การยืดอายุการวางจำหน่ายผลฟักข้าว (*Momordica cochinchinensis* Spreng.) ด้วยการใช้ชาแล็คเคลือบผิว

Shelf Life Extension of Gac Fruit (*Momordica cochinchinensis* Spreng.) Using Shellac Coating

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Abstract

Gac fruit is a tropical fruit, being rich in antioxidants with healthy benefits. However, the shelf life of gac fruit is short due to rapid senescence and fungal infection. The aim of this study was to investigate the effect of shellac coating to maintain the quality and reduce disease infection of gac fruit during storage at 25 °C. Gac fruit harvested at the orange peel maturity stage (45 days after fruit setting) were coated with 5,10, and 15% (w/v) bleach shellac, compared to uncoated control. All fruits were stored at 25 °C, 60-70% RH for 9 days. The results exhibited that 10% of shellac coating could prevent fresh weight loss, disease infection, reduce respiration rate, ethylene production and improve the appearance, while 15% of shellac coating lead to high accumulation of acetaldehyde on day 9, compared to other treatments. Thus, 10% of shellac coating on gac fruit could be considered for retailing of fresh gac fruit after storage.

Keywords: *Momordica cochinchinensis*, shelf life, shellac coating, ethylene production

บทคัดย่อ

ฟักข้าวเป็นผลของพืชเขตร้อนที่มีสารต้านอนุมูลอิสระอยู่มากซึ่งเป็นประโยชน์ต่อสุขภาพ อย่างไรก็ตามอายุการวางจำหน่ายของผลฟักข้าวนั้นสั้น เนื่องจากการเสื่อมสภาพที่รวดเร็วและมีการเน่าเสียจากเชื้อรา วัตถุประสงค์ของงานทดลองนี้คือศึกษาผลของการเคลือบชาแล็คต่อการคงคุณภาพและลดการติดเชื้อของผลฟักข้าวระหว่างการเก็บรักษาที่อุณหภูมิ 25 องศาเซลเซียส นำผลฟักข้าวที่ระยะเปลือกสีส้ม (45 วันหลังติดผล) เคลือบชาแล็คที่ความเข้มข้นร้อยละโดยมวลต่อปริมาตร 5, 10 และ 15% (w/v) เปรียบเทียบกับผลที่ไม่ได้เคลือบ เก็บรักษาผลฟักข้าวไว้ที่ 25 องศาเซลเซียส ความชื้นสัมพัทธ์ร้อยละ 60-70% นาน 9 วัน ผลการทดลองแสดงให้เห็นว่าการเคลือบผลฟักข้าวด้วยชาแล็คที่ความเข้มข้นร้อยละ 10 ช่วยป้องกันการสูญเสียน้ำหนักสด การติดเชื้อโรค ลดอัตราการหายใจและการผลิตเอทิลีน รวมไปถึงพัฒนาลักษณะปรากฏ ในขณะที่การเคลือบผลฟักข้าวด้วยชาแล็คร้อยละ 15% ตรวจพบการสะสม acetaldehyde ในเนื้อปริมาณมากใน วันที่ 9 ของการเก็บรักษา ดังนั้นการเคลือบผลด้วยชาแล็คที่ความเข้มข้นร้อยละ 10% สามารถใช้กับผลฟักข้าวในขณะวางจำหน่ายหลังการเก็บรักษา

คำสำคัญ: ฟักข้าว อายุการเก็บรักษา เคลือบชาแล็ค อัตราการหายใจ

Introduction

Gac (*Momordica cochinchinensis* Spreng), is a tropical plant grown in many countries. Gac fruit has been known as an excellent source for carotenoids, specifically lycopene, α-tocopherol and β-carotene, which obtains antioxidant properties. The major problems of gac fruit include declined firmness and disease development after harvest. Many edible coating materials have been evaluated for postharvest handling quality of fresh produce. Furthermore, edible coatings can extend product shelf life by maintaining the quality and reducing the risk of pathogen growth on food surface (Dhall, 2013). In other to prolong the shelf life of gac fruit, this study was proposed by using shellac, which is considered as an alternative. The shellac wax at 3.75% was used to be coated on tomato showing the positive result on extending the postharvest life (Chauhan *et al*., 2013). The aim of this research was to investigate the effects of different shellac coatings on gac fruit to maintain the postharvest quality at 25 °C.

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Materials and Methods

Gac fruit at the orange peel maturity stage (45 days after fruit setting) were harvested at a commercial orchard in Nakorn Pathom province, Thailand (latitude: 14º 01' 16.08" N; longitude: 99º 58' 53.63" E). The fruit were transported to the Postharvest Technology laboratory at King Mongkut's University of Technology Thonburi, Bangkok within 2 h and kept at 13°C for overnight. Fruits were washed and dipped in 200 ppm sodium hypochlorite (NaOCl) for 5 minutes for disinfection. Fruits were dried at room temperature and selected for uniformity of size (about 400 to 600 g per fruit) and color. Bleached shellac (Dewaxed) was purchased from Excelacs Co., Ltd. Company, Thailand. The shellac coatings were prepared by dissolving bleached shellac powder in alkaline aqueous medium (0.6% ammonia) at 95°C in a hot water bath for 30 min. Then, shellac solution was cooled down at room temperature followed by the addition of 0.05% Tween 20 (emulsifier). Fruits were coated with 5, 10, and 15% shellac compared to non-treated fruit. All fruits were incubated at 25 °C, 65-70% RH. Data were analyzed by SAS program version 9.1 (SAS Inc. USA) and ANOVA determined.

Results

The physical changes in quality of gac fruit were shown in Figure1. The results revealed that 10% of shellac coating reduced disease incidence and disease severity (Figure 1 A and B, and Figure 2). 10% shellac recorded the lowest disease (10.2%) compared to uncoated fruit (68.37%). Moreover, 15 and 10% of shellac coating on weight loss were the lowest percentage which were lower than 6% on day 9 compared to other uncoated fruit during storage at 25 °C, 65-70% RH, (Figure 1 G). However, the most values of color changes of gac fruit peel were observed with no significant differences between treatments. Except b* and hue angle values of color changes of gac fruit peel were significantly differences decreased after 9 days compared to all level of treatments (Figure1 C, D, E and F).

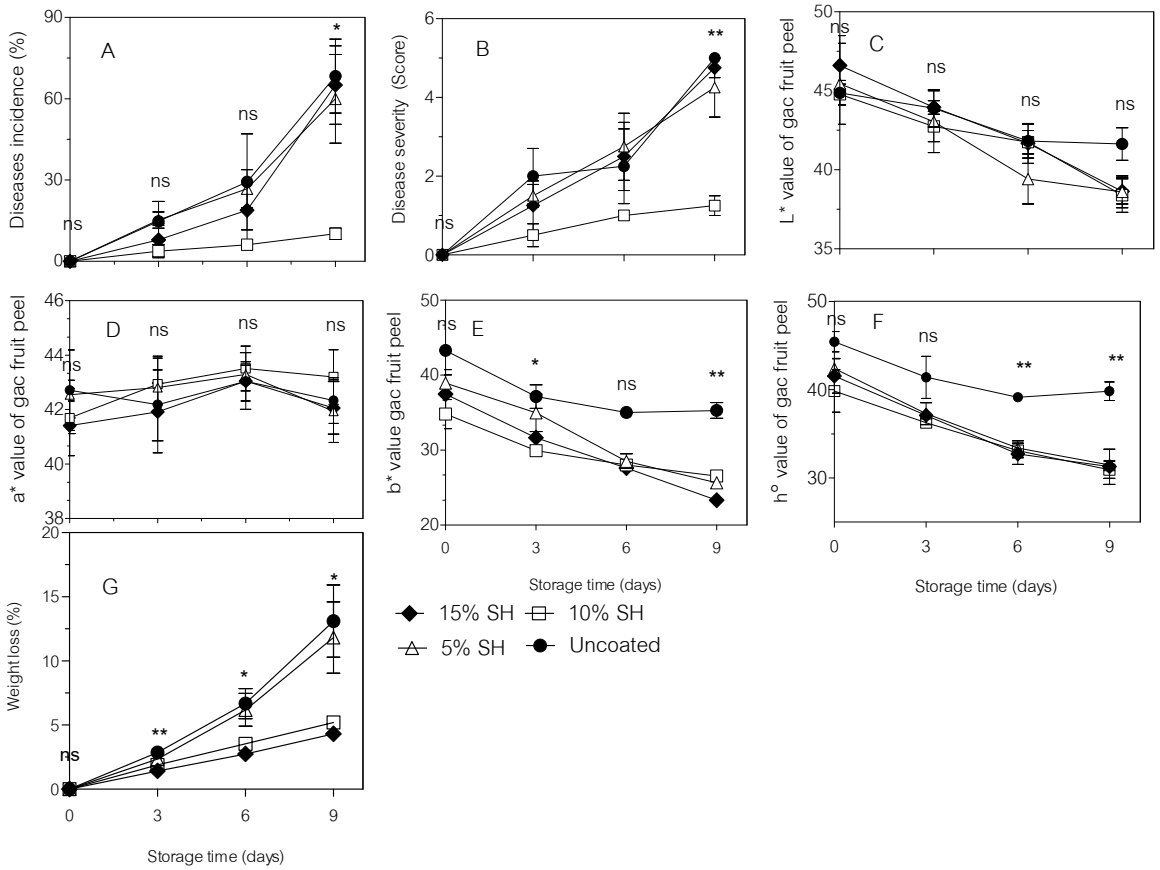

Figure 1. Changes in physical quality of gac fruit coated with different concentrations of shellac on disease incidence (A), disease severity (B), L* value (C), a* value (D), b* value (E), hue angle value (F) and weight loss (G) during storage. Error bars represent the ± SD of the mean. ns = not significantly different, * = Significantly different at $P \leq 0.05$, ** = Significantly different at $P \leq 0.01$

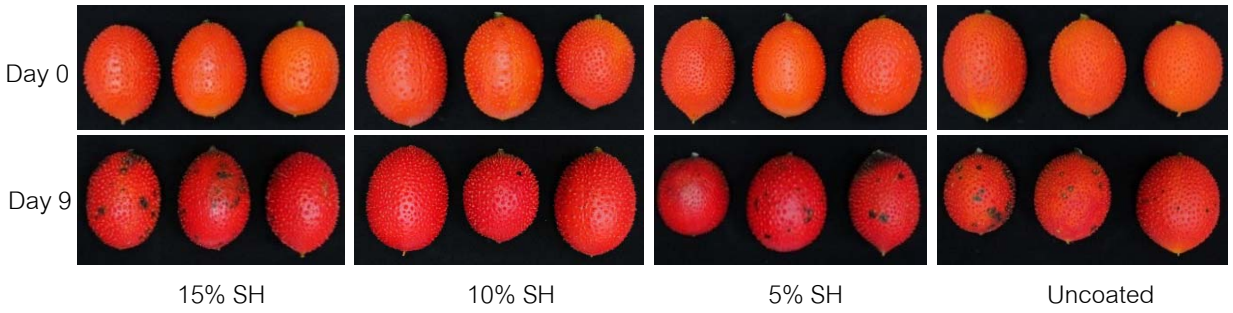

Figure 2 Visual appearance of gac fruit coated with different concentrations of shellac at 25°C on day 0 and day 9

The results of firmness on day 9 indicated that there were no significant differences among treatments. However, the accumulation of acetaldehyde was significant involved in fruit coated with 10% shellac during storage. In addition, the content of acetaldehyde coated with 15% of shellac was at 3.52 ppm which about 20 times higher than 0.11 ppm of 10% shellac at the end of shelf life (Table 1). The antioxidant activity and total phenolic content no significant in the extract from 100g gac fruit was equal to ranges 9.41 to 13.20% and 1383.7 to 1223.2mg, respectively. Furthermore, 10 and 15% shellac coating gac fruit showed lower content of ethylene production compared to uncoated fruit on day 9 of storage. And gac fruit coated with 10% shellac revealed that lowest respiration rate on day 9 of storage (Table 1).

Table 1. Internal changes of gac fruit coated with different concentrations of shellac after 9 days storage at 25°C

Treatments	Parameters					
	Acetaldehyde (ppm)	Firmness (N)	DPPH inhibition (%)	Total Phenolic (mg GAE/100g FW)	CO_2 (mg CO_2.Kg^{-1}.hr^{-1})	C_2H_4 (μLC_2H_4.Kg^{-1}.hr^{-1})
15% SH	3.517[a]	3.14[a]	10.832[a]	1246.3[a]	59.82[a]	0.529[a]
10% SH	0.1144[b]	3.49[a]	9.413[a]	1223.2[a]	45.53[a]	0.803[a]
5% SH	0	2.56[a]	10.928[a]	1383.7[a]	66.32[a]	2.588[a]
Untreated	0	3.66[a]	13.204[a]	1345.2[a]	79.02[a]	4.838[a]

Discussion

Gac fruits were coated with different shellac concentrations of 15%, 10% and 5 % for maintaining the postharvest quality during storage at 25°C. According to previous studies, water diffuses preferentially through a liquid aqueous phase in the cuticle (Ben-Yehoshua *et al*., 1985; Amarante *et al*., 2001), that fruit skin damage increases fruit weight loss (Jansasithorn *et al*., 2014). Shellac coating can effectively prevent water loss, due to the nonpolar properties of shellac which can act as a barrier to protect the fruit surface and reduced water evaporation (Chitravathi *et al*., 2014; Jitareerat *et al*., 2018), thereby contributing to reduced weight loss in 15% and 10% of shellac coated on gac fruit (Figure 1). Deterioration in firmness might be caused by changes in the polygalacturonase activity in composition of pectic substances in the soluble fractions (Taira *et al*., 1987; Seymour *et al*., 1993). The shellac with aloe-gel coated surface apple slices showed significantly inhibited microbiological between the coated and uncoated samples, suggesting a bio-preservative function of the coatings applied (Chauhan *et al*., 2013). Furthermore, shellac has been reported in antimicrobial function against specific microbial flora, such as *Enterobacter* and *Klebsiella* spp. (McGuire and Hagenmaier, 2001). Reported by Khorram *et al*.,

2017, the low concentration of shellac coated on orange fruit showed the lowest of ethylene production and respiration rate during 60 days of storage at 5°C. Peel a* values of orange fruit was quickly increased to red color reached normal ripening stored at 25°C, that similar to the results (Soe *et al*., 2015). The higher concentration of shellac coating showed the better postharvest quality of gac fruit. However, fruit coated by 15% showed higher acetaldehyde accumulation. This could imply that anaerobic respiration was switched to anaerobic pathway inside the fruit which could further lead to the dead of cell in the longer period.

Conclusions

In conclusion, 10 and 15% shellac were due to maintained weight loss of gac fruit during storage at 25°C. However, 15% shellac coating revealed high acetaldehyde accumulated in the pulp. The appearing of disease incidence on gac fruit on day 9 showed that 10% shellac coating was better than other treatments. Moreover, the respiration rate and ethylene production of gac fruit were decreased by coating with 10% shellac. Therefore, 10% shellac coating can be used to maintain the quality of gac fruit during storage at 25°C, 65-70% RH.

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