as a surface coating for fruits and vegetables. The European quince seed mucilage was applied in the form of a film for improving the quality of rainbow trout (Jouki *et al*., 2014). Thus, the aim of this research was to investigate the properties of the films derived from lemon basil seeds and Chinese quince seeds and to apply them for prolonging the shelf life of Japanese cucumber fruit.

Materials and Methods

1. Extracting mucilage from lemon basil seeds and Chinese quince seeds

Lemon basil (*Ocimum basilicum*) seeds and Chinese quince (*Pseudocydonia sinensis*) seeds were soaked in warm distilled water (55°C) at a water:seed ratio of 60:1 (Akbari *et al*., 2014) and 30:1 (Jouki *et al*., 2013), respectively for 1 hour. The solutions of mucilage were then filtered through cloth sheet. Lemon basil seed mucilage (LBSM) at 0.3% and Chinese quince seed mucilage (CQSM) at 1% were added to 30% glycerol and 0.5% Tween 80 and mixed simultaneously at 45°C for 15 minutes.

2. Coating Japanese cucumber fruits and analyzing quality changes

Japanese cucumbers were ordered from the Royal project's shop in Chiang Rai. They were cleaned, immersed in 2% sodium hypochlorite for one minutes and dried at room temperature before being coated with 0.3% LBSM and 1% CQSM. All the samples (coated and uncoated) were stored at 11±1°C, 95% RH for 18 days. Thereafter, the fruits were evaluated for quality changes every three days. The collected data included weight loss, peel color changes (using Chroma meter), and texture changes using a texture analyser TAXT2. Statistical analysis was CRD with three replications. Each replication consisted of three samples. Treatment means were compared using Duncan multiple range tests with significance value at $p<0.05$.

Results and Discussions

The mechanical and permeability properties of the edible films derived from 0.3% LBSM and 1% CQSM are shown in Table 1. There was no statistical difference in thickness, tensile strength or elongation at break between the two films. Normally, thickness films need more tensile strength and have higher elongation at break. In such films, the polymer matrix is denser and rich in inter-, and intra-molecular interaction and, consequently, they are more resistant to rupture (Mali *et al*., 2005). In contrast, there were significant difference the water vapor permeability oxygen permeability. There may be caused by the non-significant difference in film thickness. Galdeano *et al.* (2013) found that the permeability of hydrophilic films increased with decreased film thickness. This finding is consistent Fick's law, which starts that films permeability is inversely proportional to film thickness. Plasticizer addition could cause film thickness to have a positive relationship with film permeability (Longares *et al*., 2004).

Table 1 Thickness, water vapor permeability (WVP), oxygen permeability and mechanical properties of edible film derived from lemon basil seed mucilage (LBSM) and Chinese quince seed mucilage (CQSM).

Sample	Thickness (mm)	WVP ($X10^{-3}$ g.mm/day.cm².mmHg)	Oxygen permeability (cc.mm/m².D kPa)	Tensile strengh (MPa)	Elongation at break (%)
0.3% LBSM	0.0205±0.0003[a]	5.40±0.89[a]	149.58±0.25[a]	8.806±4.636[a]	7.110±1.496[a]
1% CQSM	0.0202±0.0007[a]	6.61±0.33[b]	168.58±2.85[b]	9.103±1.077[a]	8.443±1.083[a]

Means with the same column followed by different letters are significantly different at $p<0.05$.

The postharvest change of Japanese cucumbers as influenced by coating with 0.3% LBSM and 1% CQSM are shown in Figure 1. There was a significant difference in the change in peel color during storage between the uncoated and coated fruits. The peel color of the latter had lower L and a* value, but a higher b* value than the peel color of the former due probably to the fact that the seed color was dissolved in mucilage, resulting in the coatings dark in color. Millard browning reaction occurred, especially in lemon basil seeds in which polysaccharides became monosaccharides as a result of using high temperature. The resulting monosaccharides reacted with amino acid derived from the proteins in lemon basil seeds, giving off black substances during mucilage extraction (Ruangchakrpet and Anprung, 2002). The weight loss of the fruits in all treatments increased with time in storage. Although there was no statistical difference in weight loss among treatments, coating 0.3% LBSM was the most effective in reducing fruit weight loss. Japanese cucumbers have thin skin. Therefore, they have a high rate of water loss. In addition, the coating applied to their skin may not be thick enough for decreasing weight loss. There was a significant texture changes between uncoated and coated fruits only on day 12. It was reported that the edible coating derived from cactus mucilage could extend the shelf lives of papaya and strawberry fruits (Oluwaseun *et al*., 2014;Del-Valle *et al*., 2005).

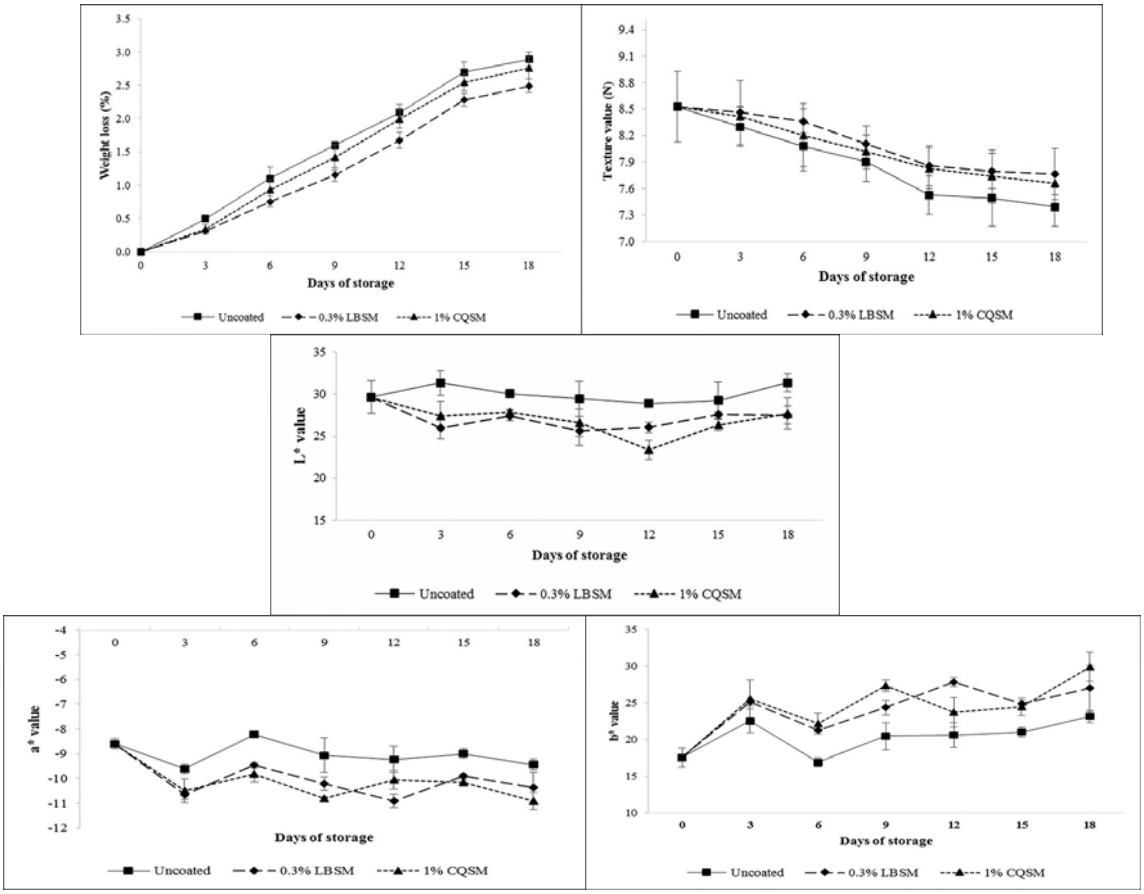

Figure 1 Effect of different treatments on postharvest changes of Japanese cucumbers during storage at 11±1ºC, 95% RH.

Conclusion

This study showed that edible coatings derived from 0.3% LBSM and 1% CQSM can be used for prolonging the shelf life of Japanese cucumber fruits up to 18 days. The results indicated that 0.3% LBSM coating was most effective in the extending the shelf life of Japanese cucumbers by slowing weight loss and delaying physical changes during storage.

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