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Application of Edible Film based on Chitosan-PLA in the Prolongation of the Shelf Life of Longan Fruit

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ABSTRACT

Longan fruit *(Dimacorpus longan lour)* is one of non-climacteric tropical fruit. Longan fruit has a short shelf life under room temperature. Pericarp browning and microbial decay are the majir factors reducing the longan shelf life, it can cause the limitation of consuming the longan fruits. An alternative means without toxic and pollution effect for preventing and controlling the the post harvesting fruits are needed such as blend film and edible coating application. Application of edible coating is promising to improve the quality and extend live of post harvested vegetable and fruits. Therefore the aim of this study is to define the potential of Chitosan-PLA (Ch-PLA) composites to extend the shelf life of longan fruits. In this experiment, we investigated those with the effect of PLA content to the chitosan film on water vapour permeability, pH condition, film thickness and weight loss of longan fruits.

Keywords: *edible film, longan fruits, Chitosan, PLA, biomaterial*

1. INTRODUCTION

Longan fruit *(Dimacorpus longan lour)* is one of non-climacteric tropical fruit, and is cultivate in many counties especially in China (Jiang et al., 2002). Longan fruit has a short shelf life under room tempareture. Pericarp browning and microbial decay are the majir factors reducing the longan shelf life, it can cause the limitation of consuming the longan fruits (Thavong et al., 2010).

From a mid-twentieth century, synthesis polymer such as polyethylene and polypropylene have been found to hold a good stretching properties, high strength and low weight (Naseri et al., 2020). This synthesis polymers have become a crucial environmental problem in the world (Xanthos and Walker, 2017). Nowadays the most popular way to prevent the longan fruit decay and browning was SO_2 fumigation and fungicide dips. These ware an effective and low cost technique to extend the longan fruit shelf life. However this method leave the sulphite residue and cause the toxic effect on human body (Jiang and Li, 2001). An alternative means without toxic and pollution effect for preventing and controlling the the post harvesting fruits are needed such as blend film and edible coating application (Lin et al., 2011).

Blend film is a thin layer made of biomaterial. There are three main constituent components, namely fat, protein and polysaccharide. One of the ingredients commonly used as blend film is chitosan. Chitosan is the second most abundant biopolymer after cellulose, it is a natural material derived by deacetylation of chitin (Parhi, 2020). Chitosan has magnificent features due to its biodegradable, biocompatible and non-toxicity (Alishahi et al., 2011) however, chitosan is fragile material and generally insoluble in water (Qin et al., 2006). One alternative methods *to improve* the *chitosan* strength and barrier characteristics was by adding Poly Lactic Acid (PLA) into chitosan composite.

PLA is a biodegradable materials, a thermoplastic polyester, which commonly obtained by polycondensation process of lactic acid (Wardhono et al., 2019). PLA can be acquired from cellulose, corn starch, tapioca roots, sugarcane, and glycerin from biodiesel by-products (Lasprilla et al., 2012). It has been attracted considerable recent interest for different purposes, including materials coating such as dairy products, bread and poultry products.

Several stidies was conducted to prevent the post harvested vegetable and fruits shelf life such as using the chitosan composite, especially on longan fruits and preservation of jujube using chitosan film with nano-silicon dioxide (Yu et al., 2012). Therefore the aim of this study is to define the potential of Chitosan-PLA (Ch-PLA) composites to extend the shelf life of longan fruits. In this experiment, we investigated those with the effect of PLA content to the chitosan film on water vapour permeability, pH condition, film thickness and weight loss of longan fruits.

2. MATERIALS AND METHODS

2.1 Materials

Chitosan was obtained from Nano Center Indonesia, L-lactic acid (90%), NaOH, *anhydrous acetic acid*, and glycerol were purchased from Merck (Indonesia).

2.2 Methods

Chitosan preparation

Chitosan was prepared by dissolved 5 g chitin into 50% w/w NaOH solution (50 ml). The solution was then isolated under the ultrasonic irradiation 40 kHz for about 25 minutes and 30^{0}C, the solution was then discharge and the precipitate was washed and dried (DANGARAN et al., 2004).

Chitosan dissolution mechanism

2 g of chitosan was dissolved in 100 ml of acetic acid (1%). The solution was stirred gently for 4 hours.

Poly Lactic Acid (PLA) Preparation

PLA was obtained by direct polycondensation mechanism. 50 ml of lactic acid and PLA was poured into four-neck flask. First condensation was carried out in 120^{0}C and 1 hour, then was gently reheated about 2 hours 150^{0}C and finally continued in 180^{0}C for 2 hours

Synthesis Ch-PLA blend films

PLA was conducted from the preparation process. It was heated using a hot plate in 120^{0}C until melted. Chitosan solution was then pour into PLA. In the next step, 3% v/v of glycerol were added into this solution. The solution was then gently stirred in 2 hours. Finally, the initial solution was been casting on a flat glass and carefully heated in the oven 70^{0}C for 10 hours (Kanani et al., 2017) (Rahmayetty et al., 2018).

Analytical methods

PLA characteristics, blend film mechanical characteristics include film permeability, thickeness, pH, and weight loss of longan fruit analysis.

3. DISCUSSION

3.1. Water Vapor Permeability (WVP)

The WVP of Ch–PLA blend film can be shown in figure 1.

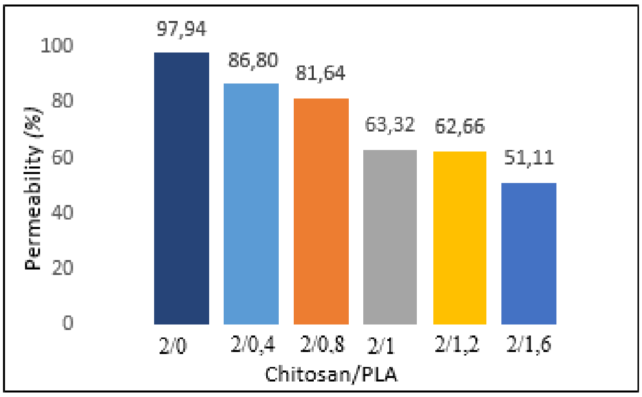

Fig. 1. Chitosan-PLA film permeability

WVP is one of important parameters studied in Chitosan-PLA film. In fig. 1 shows the WVP value of various PLA ratio. It shows that the film permeability for longan fruit from Ch-PLA blending have considerably as water barrier properties.

WVP of samples range between 51.11 to 97.94%, these are significantly affected by PLA ratio. Obviously, by increasing PLA content it shows the change of permeabityly of the film. At the point 2/1.6 of chitosan-PLA ratio, it shows that the film had a poor water resistance by its lower WVP (51.11%). In contrast, at the point of 2/0 (Ch:PLA) it shows the highest WVP obtained. It can be described that the component of PLA has hydrophobic properties, however that film had highest water resistance.

3.2. Thickness

Ch-PLA thickness in the presence of 2% of Ch with various of PLA content. Film thickness can be shown in fig 1 as follows. The thickness of Ch-PLA was have similar value in difference ratio of PLA. PLA solution had no pronounce impact on thickness of the resulting film (0.05 mm). This suggested that the PLA solution might distribute uniformly in the film network. Due to its water content in the PLA solution did not cause the protrusion of film matrix.

Table 1. Film thickness

Chitosan /PLA ratio	Thickness(mm)
2/0	0.05
2/0,4	0.05
2/0,8	0.05
2/1	0.05
2/1,2	0.05
2/1,6	0.05
2/2	0.05

Source : Laboratory analyzing

3.3. pH analysis

The pH value were analysis to control the sample during the study period. The pH differences were found between coated and uncoated samples. At a room temperature for the first day, the pH of longan fruir was indicate at the range 7.1 to 7.6. after 3 days the pH of longan fruit without coating began to decrease the pH and initial spoilage. The pH analysis can be shown in figure 2 and 3 as follows:

Fig 2. Longan fruit with and without coating

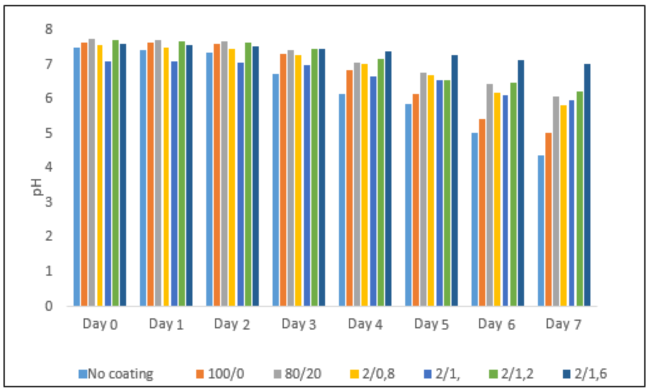

Fig 3. pH analysis of longan fruit with and without coating

For the coating longan fruit, no pH changing (pH 7) was observed during 5 days, but after this time the pH decrease to 6. Therefore the uncoating longan fruits pH was 5 which is an indicative of spoilage.

3.4. Weight loss analysis

During storage of Longan fruit in room temperature, indicate the longan weight change as shown in figure 4.

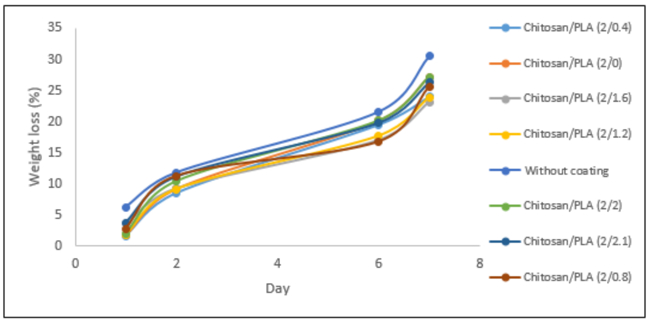

Fig 4. Weight loss analysis

Weight loss is a one of determinant storage life parameter of longan fruits *(Shi et al., 2013)*. From the experiment, without coating significantly reduce the weight loss of longan fruits until the 7th day (34.356%). By contrast, longan fruit weight loss in Ch-PLA coating in ratio (2/0.4) was give lower weight loss during the storage (25.983%). The reduce weight loss of longan fruit using the Ch-PLA coating can minimized the package condensation and extend the fruit shelf life.

The slower weight loss rate from the Ch-PLA coating could be attribute to the additional barrier against diffusion through the fruits *(Perez-Gago et al., 2006)*. It was evident from this study that longan fruit with Ch-PLA coating reduce the weight loss compared with the control (uncoating longan fruit), the film coating probanly covering the fruit surface to prevent the weight loss.

4. CONCLUSION

Ch-PLA blend film is a biodegradable and biocompatible matrix for food packaging. PLA addition not effect to the blend film thickness but can decrease the water permability, pH and covering the fruit surface to prevent the weight loss.

5. ACKNOWLEDGMENTS

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